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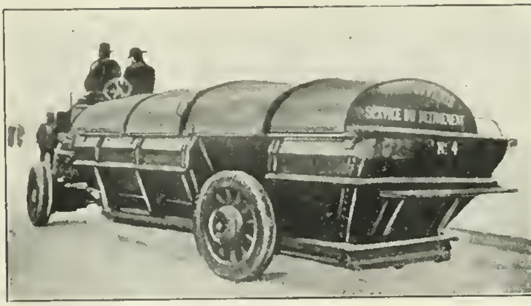
MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.



A FRENCH AUTOMOBILE TRUCK *for hauling garbage.*

Vol. XLVI. JANUARY, 1914. No. 1.

"There is a time in every man's education when he arrives at the conviction that envy is ignorance; that imitation is suicide; that he must take himself for better for worse as his portion; that, though the wide universe is full of good, no kernel of nourishing corn can come to him but through his toil bestowed on that plot of ground which is given him to till."—Emerson.

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PAVING METHODS IN BALTIMORE

By Harry D. Williar, Jr., Asso. M. Am. Soc. C. E.,
Assistant Engineer, Baltimore Paving Commission.

Mr. Williar has been actively engaged in the construction of roads and pavements first with the State Roads Commission of Maryland and later with the Paving Commission of Baltimore and shows in this paper the methods which have been developed by the latter commission in transforming Baltimore from the city of cobblestone streets to a city of modern pavements. The experience of other cities has been supplemented by local experiments and the results upon the latest of the large cities to modernize its paving are very noticeable.

THE City of Baltimore has, up to the past few years, been generally recognized as "The City of Cobblestone Streets," and this unique distinction has not been undeserved. Since the first cobblestone was laid in 1781, Baltimore has steadily increased its mileage of this class of paving until, on January 1, 1912, out of a possible 590 miles of street, 408 were paved with cobbles.

In order to better meet traffic demands and hasten the elimination of cobblestones, the city has been divided into two paving sections, each division being under the supervision of a separate commission. The paving of that portion of the city lying between the old and new city limits, or the outskirts, is being done by the Annex Improvement Commission, while the paving of the city proper is under the supervision of the Paving Commission of Baltimore.

¶ CAREFUL ATTENTION *to the selection of materials bears a most important relationship to the success of any pavement and each factor governing quality and use of material should be carefully considered.*

The writer's purpose is to discuss conclusions reached by actual practice, and ideas obtained thru careful study from a Baltimore viewpoint, the conclusions being applicable, in a general way, to any other city.

The most important consideration in selecting the materials to be used for certain streets are:

1. The location of the street, as to whether it is in a business or residential district.
2. The character of traffic to which the street is to be subjected, as to whether it is light, heavy, "standing" or thru traffic.
3. The grade of the street.
4. The width of the street.
5. The existence or non-existence of street railway tracks.

¶ THE QUALITIES OF PAVEMENTS *on which depends the choice of material are briefly stated.*

There are few cities where one class of material can be laid on a street for its entire length. Due to the heavy grades and general topography of the city, this feature is particularly noticeable in Baltimore, and it is often spoken of as the city of variegated paving.

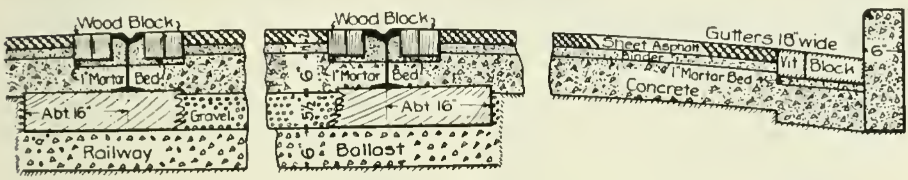
The following general qualities may be accepted as absolutely essential to good paving:

1. It should be impervious.
2. It should afford a good foothold for horses.
3. It should be hard and durable, so as to resist wear and disintegration.
4. It should be adapted to the grade.
5. It should suit traffic conditions.
6. It should offer the minimum resistance to traction.
7. It should be as near noiseless as possible.
8. It should yield neither dust nor mud.
9. It should be easily cleaned.
10. It should be economical.

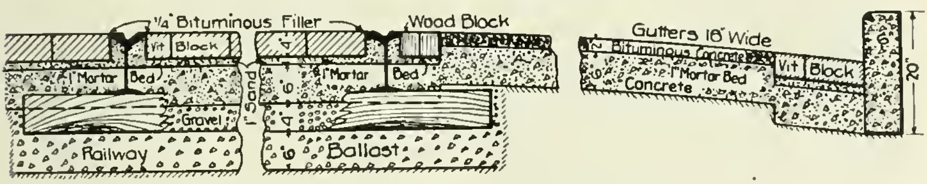
Vitrified Block comes in between Granite Block and Sheet Asphalt, and up to 7 per cent. grade makes an excellent and sanitary paving for the semi-residential thorofares of average traffic. On grades between 5 per cent. and 7 per cent., "Hillside Block" can be used to great advantage. With the uphill edge of the blocks beveled, a better foothold for horses is given.

Wood Block Paving, when the blocks are properly treated, is recognized as an exceptionally durable surfacing, but should not be used on over 2 per cent. grades, and then only in the immediate vicinity of hospitals, where unnecessary noises are to be avoided.

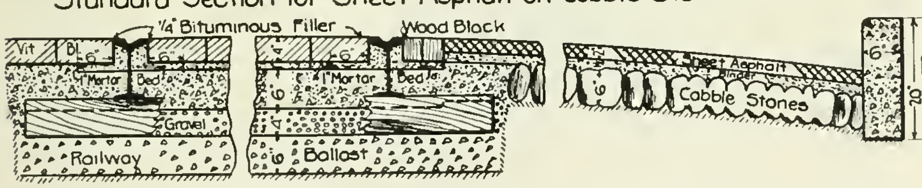
Standard Section for Sheet Asphalt.



Standard Section for Bituminous Concrete.



Standard Section for Sheet Asphalt on Cobble Stone.



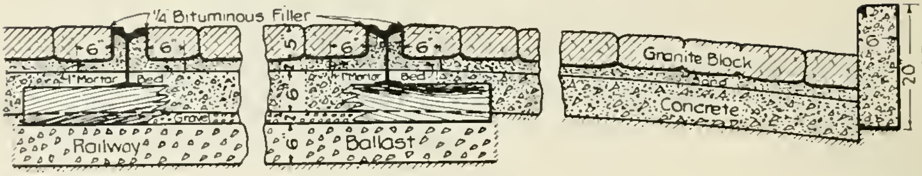
From these general essentials, the following deductions are logically made:

Granite Block should be used on all streets of steep grades, and in business districts where the traffic is either heavy or standing.

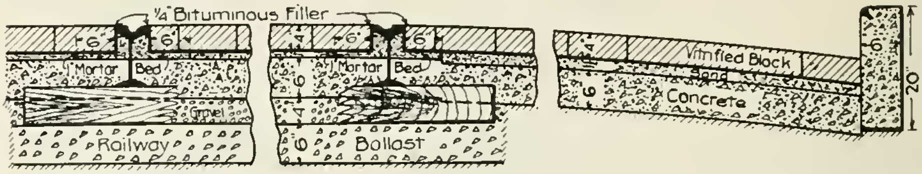
Sheet Asphalt is the standard surfacing for residential sections. It may also be used to advantage in the business districts where there is thru, but not exceptionally heavy, traffic. On grades up to 5 per cent. it gives excellent results; on steeper grades it becomes slippery and unsafe.

Bituminous Concrete is a paving which is slowly, but surely, working its way to the front. It is entirely a light traffic surfacing, and should be used almost regardless of grades in the residential districts. On suburban streets, where sufficient width may be obtained to avoid concentration of traffic, along and in city parks, thru towns and villages, bituminous concrete makes an admirable pavement.

Standard Section for Granite Blocks



Standard Section for Vitrified Blocks.



It will be found that most failures in paving are on streets where there are railway tracks, and, to be more specific, these failures are, nine out of every ten, immediately adjacent to, and running parallel with, the rails.

The material used adjacent to the rails may be any of the following: wood block, vitrified block or granite block. In no case should sheet asphalt or any bituminous paving come in direct contact with the rails. If granite block or vitrified block be selected for a street with car tracks, the thorofares may be paved with either of these two materials thruout.

If sheet asphalt or bituminous concrete be used, they should stop at least 6 inches from each rail, and two rows of either wood block or vitrified block be laid as liners. The wood block is preferable as it does not chip off by traffic turning in and out of the track.

Wood block liners may be used to advantage on vitrified block streets for the above reason. In any event, to insure less failure of paving at the rails, the writer advocates the liners adjacent thereto being laid on a 1-inch mortar bed instead of on sand, this bed to extend 6 inches from each rail.

As to the wearing qualities of these standard paving materials, it may be well to note the result of a test made by the city of Baltimore in 1901. The city furnished the concrete foundation and labor, while the competing contractors furnished free their different samples of paving material. The block of street when finished, presented in neat little widths two kinds of sheet asphalt, seven kinds and colors of vitrified block, two kinds of granite block and one sample of wood block. The traffic at this particular place was very heavy, and it was not long before the bed of the street resembled a relief map. It was a sure and conclusive test, and the granite block and wood block, alike, stood it better than any other.

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¶ RESULTS OBSERVED *in Baltimore's test pavement were made use of in designing new pavements as well as the factors governing the life of a pavement which are usually considered.*

Baltimore immediately proceeded to profit by this experiment and laid a large amount of wood block paving, but there is practically no wood block paving being laid in Baltimore now, on account of its tendency to become very slippery in damp and rainy weather. In order to overcome this objection on the wood block streets laid some years ago, a thin coat of Fairfield or Ugite binder with stone chips is being spread at a cost of 14 cents per square yard, and is giving the desired results.

The life of any pavement is entirely dependent upon: (1) construction; (2) maintenance; (3) traffic. The life of pavements, well constructed, maintained and in a section where traffic is uniformly distributed over different streets, may be taken as follows:

Granite block, from 25 to 35 years.

Granite block, from 25 to 35 years.

Sheet asphalt, from 15 to 20 years.

Wood block (treated), from 20 to — years.

Bituminous concrete, from 8 to — years.

Bituminous concrete and creosoted wood block are both comparatively new pavements, but there is every indication that the treated wood block will be a material of great endurance.

¶ THE COST *often determines the material and design to be used.*

The cost plays a large part in the selection of materials for streets, but it should not be overlooked that expensive pavements are not necessarily the best, nor are those which cost the least the cheapest. The following are average prices for Baltimore city during 1912:

Granite block, 6-inch concrete base and cement filler, $3.21 per square yard.

Granite block, 6-inch concrete base and bituminous filler, $3.32 per square yard.

Vitrified block, 6-inch concrete base and cement filler, $2.14 per square yard.

Wood block, 6-inch concrete base, and bituminous filler, $3.00 per square yard.

Sheet asphalt, 2-inch topping, 1½-inch binder and 6-inch concrete base, $1.71 per square yard.

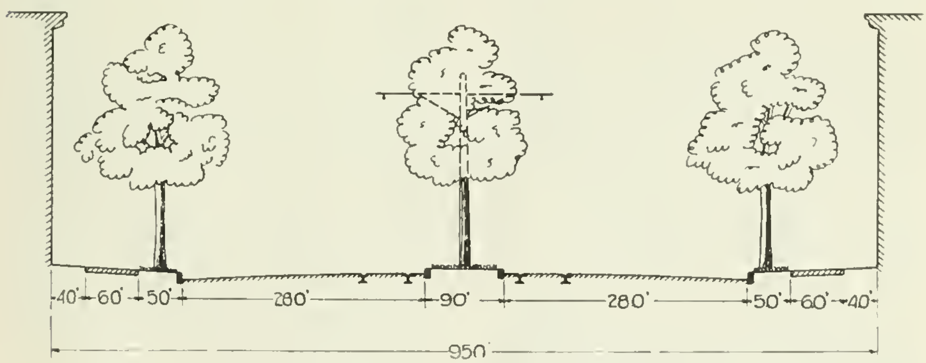
Bituminous concrete, 2-inch thick, 6-inch concrete base and paint coat, $1.46 per square yard.

¶ DESIGNING OF BALTIMORE STREETS *is based on a thoro technical study.*

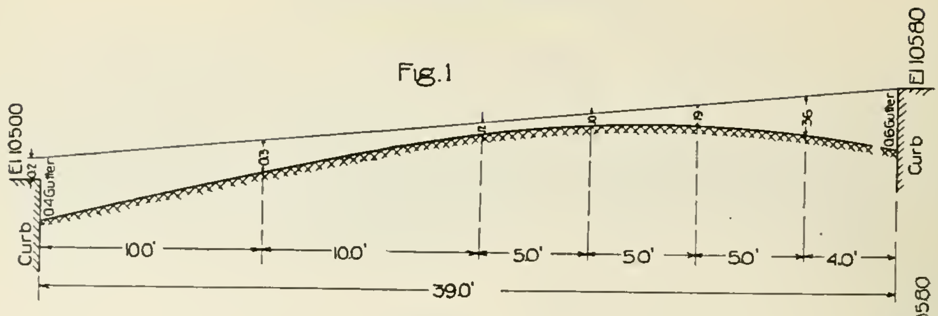
Baltimore today is constructing a great number of miles of improved paving along lines recommended by the Topographical Survey Commission.

There is a great deal of money wasted in paving a street along its original lines, just because they are original. If a 42-foot street, with 66 feet between building lines, can, without reducing its usefulness, be narrowed to a 30-foot street, it is decidedly advantageous. As 13-foot sidewalks are sufficiently wide, the space remaining between the edge of the walks and the new curb of the narrowed street may be used as a parking space. With properly selected shade trees at certain intervals and grass planted in such places, a most pleasing effect is obtained.

On streets lying on the outskirts of the city, along public parks or other municipal property, or on streets where the distance between building lines is exceptional, it is possible to construct a street



A DESIGN *for a cross-section of a street with a double line of street car tracks which alternates trolley poles and trees in the wide space between tracks. Small trees give little trouble, but as they grow they must be trimmed carefully if not rendered unsightly.*



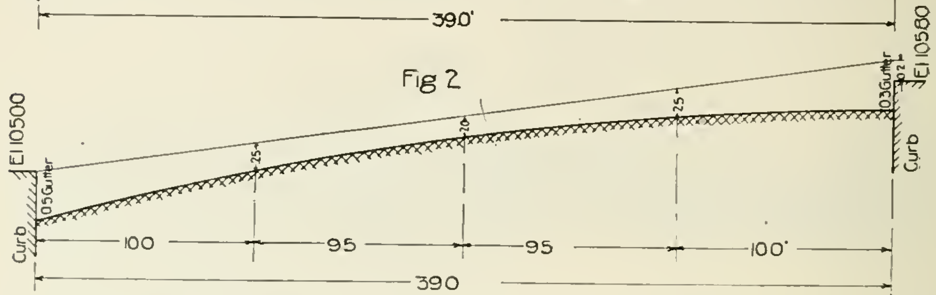


FIG. 1 *shows a cross section of a street on a side hill which requires some gutter area on the upper side. Fig. 2 shows a side-hill street with all the water turned to the lower side. The water must be removed from the street by inlets to sewers or drains at frequent intervals if either design is used.*

of ample width, putting the car tracks off to one side and a planting area between. With proper shade trees, grass and hedge in the planting space the effect of this entire layout is most admirable.

On streets where railway tracks must, of a necessity, be paved in the regular cross-section of the street, the width and location of the thorofare should govern the cross-section to be used. If the greatest width that can be gotten between curbs is from 40 to 50 feet, the section should be a regular parabola with the tracks in the center, but, where possible to get a street from 50 to 70 feet wide in the residential district, the writer recommends some form of parking to be used instead of paving the entire street. For instance, a car track street of 65 feet between curbs may be divided up into two 28-foot driveways with a 9-foot planting space between. A track on either side of this parking area, with trolley poles and trees planted alternately therein, aside from hiding from public view the overhead center pole construction of the railway company, gives the street a very pleasing boulevard effect.

If a street is without car tracks, and has four steady streams of varied traffic, some slow and some fast moving, it is possible, by giving each kind of traffic a section of the street to itself, to avoid accidents and not retard or congest traffic of either class. Should a layout be desired to accommodate such conditions as these, an opportunity is afforded to construct an imposing thorofare. Planting spaces lined with trees along and between the several thorofares, with a line of shade trees at the extreme curbs, will add greatly to the appearance of the boulevard.

¶ GRADES *can not be greatly changed in a built-up city. Cross-sections are affected by transverse grades.*

In Baltimore, where the thorofares to be improved are mostly in built-up sections of the city, it is impossible to do much changing in the grades of the streets. A cut or a fill where houses are only 12 or 14 feet from the old curb line would result in great damage to property.

The cross-section of all streets should be worked out to conform to a parabola, as a "typical cross-section," to which there are several variations.

On average width streets, when the difference in elevation of the curbs is 6 inches or more (hillside streets), one of two sections may be used: (1) Where there is gutter water or "daily flow" to be taken care of on the high side of the street, it becomes necessary to design a section to conform to a compound parabola that will confine the drain water to the gutters. In this case, the crown should be near the quarter point on the high side of the street, with the cross slope falling therefrom to both curbs. (2) If there is no gutter water on the high side of the street to be taken care of, a section of a parabola may be used that will throw all the surface water to the one gutter on the low side.

Sections similar to that of the latter case are ideal in business dictricts, around freight yards and warehouses where the backing in of teams demands the extension of the paving from the curb line on one side to the building line on the other. In such cases, only one gutter is practicable. If local conditions demand the abolition of both curbs, and the paving to extend from building line to building line, then it becomes necessary to design a section that will drain both sides of the street to a gutter in the center. This form of section is not advocated by the writer, as it is bad on horse traffic in freezing weather, but, where it cannot be avoided, an inverted parabolic section should be used.

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CROSS SECTIONS *of pavements should be computed by these formulae or taken from the accompanying table.*

Streets of smooth surfacing require less crown and cross slope than those of rough. The following formula, for determining the cross-sections of the different kind of paving, is in general use, and is an excellent one:

For sheet asphalt pavements:

$$C = W/600\ (9-G)$$

For brick, stone and wood pavements:

$$C = W/1{,}600\ (20-G)$$

Wherein,

C is the crown of pavement in feet.

W is the distance between curbs in feet.

G is the number of feet fall per 100 feet of street.

Crowns for Brick, Stone and Wooden Pavements in Feet

Distance between Curbs	Grade of Street. Level	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%
20 Feet	.25	.24	.23	.20	.20	.19	.18	.16	.15	.14	.13	.11	.10	.09	.08	.06	.05			
25 "	.32	.31	.29	.27	.25	.24	.22	.21	.19	.18	.16	.14	.13	.11	.10	.08	.06	.05		
30 "	.38	.36	.34	.32	.30	.29	.27	.25	.23	.21	.19	.17	.15	.14	.12	.10	.08	.06		
35 "	.44	.42	.40	.38	.35	.33	.31	.29	.27	.25	.22	.20	.18	.16	.14	.12	.09	.07		
40 "	.50	.48	.45	.43	.40	.38	.35	.33	.30	.28	.25	.23	.20	.18	.15	.13	.10	.08	.05	
45 "	.57	.54	.51	.48	.45	.43	.40	.37	.34	.32	.29	.26	.23	.20	.17	.14	.11	.09	.06	
50 "	.63	.60	.57	.54	.50	.47	.44	.41	.38	.35	.32	.29	.25	.22	.19	.16	.13	.10	.06	
55 "	.69	.66	.62	.59	.55	.52	.48	.45	.42	.39	.35	.32	.28	.25	.21	.18	.14	.11	.07	
60 "	.75	.72	.68	.64	.60	.57	.53	.49	.45	.42	.38	.34	.30	.27	.23	.19	.15	.12	.08	
65 "	.82	.78	.74	.70	.65	.61	.57	.53	.49	.45	.41	.37	.33	.29	.25	.21	.16	.12	.08	
70 "	.88	.84	.79	.75	.70	.66	.62	.57	.53	.49	.44	.40	.35	.31	.27	.23	.18	.13	.09	
75 "	.94	.90	.85	.80	.75	.71	.66	.61	.57	.52	.47	.43	.38	.34	.29	.24	.19	.14	.09	
80 "	1.00	.95	.90	.85	.80	.75	.70	.65	.60	.55	.50	.45	.40	.35	.30	.25	.20	.15	.10	.05

Crowns for Asphalt Pavement in Feet

Distance between Curbs	Grade of Street. Level	1%	2%	3%	4%	5%	6%	7%
20 Feet	.30	.27	.23	.20	.17	.13	.10	.07
25 "	.38	.33	.29	.25	.21	.17	.13	.08
30 "	.45	.40	.35	.30	.25	.20	.15	.10
35 "	.53	.47	.41	.35	.29	.23	.18	.12
40 "	.60	.54	.47	.40	.34	.27	.20	.13
45 "	.68	.60	.53	.45	.38	.30	.23	.15
50 "	.75	.67	.59	.50	.42	.33	.25	.17
55 "	.83	.73	.64	.55	.46	.37	.28	.18
60 "	.90	.80	.70	.60	.50	.40	.30	.20
65 "	.98	.87	.76	.65	.54	.43	.33	.22
70 "	1.05	.94	.82	.70	.59	.47	.35	.23
75 "	1.13	1.00	.88	.75	.63	.50	.38	.25
80 "	1.20	1.07	.93	.80	.67	.53	.40	.26

THE REFUSE DESTRUCTOR

at Northampton, England.

The English sanitary engineers have developed the high-temperature refuse destructor to a high state of perfection and this article gives a description of a large plant located in a densely populated district, concerning which there are no complaints of nuisances caused by odors. Alfred Fidler, M. Inst. C. E., Boro Engineer and Surveyor, was in charge of the construction and supplied most of the information presented.

The refuse destructor is situated in Castle street, in a densely populated portion of the town, on a site about 1¼ acres in area and nearly surrounded by dwelling houses, the destructor itself being in close proximity to houses on the western boundary. It was completed and put into operation in August, 1903, and has since been in continuous use.

The plant consists of an 8-cell Heenan & Froude destructor built in two units of four cells. The grates are 4 feet 9 inches by 5 feet with boilers behind and parallel to the destructor, connected by means of combustion chambers with by-passes in the main flue, with a flue beyond to the chimney. The plant is installed with Howden's system of forced draft, and is accommodated in a steel framed structure lined with brick, 102 feet by 50 feet wide, arranged in two floors, the lower floor being the clinkering floor and the upper floor being the charging floor from which the refuse is distributed into the furnaces.

The charging floor is approached by an inclined roadway leading from the main entrance. The forced draft consists of a 78 in. diameter blowing fan fixed on the charging floor from which it takes the supply of air, the fan being driven by an inverted type single cylinder enclosed self-oiling steam engine. The air drawn in by the fan is passed thru an air-heater which is placed in the main flue of the destructor and is forced into the various furnaces at an average pressure of 2½ inches and a temperature of about 300 degrees F.

The steam plant consists of two double-flued steel Lancashire boilers, 30 ft. long and 8 ft. in diameter, suitable for a working pressure of 160 lbs. per sq. in.

Boiler Feed Pumps. There is one Worthington type and one Weir type pump, each capable of pumping 2,000 gallons of water per hour against the working pressure of the boiler.

Economiser. The economiser is Green's and is fixed in the main flue and of the usual type.

Chimney Stack. The chimney is circular and 125 ft. high. It is lined with firebrick to a height of 100 ft. The base of the chimney internally is formed to act as a dust catcher and to give the gases a cyclonic action and to aid precipitation of dust which is held in suspension. Cleaning doors are provided at intervals for removing accumulations from time to time.

The plant is designed to be capable of reducing to clinker 80 tons of domestic and trades refuse of average quality per day of 24 hours and has been tested and proved capable of evaporating 1.32 lbs. of water per lb. of refuse consumed.

The maximum combustion chamber temperature has been recorded of 2,255 degrees F., the average air pressure in the ash-pits being 2¾ in. (W. G.). The percentage of residual (clinker and ash) on the total of refuse consumed was 19 per cent.

Owing to complaints of dust and steam arising from the cooling of the clinker, a clinker shed has been erected adjacent to the destructor, in which have been provided compartments for placing barrows loaded with hot clinker. These are drenched with water taken from the adjacent cooling tower, the escaping steam being drawn into the chimney thru a flue. The clinker is afterwards tipped into the clinker house to await removal.

¶ THE FORCE *operating the plant works in two shifts six days a week.*

The plant is worked on an average 17 hours per day, for 6 days per week, the men working in 9-hour shifts. The staff consists of a foreman at 35s ($8.50) per week, 4 stokers at each shift at 5c ($1.22) each per shift. One charging man for the afternoon shift at 5s ($1.22) per shift. The plant is capable of dealing with all the available refuse collected in the town with the exception of the outlying portions, and this enables economical hours to be worked. Were it necessary for a 24-hour day to be worked, 25 per cent. of the heat generated could not be utilized economically.

It was originally intended when it was first decided to erect the destructor to utilize the steam for a slab-making plant and for public baths. These two ideas could not utilize anything like the amount of steam that can be generated.

In 1903 Mr. Fidler was instructed to prepare a scheme for the electrification of the Northampton corporation tramways, and recognizing the value of the destructor as a steam-raising plant Mr. Fidler advised the corporation to utilize this in their scheme, which advice they followed with the result that the capital outlay for the steam raising plant and distributing mains was considerably reduced. Steam is now supplied to the tramway power station, which has been erected on the same site, during the whole of the working day. One of the drawbacks of the utilization of the refuse destructor in connection with the steam-raising plant of the electrical power installation is the intermittent temperature, which results from the lengthy operations of charging and clinkering. To obviate this a boiler is always kept under steam in the tramway power station and steam from it is passed into the destructor steam mains, which results in an average pressure being obtained. Before entering the engines the steam passes thru a superheater placed in the back flue, which raises the steam to a temperature of 500 deg. F.

The amount received from the tramways committee for steam supplied during the past 12 months is £350 ($1,700), but it is expected that this figure will be considerably exceeded during the ensuing 12

THE REFUSE *of the city of Northampton, England, is incinerated in this high-temperature plant, entering from the left over the bridge, passing thru the furnace cells and removed as clinker on the floor below. A tall stack, shown in part, produces strong draft.*

months. This figure of £350 represents a saving in the coal bill of 35 per cent. and is a very welcome aid towards lowering the annual working cost of the destructor.

The total amount of refuse consumed per annum is about 15,000 tons. The resulting clinker is used for the foundation of footpaths on the various recreation grounds belonging to the corporation, a small portion is sold, and the remainder is carted away to tips. All irons, tins, buckets, etc., are sorted out from the refuse and a ready sale is obtained for them, the material being flattened by the use of the steam roller to make it more portable.

¶ THE ELECTRIC POWER STATION *for which the destructor supplies some steam is of large capacity.*

It may be of interest to give a few notes concerning the electric power station which consists of an engine room 63 ft. by 40 ft. by 32 ft. 3 in., a boiler house 46 ft. 3 in. by 14 ft. 6 in., store room, mechanics' shop, offices, battery room, etc., 38 ft. by 38 ft. with single storied offices, bathrooms and lavatories. There are three boilers of the "Economic" type made by Davey, Paxman & Co., of Colchester, each capable of evaporating 8,000 lbs. of water per hour. The boilers are also fitted with mechanical stokers of the Bennis type and superheaters are placed in the boiler flues capable of superheating the steam to 500 degrees F. The boilers are fitted with an induced draft plant provided with two motor driven fans and a steel stack 50 ft. high. The feed pumps are of the Weir type and the steam valves of Templar and Rance's make. The condensing and cooling plant consists of a Mirrilees-Watson condenser, capable of condensing 12,000 lbs. of steam per hour. The centrifugal circulating pumps and an Edwards air-pump are motor driven. The cooling tower is of the Klein type, about 70 ft. high. It is of timber and of the natural draft type, resting on a brick-faced tank 22 ft. by 7 ft. deep. A Paterson water softener and oil separator are provided to deal with the make-up water and oil, after the water leaves the condenser. The water supply is obtained from a well sunk on the site supplemented by town water. The water from the well is very hard and is rendered fit for steam raising purposes by the use of the water softener.

Generating Plant. This consists of two 200-k.w. sets composed of Willans compound 3-crank engine working 350 revolutions per minute, and capable of giving 360 i.h.p., and an International Electrical Engineering Co.'s dynamo. Also a compound set capable of giving an output of 120 k.w., consisting of a Willans 2-crank compound engine of 350 revolutions per minute and capable of giving 240 i.h.p., and a dynamo of the International Electrical Co.'s make.

There is also a battery made by Ashdown, Benson & Pease, of Stockton on Tees. It consists of 250 cells and is capable of giving out 170 amperes for 3 hours. There is also provided a reversible booster and milking set, both made by the International Company.

¶ A TRAMWAY SYSTEM *is operated by the power from the destructor thru the electric generating station.*

The length of the tramway system is 5½ miles, mostly of double line. There are at the present time 22 cars in operation. The car shed and tramway depot is situate in St. James End. The main building is 150 ft. long and 69 ft. wide and 19 ft. 6 in. to the tie-rods and will accommodate 30 cars. The offices, stores, etc., adjoin the building.

From the above short description the reader will no doubt be able to realize that the destruction of all waste and refuse matter collected which disseminates germs of disease besides creating intolerable nuisances, is possible without offence, and converts by the destruction all the organic particles into a perfectly inoccuous residual, which is of some utilitarian value, and at the same time the heat can be utilized to a commercial advantage, and assists one of the departments, which is nowadays recognized to be one of the duties of every up-to-date municipality, namely, the provision of a ready, cheap and agreeable means of locomotion, i. e., the electric tramways.

WATER STERILIZATION PLANTS

One of the problems in water sterilization is the removal of the excess of hypochlorite after its bactericidal action is complete. This article, from our English correspondent, describes several English plants which have installed satisfactory devices for insuring the removal of all taste and odor of the chemical from the sterilized water.

IN THE United States and Canada no special means are provided ordinarily for eliminating from the water any surplus free chlorine which it may result from the hypochlorite treatment, except that time may be given by storage of water to allow the hypochlorite to dissipate. In England consideration is given to the prevention of taste or smell in the water when it reaches the consumers, and therefore, except in a few cases of urgency, the hypochlorite treatment has been combined with a process for eliminating the free chlorine from the water after the germicidal action is complete. The process of an English firm of mechanical filter makers, consists of first dosing the water with the hypochlorite, allowing a definite time for it to destroy the bacteria and then passing the water thru a bed of prepared vegetable carbon which has the property of entirely removing any taste or smell.

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¶ DE-CHLORINATING BEDS *in a plant with pressure filters.*

Alex. C. Jarvis, an English engineer, states that in the course of perhaps two years continuous working the carbon becomes exhausted and requires renewal. Heating to redness in the absence of air, however, revivifies it. This combined chlorination and dechlorination process has been developed in both gravity and pressure systems, in plants pumping direct to consumers and in gravity supplies, in some cases combined with filtration.

One English town takes its supply from a small navigable river, the water from which, in times of flood, is turbid and colored. This water flows thru rough prefilter chambers and is then lifted by water-wheel driven pumps to the service reservoir, on the way receiving a dose of alumina and a dose of chlorine. Thence it passes thru a battery of pressure filters where it is filtered and allowed time for germicidal action. It is lastly dechlorinated, eventually reaching the reservoir, clear, bright, and almost sterile. There are no sedimentation basins and the filters run about 5 days between washings, working 24 hours per day. Of course, after pre-filtration the turbidity is not great and the quantity of alum used is small.

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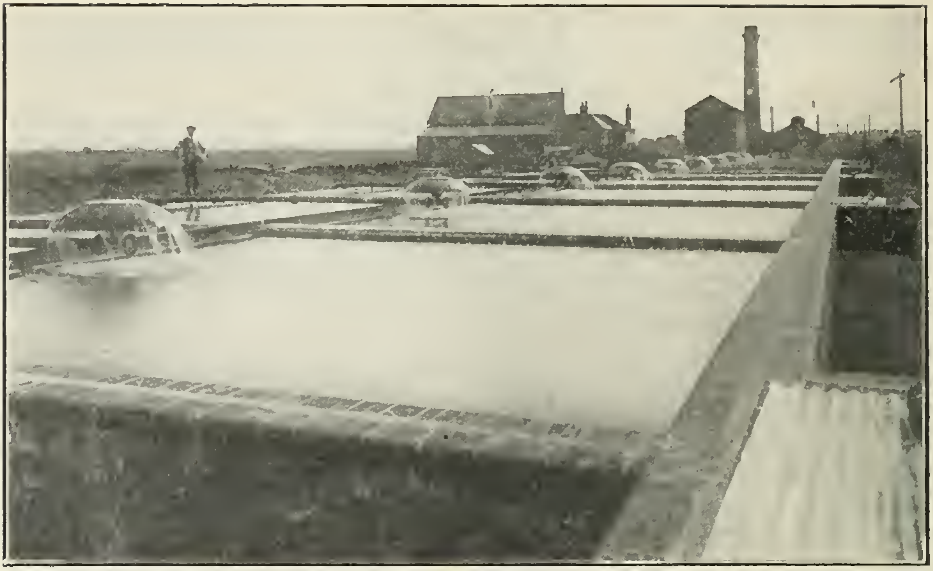
¶ THE PROCESS *applied to a plant with slow sand filters.*

In another English town the water from a stream gravitates thru slow sand filters and is then pumped to the consumers. The slow sand beds, with the greatest of care, would not produce a good water bacteriologically, and as, furthermore, the old clear water basin admitted polluted surface water by leakage, it was decided to treat the supply on the pumping main. The water passes from the pumps thru a battery of cylinders having de-chlorinating beds in the lower portion thereof, the upper portion giving the water "contact time." Hypochlorite solution is injected into the inlet main of the battery.

In still another English town the water



GENERAL VIEW *of English water purification works. Filters at farther end taken for dechlorinating plant. See drawing of plan for details of this emergency plant.*

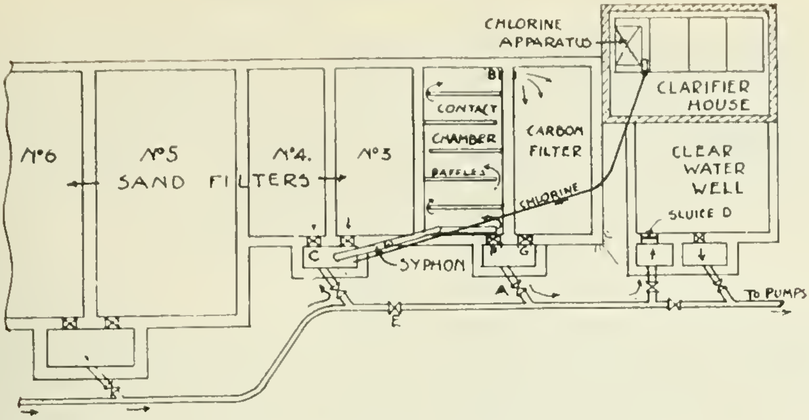
was pumped from a river thru some old cast iron clarifying boxes containing gravel into sand beds, whence it gravitated to a clear water well and was pumped to the consumers direct, the surplus being received by high level reservoirs. The supply, even after filtration, had always been more or less unsatisfactory, the river being sewage polluted and the sand bed area inadequate. The ubiquitious B. coli was very much in evidence, and when a serious typhoid outbreak occurred at a small town which discharges all its sewage impurities into the river only 10 miles above, the situation became alarming, especially as the threatened town was a high-class seaside resort which a typhoid epidemic would have ruined. The local government board called upon the water authority to take immediate action.

The difficulty was not so much in the chlorination, as in the de-chlorination of the supply. Absolute freedom from taste or smell was insisted upon, as any suspicion of flavor in the water would have started a scare immediately.

It was decided to treat the water after filtration, and before it reached the clear water well. The first four sand filter beds were small and two of these were utilized, as shown on the accompanying drawing. Filter No. 2 was entirely emptied of material and cleaned, and No. 1 was emptied down to the gravel and drains, and washed thru hose. Bed No. 2 was used as a contact or time chamber, and timber baffle partitions were put in to prevent the water running straight across from inlet to outlet, thus insuring utilization of the full capacity. A hole was cut thru the wall near the top and a 10-inch pipe was cemented in to pass the water into No. 1 bed. This bed was filled with carbon on top of the existing gravel to a depth of 2 feet, and a foot of grit and gravel was spread over it to keep it from floating up.

A siphon of 8-inch cast iron spigot and socket pipe was made up to connect the filtered water chamber with the contact chamber, and a small semi-rotary pump was rigged up to exhaust this siphon. The sluice was dismantled and a sheet-iron rectangular notch was put in its place with a hook gage to ascertain the flow and regulate the amount of chlorine.

Adjoining the clear water well is the clarifier house, containing the rough gravel clarifier boxes, and this was pressed into the service to house the



PLAN *of emergency dechlorinating plant. Sand filter No. 2 was taken for the contact chamber of the chlorinating apparatus and filter No. 1 was taken for the carbon filter to remove the taste and odor from the water due to the use of enough hypochlorite to insure destruction of bacteria.*

chlorinating apparatus, which was made up with a double compartment tank found on the works, a small ball-valve balancing tank, a special hand grinding mill to mix the bleach with water, and the necessary pipes, valves, and fittings. The solution was regulated by a cock on the balancing tank (with an independent cock for shutting off) and run by a funnel and wrought iron pipe (marked "chlorine" in drawing) across to the filtered water chamber. One compartment of the solution tank was in use while the contents of the other were settling ready for the following day. One part of available chlorine per million was used.

CONTACT CHAMBER, *carbon filter and siphon installed as an emergency dechlorinating plant in the works shown in the photograph on preceding page and drawing on this page.*

Municipal Electric Lighting Plants for Cleveland, Ohio.

By W. A. Springborn, Director of Public Service

The city of Cleveland, Ohio, is operating two small electric light plants to which it fell heir when suburban villages were incorporated in the city. W. J. Springborn, in this extract from a recent paper before the Cleveland Engineering Society, gives a clear and enthusiastic account of the greater or less success of these plants and his predictions regarding a proposed large plant which will ultimately serve the whole city.

The Brooklyn plant has been in operation long enough to demonstrate what can be accomplished with a municipal light plant. This plant came to the city thru the annexation of the village of South Brooklyn. The city began its operation on January 1, 1906. The village of South Brooklyn sold $30,000.00 in bonds for the construction of the plant. It was located on Broadview road, some distance from any railroad connection, and it cost about 40 cents per ton to haul the coal from the nearest switch. Soon after annexation additional funds were secured and the plant was enlarged by the erection of a new building in Big Creek valley, adjacent to the Baltimore & Ohio railroad. In this building was first installed a 500-k.w. steam turbine. Later on a 1,000-k.w. steam turbine driven unit was put in.

During the seven years the city has operated the plant, the earnings in excess of operation and maintenance have been put into extensions and enlargements, so that the property on December 31, 1912, had a book value of $483,934.81, less depreciation written off of $97,232.61, leaving the present net value of the plant and equipment $386,702.20. In addition to the original $30,000.00 for which bonds were issued the city has put into the property about $70,000.00 from taxes in excess of the value of the service rendered in furnishing street lights during the early years of its operation.

At the time of annexation about 100 residences were served with current and 100 street arc lights were maintained. On August 1, of this year, there were 3,262 private consumers and 1,312 arc lights were furnished and maintained.

The operation of this plant has had its influence upon the cost of street lighting in the city. The street lighting department has always paid the same rate per lamp to the Brooklyn plant that is charged by the Cleveland Electric Illuminating Company under its contract with the city for a similar service. In 1907 the rate for arc lights was $69.72 per lamp jer year. In order to forestall the enlargement of the Brooklyn plant the Illuminating Company cut its rate under its 1908 contract to $54.96. This resulted in a saving of about $40,000.00 per year in street lighting alone. Further annual reductions have been made so that now the city is paying $49.80 for arc lights.

The monthly rate for current from the Brooklyn plant is as follows: 8 cents for the first 10 units; 5 cents for the next 690 units; 3 cents for all in excess of 700 units.

The lines from the Brooklyn plant have been run as far northerly as Detroit avenue, so that a considerable portion of the west side is covered, occupied largely by the small home owners, small stores, etc. There are very few large users of current.

The receipts for the year 1912 were as follows:

From commercial lighting.....$	61,606.17
From street lighting..........	55,150.94
From current for power.......	22,889.22
Making a total of...........$	139,646.33

The expenses for the year were as follows:

For supervision ....$	4,354.84
Office expense	1,355.25
Station operation cost........	41,849.56
Maintenance cost	30,096.02
Total ....$	77,655.67

Expressed in percentages this would be as follows:

Supervision was equal to 3 per cent. of the receipts.

Office expense was equal to 1 per cent. of the receipts.

Station operation cost was equal to 30 per cent. of the receipts.

Maintenance cost was equal to 21 per cent. of the receipts.

Making a total of 55 per cent., which is regarded by power house engineers as a very reasonable percentage of the receipts to cover all operating and maintenance costs.

The fixed charges were as follows:

For interest on the $30,000.00 in bonds ....$	1,500.00
For depreciation	13,992.15

being 11 per cent. of the receipts, thus making the total expense for the year, including fixed charges, $93,147.82, or 66 per cent. of the revenue, leaving, therefore, 34 per cent. of the revenue as profit on the year's operation.

THE ECONOMY *of operating the plant is shown by the statement of output and average cost of current.*

In 1912 were generated 4,611,853 k.w.-hours, the average sale price for these being 3.02 cents. 3,766,265 k.w.-hours were sold at an average selling price of 3.70 cents. The difference in k.w.-hours generated and k.w.-hours sold represents the loss in transmission and current used at the stations, and for testing and other purposes. The average cost price for all kilowatts sold was 2.06 cents. The average cost price per kilowatt generated for depreciation, interest, etc., was 0.33 cent. The average cost price for kilowatts sold was 0.44 cent, leaving an average profit of 1 cent per kilowatt-hour generated and of 1.23 cents for all kilowatt-hours sold.

From the above it will be seen that the average sales were at less than 4 cents per kilowatt. If this can be done from a small plant of only 1,500 k.w. capacity and a handsome profit shown, it is not unreasonable to state that current can be sold at 3 cents or less from a 15,000-k.w. plant, as many of the items that enter into the cost are equally as great in a small plant as in a larger one.

THE PROFITS *on the Brooklyn plant for 1913 show increase over preceding years on account of increase in consumption. The Collinwood plant is smaller and less profitable.*

Take the same plant for the first seven months of this year and the showing will be even better than last year. The receipts for the seven months amounted to $100,941.04. The total operating and maintenance cost was $53,811.74, leaving the profit $47,129.30. From this, of course, must be deducted the fixed charges for interest and depreciation. Even after this is done the profit will be greater than in the year 1912. The remaining five months will show a larger earning, due to the fact that the burning hours are longer.

The total number of k.w.-hours generated in the seven months was 3,734,436, the average sale price being 2.70 cents. The number of k.w.-hours sold was 2,768,869, the average sale price being 3.64 cents. The average cost price per k.w.-hour generated was 1.44 cents. The average cost price per k.w.-hour sold was 1.94 cents. The average profit per k.w.-hour generated was 1.26 cents. The average profit per k.w.-hour sold was 1.70 cents. The average cost price per k.w.-hour at the switchboard during the seven-month period was 0.94 cent.

The city also operates what is known as the Collinwood plant. This plant, however, is much smaller and does not show so good a profit as the Brooklyn plant, due to the fact that the equipment is old and obsolete.

A fierce contest is waging over this design for a circular court house for New York City. It has already been modified and should be adapted to the civic center plan described in this article.

A CIVIC CENTER FOR MANHATTAN

THE fact that city, county, state and federal business in the Boro of Manhattan, New York City, has outgrown the space heretofore allotted to it has given rise to a number of plans for providing the necessary accommodations in buildings which shall be of monumental character as well as of business convenience.

The federal government is building a new postoffice far up town and will soon abandon the old postoffice on City Hall square for that purpose. It is now considering procuring another site for a federal court building.

The state of New York now rents many offices in the city, the annual cost of which would go far toward paying the capital charges on a suitable site and building for them.

The county courts have been so crowded that a new site for a building for them has been purchased a block or two north of the present locations of city and county buildings, and active steps have been taken, as stated below, toward a building.

The city hall has long been inadequate, even for the limited city purposes to which it is now assigned, and the enormous sums paid for rent of offices for the thousands of city employes have been capitalized for the future and put into the great municipal office building next to the City Hall park and the Brooklyn bridge, which is now completed.

Mr. Lowell proposed a circular building

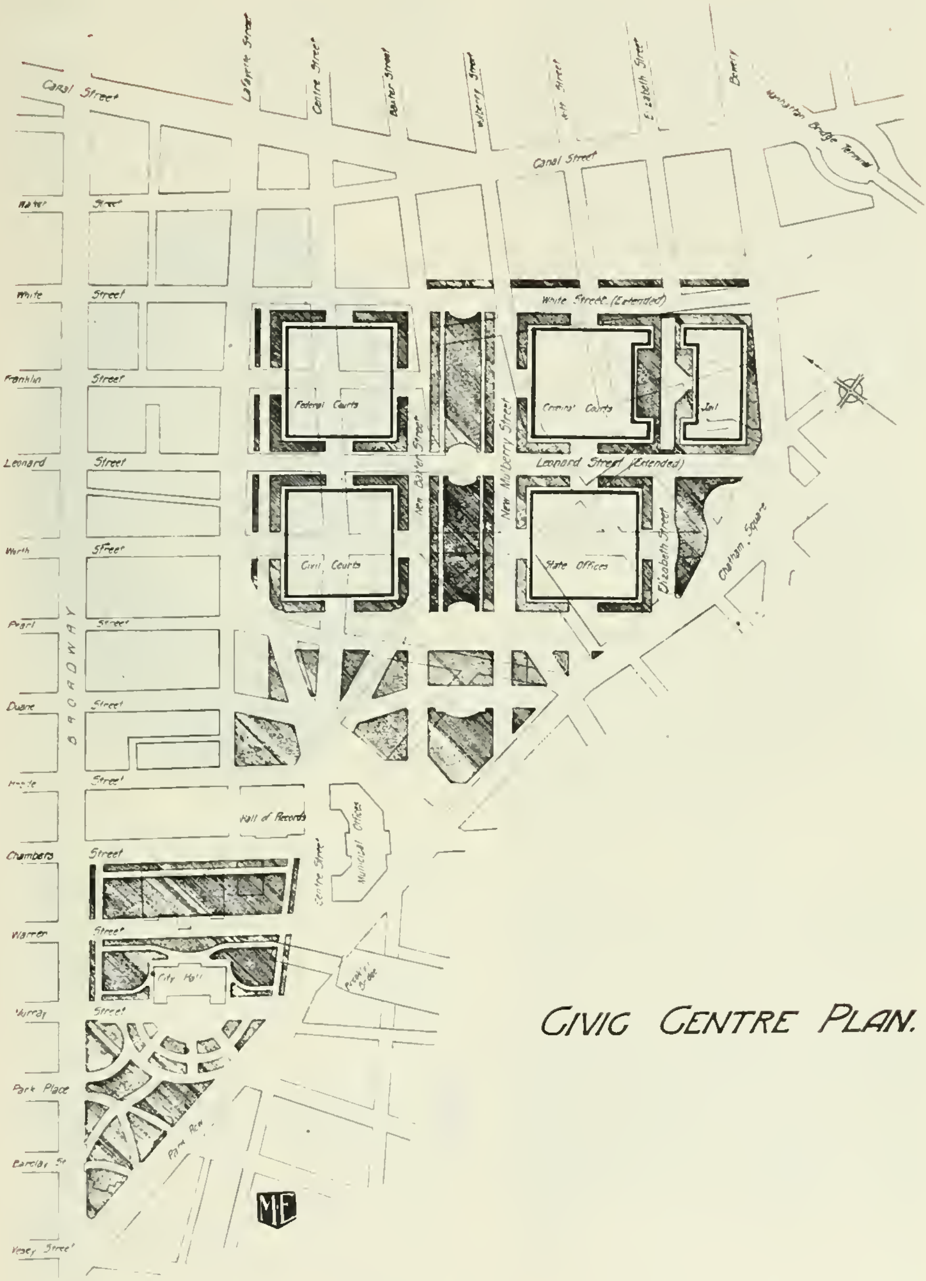
The congestion of traffic in the area between the Brooklyn and Manhattan bridges has become almost unbearable.

All these things have set men's wits to working and several schemes have been presented for relieving conditions to a greater or less extent.

¶ PLANS *for relieving the congestion and beautifying the quarter have concentrated upon one which should be pressed to adoption.*

Thus, one plan attempts only to secure a more direct and commodious passage from the Manhattan bridge plaza to the new municipal building. This would be secured by widening Canal street for four blocks to Baxter street, and widening Baxter street for one block from Canal street to the new court house site, by purchasing 100 feet width of property. This same width taken from the court house site would carry the new boulevard to its destination. The property to be acquired is assessed at $1,800,000.

President McAneny, of the Boro of Manhattan, and Alanson T. Briggs, secretary to the Court House Board, have prepared a much more elaborate plan, a



THE McANENY-BRIGGS *plan for relieving and beautifying New York's most congested and unsanitary district, lying between the Brooklyn and Manhattan bridge terminals.*

sketch of which is shown herewith. This plan takes into consideration the needs of nation, state, county, city and local traffic and provides for them all and at the same time makes possible a majestic and beautiful civic center which will extend without a break along Park Row, Chatham Square and the Bowery from Broadway to the Manhattan bridge approaches. This is shown in the reproduction of the sketch herewith.

The areas within the heavy black lines are the new buildings, federal, civil and criminal courts, jail and state offices.

The shaded areas are the park spaces about the new buildings and the old buildings remaining. Within this park area the buildings to be removed are shown by fine lines showing their present contours. They include the old postoffice, the buildings between Warren and Chambers streets on the north end of City Hall park, and all the buildings between the old streets shown in fine lines across the proposed new civic center.

A considerable area south of Worth street has already been purchased for the site of the new county court house, costing some $6,000,000. The property to be taken for the whole plan is assessed at $15,647,000, which is the sum necessary to secure the ground on which to build it.

¶ THE PROPOSED NEW COURT HOUSE *would interfere with the new civic center plan and should be made to conform.*

A bill is now before Congress to appropriate $3,000,000 to purchase a site for a federal court house. The site of the state office building is assessed at $1,940,000; that of the criminal court and jail at $3,569,000. If the state can be induced to purchase these sites, there would remain a little over $7,000,000 for the city to raise to pay for the better street areas provided and for the park features.

This plan would leave only the old city hall in the City Hall park and would clean up what has been for many years one of the most objectionable areas in the city. It would give a breathing spot with comparatively low buildings in the midst of the forest of skyscrapers and would add incalculably to the comfort of business conditions in the most seriously congested area in any city.

This plan would be interfered with by the construction of the new court house, over the plans for which there is much controversy. This was begun over the competition for the preliminary plans,

GUY C. LOWELL, *the designer of the proposed circular court house.*

the first prize in which was awarded to Guy Lowell, a young architect of New York, one of the famous Lowell family, and cousin of the president of Harvard University.

¶ THE CIRCULAR COURT HOUSE *plan is well worked out and presents a notable solution of the difficult problem of putting a circular building to practical use.*

Mr. Lowell proposes a circular building approximately 400 feet in diameter and 200 feet high. Its general appearance can be judged from the accompanying photograph of the south elevation. Rectangular rooms in a circular building would seem to present great difficulties, but Mr. Lowell has utilized every odd space with small rooms essential to the proper use of the building until it seems that he has saved room rather than lost any. The circular form gives more actual floor space for the same length of exterior wall, so that there is material saving in cost on this account. It has been possible by arrangement of offices, courts, judges' rooms, etc., on differeut floors, to serve the public doing business with the court offices on the first floor, to give the public immediate access to any court room and its appurtenant rooms, to separate spectators from those engaged in cases before the courts and to give the utmost privacy to judges, jurors and court officers requiring it.

The building would occupy the site on the civic center plan marked "Civil Courts" and there seems to he no good reason why it could not conform most acceptably with classic designs for rectangular buildings upon the other sites. A building of its dimensions will certainly show its beauties much more clearly and satisfactorily in such surroundings than it will if located on the plat provided for it alone and closely surrounded with business buildings, especially if they are as tall as are their neighbors, of which the great municipal building is but one.

¶ THE DELAY *caused by the refusal of the judges to approve the court house plan gives pause for the promotion of the civic center plan.*

The Supreme Court judges in New York city entered formal objection to the circular plan, the twenty-six judges being unanimous in requiring more light than the plans provide. They point to the gloomy court rooms in the present county court house which have light from only one side as evidence of the practical basis for their objections and to the fact that the most desirable court rooms in the present structure are those in the Eidlitz extension from the main building, which have light on three sides. Justice Dugro, the chairman of the committee of judges on the subject, himself a very competent expert on the architecture of courts, has recently visited court houses in London, Paris, Berlin and Brussels and was particularly pleased with the new courts in London, which are lighted from three sides and also from the ceiling.

Mr. Lowell, after unsuccessful efforts, seconded by Walter Cook, the consulting architect of the court house commission, to secure the adoption of his plans by the judges, has modified his circular plan somewhat, but did not adopt Justice Dugro's suggestions, because they would require an entirely new plan.

¶ THERE ARE OBJECTORS *to the Lowell court house plan other than the judges of the courts to be housed.*

Some of the architects have taken a hand in the controversy and even attack the validity of the ordinary architectural competition on the ground that the novel effects shown so convincingly by Mr. Lowell in his plan hypnotized the architects, R. S. Peabody, Frank Miles Day and J. L. Mauran, who with Mr. Cook were the jury making the award.

It is even thought probable that legislation will be necessary to resolve the difficulty, since the plans under the present law must be approved by the Supreme Court judges as well as by the Court House Commission and the Municipal Art Society, before the work can begin.

Perhaps this delay over the plans will operate to the benefit of the plans for the civic center, because they provide sufficient space and light, whereas the site for the court house now provided is insufficient to meet all the demands made by those whose opinions govern.

THE NEW WATER PLANT
OF SOUTH ORANGE, N. J.

The story of the building of a new plant for supplying deep well water to a large village is one of considerable interest, especially as it tells of a successful application of the air-lift system and gives quite full detail of the cost of construction.

The village of South Orange, N. J., had a population in 1910, at the time the movement for a municipal water works was started, of about 6,000, which had doubled in 20 years.

Dissatisfaction with the service and supply of the private company, one which served several municipalities led to the development of the present deep well supply after careful studies of the situation by several competent engineers, including John J. Boyd, the designing engineer, and Nicholas Hill, Jr., and C. C. Vermeule, consulting engineers of national reputation.

A special act of the legislature giving the village the power to construct its own water plant was necessary and was obtained, together with the consent of the state water commission and the approval of the supply by the state board of health. All these steps occupied some two years and the contract for construction of the works was let late in the summer of 1912.

The completed plant is described as follows:

The pumping station is a substantial brick building, on heavy reinforced concrete foundations, with tiled roof, lined with cement and absolutely fireproof. It is in tasteful and appropriate style of architecture. Inside, the walls of the engine room are wainscoted with white glazed brick up to 8 feet from the floor. The whole interior can easily be kept clean and sweet as a water plant should always be. The stack is also a fine piece of work, of material matching the main building. A siding from the railroad brings cars directly to the coal pockets along side of the boiler room.

The machinery is in duplicate thruout, as follows:

Two 210-h.p. water tube boilers, of the Murray Iron Works manufacture, capable of operating at 190 pounds working pressure, altho normal pressure carried will not be in excess of 150 pounds.

Two cross-compound, two-stage, Meyer valve gear on the steam end, compressors of the Laidlaw-Dunn-Gordon manufacture, of the dimensions: High pressure steam cylinder, 11 inches: low pressure steam cylinder, 20 inches; intake air cylinder, 20 inches; compression air cylinder, 13 inches diameter; stroke, 12 inches. Under the well conditions as at present determined, the capacity of each of these compressors will be 1,300,000 gallons per day of 24 hours.

Two triple-expansion pumping engines, made by Epping Carpenter Co., of a guaranteed duty of 80 million foot pounds of useful work per 1,000 pounds of commercially dry steam, of dimensions: high pressure steam cylinder, 8 inches; intermediate steam cylinder, 12 inches; low pressure steam cylinder, 30 inches; water cylinder, 9½ inches diameter; length of stroke, 16 inches; capacity 800 to 900 gallons per minute, but could in emergency be increased to 1,000 gallons per minute, or 1,440,000 gallons per day of twenty-four hours.

The chimney is 5 feet in diameter at its smallest point, the top, and is built of radial brick and carried to a height of 125 feet. This has been furnished and installed by Messrs. H. R. Heinecke, Inc.

The auxiliary machinery consists of two independent jet condensers, each of sufficient capacity to condense the steam from one compressor and one pump, of the Blake and Knowles manufacture; two boiler feed pumps, each of ample capacity to supply either one of the boilers, of the Henry R. Worthington manufacture; one feed water heater, so proportioned as to take the exhaust from the condenser pump and the boiler feed pump, using the exhaust steam for heating the feed water for the boilers and raising the temperature of this water to 190 to 210 degrees F.

¶ THE DIVISION *of the plant into units is such as to make the economy of operation under any probable load a maximum.*

The whole plant is designed so that one boiler will operate one compressor and one pump. Both pumps and compressor will operate condensing, the water for this purpose being taken from the east branch of the Rahway river and returned thereto. Each unit will have a normal capacity of 800 gallons per minute, or 1,200,000 gallons per day of 24 hours; or, if only operated 10 hours, 480,000 gallons, but should it be desired, the speed of the compressor and the pump can be increased so as to deliver 1,000 gallons per minute, or 600,000 gallons per day of 10 hours. Should it be desired, more water could be pumped in less time by putting in operation the extra units of the compressors and pumps; or by operating one compressor and pump, and increasing the time of operation, the same results could be obtained.

The plant also includes a dynamo for lighting the building and grounds and the plans provide a storage battery for lighting when the boilers are shut down, and also an air tank and fire whistle for sounding alarms, the latter being connected with the fire-alarm system of the village and actuated from the boxes, the police headquarters or the fire-house.

It is not the plan to pump continuously for the present. That would require extra labor and add to the expense. The capacity of the wells and pumps is such that enough water can be raised in an ordinary working day to supply the village for twenty-four hours. The reservoir has a capacity of 2,000,000 gallons, and the ordinary daily requirements are only four hundred thousand. The reservoir will be filled and after that the daylight run of the pumps will keep the supply up to the demand. The twelve-inch main which runs from the pumps to the reservoir, is connected with the supply main of the distributing system for the village, at the corner of Lenox road and Ridgewood road. The pumps will work directly into the mains during the day, the unused surplus going to the reservoir, and after the pumps are shut down at night, the supply will be drawn entirely from the reservoir. The valves are so arranged that the reservoir may be disconnected and all the water pumped directly into the mains, or the pumps may be cut off and all the water taken from the reservoir.

¶ THE WELLS, *their depths, capabilities and locations, show the advisability of the application of the air lift.*

There are at present seven wells completed and in service. Upon completion of each well, a test was made of the quality and flow for a period of 72 hours. The record is as follows:

No.	Depth.	Flow per day.	Completed.
1	274 ft.	350,000 gal.	Oct. 28, 1911
2	276 ft.	300,000 gal.	Jan. 27, 1912
3	275 ft.	210,000 gal.	May 25, 1912
4	400 ft.	70,000 gal.	Aug. 31, 1912
5	300 ft.	288,000 gal.	Nov. 2, 1912
6	300 ft.	350,000 gal.	Feb. 15, 1913
7	300 ft.	125,000 gal.	April 26, 1913
		1,693,000	

The air lift is used in raising the water from the wells. The full dimension of the wells is 8 inches. Within this and extending down below the surface of the water about 140 feet, is a 5-inch pipe and inside that is a 4-inch pipe reaching nearly as far down. Air from the compressors in the pumping station is forced down the space between these two inner pipes to the bottom of the 4-inch pipe, thru which it rises in a series of bubbles, which lighten the water in the inside tube so that it is pressed upward by the weight of the solid water outside, and is driven out at the top in aerated jets. At the top of each 4-inch pipe a deflector turns the water into pipes thru which it flows by gravity to a basin at the pumping station and from there the pumps deliver it to the reservoir. This method has many practical advantages. There is no machinery in the wells that can get out of order and it is capable of indefinite extension to wells at a long distance from the power house, limited only by the capacity of the air compressor. The seven wells give an ample supply of water for a number of years to come, pumping at first only in day time, and later on, when the consumption demands it, pumping day and night. Additional wells may be driven as the demand increases.

¶ THE RESERVOIR *is near the top of the mountain above all present habitations.*

The reservoir near the top of the mountain on South Orange avenue is in the shape of a truncated triangle, 255 feet long, 90 feet wide at one end, 20 feet wide at the other, and 23 feet 9 inches deep, the shape conforming to the lay of the land. It will hold 2,000,000 gallons of water, about enough for five days supply, at the present rate of consumption. It is divided in two sections, each of which can be cut off for cleaning, leaving the other for service. Its elevation will give a pressure of 117 pounds at the village hall, a little more than that of the present supply when the latter is up to normal, and it will provide constant pressure at any house now in the village. If houses should be built near the top of the mountain too high to be served from the reservoir, they can be supplied from a small standpipe set on land which belongs to the village on the mountain above the reservoir, and this can be filled by an electric pump, operated from the power house. A conduit for electric wires for telephone, lighting and power, has been laid over the main which connects the pump-house with the reservoir. The reservoir was made by excavating rock from the mountainside and lining the cavity with walls and floor of reinforced concrete. It is covered with a reinforced concrete roof, supported on steel columns, encased in cement and the top is covered with earth, and seeded in grass.

¶ LAND *sufficient to protect the purity of the water and to extend the well system has been provided.*

The board has acquired from various owners a tract in the valley, adjacent to the pumping station, of about 27 acres. It includes the low lands where the wells are driven and space for additional wells, when they may be required. It also includes adjacent land on higher ground than the wells, extending up to Walton road, and southward to Hilldale avenue. It was considered a wise policy, and it was in accordance with the recommendation of the engineers, to acquire this land and control it absolutely so as to prevent encroachments at any time in the future. The land has all been bought outright, without recourse to condemnation proceedings in any case. The tract on the top of the mountain where the reservoir is located extends back from South Orange avenue beyond the crest of the mountain and cuts off encroachments from that side. This will make an attractive public park, and it commands a magnificent view. The grounds around the pumping station and wells, will also be a public park. It will be enclosed by a fence with gates at convenient points of access.

The vital feature of the plant is the quality of the water. This is of the highest degree of purity and reasonably sure to remain so. Tests have been made from every well by three separate chemists, representing the state board of health, the village board of health and the engineer. All agree, in every case, that the water is of good quality, entirely free from any contamination. The geological structure of the ground is favorable. A section of the strata thru which the wells are driven shows that the top is a layer of earth, then a layer of clay 12 feet thick, then a layer of hard pan, then another layer of clay, about 9 feet thick, over 30 feet in all and then 230 to 270 feet of solid rock down to the water bearing stratum. The water that is found there has no connection with the water on the surface. The engineer of the joint trunk sewer which passes near the tract, was requested to make an examination and ascertain whether there is any danger of contamination of the wells from that source. He made an exhaustive and thoro series of tests, and his report shows that there is no connection between the surface water and the wells and no cause for apprehension on that score. The geological formation is such that the overlying bed of drift and clay everywhere protects the rock strata.

¶ THE WELL TUBES *are made watertight by standard methods.*

To make the well tubes water tight, the iron pipe which comprises the top section of each well is driven down into the rock for several feet, making a close joint. Around the top of each well tube, a block of concrete was built 16 inches thick and 8 feet across, cutting off any surface water that might follow down the pipe.

The following analysis of well No. 7, on May 8, 1913, is typical:

(Results expressed in parts per million.)

Temperature	52° F.
Odor	None
Turbidity	0.5
Color (platinum standard)	15.
Nitrogen as free ammonia	.034
Nitrogen as albuminoid	.070
Nitrogen as nitrites	0.
Nitrogen as nitrates	4.0
Chlorine	10.
Temporary hardness (alkalinity equivalent to carbonate of lime)	97.0
Permanent hardness	.0
Total solids (residue on evaporation)	193.0
Loss on ignition of residue	30.0
Fixed mineral matter	163.0

Bacteriological.

Fermentation in lactose bile (10 tubes, 1 C. C. of water in each), positive, 0; negative, 10.

Litmus lactose agar	0
Red colonies	0

Bacteria per C. C.

Growing in 24 hrs. at 37° C.	0
Growing in 48 hrs. at 20° C.	190

No deleterious chemical properties are found, and it is absolutely free from the B. coli, the sign of sewer or other excremental contamination. The bacterial count is not large. This feature is present to some extent in all water, and is not necessarily harmful. It is likely to decrease with the constant pumping of the wells.

About one-third of the floor space of the pumping station is left vacant, that the village may install an electric plant for lighting the streets when it is considered advisable to do so. The generator could be run from the same boilers as the pumps, one being operated chiefly at night and the other in daytime, or both together, if necessary, or there is space in the boiler room for another boiler, if it should be required.

¶ THE FINANCIAL STATUS *of the plant will improve as the number of users of the water increases within or without the village limits.*

At the normal consumption of water at the present rate, the earnings of the department will be sufficient to meet all charges for operation, interest and sinking fund. As the population increases and more water is used, the profits will increase with the possibility of lower rates being feasible. There is also the very imminent probability that some of our neighboring municipalities, several of which are in straits over their water supply, may look to South Orange for assistance, which could easily be furnished from the surplus available. The approximate cost of the plant is as follows:

Real estate (36 acres)	$ 70,369.84
Wells	10,697.47
Pumping station, machinery, etc.	65,564.89
Reservoir	46,694.09
Pipe lines	9,111.93
Engineering, inspection, etc.	9,223.96
Interest	6,082.00
Grading roadway, etc.	2,284.30
Miscellaneous	1,820.02
	$221,749.50

THE DESIGN OF A STREET INTERSECTION

By Paul E. Kressly, City Engineer, Inglewood, Cal.

A Practical and Individual Solution of the Problem of Designing a Satisfactory Street Intersection.

THE proper form of the surface of a pavement and the method of drainage at street intersections, are matters which in the opinion of the writer, require careful study and consideration. It is usually difficult properly to decide all the various matters that must be considered in determining the best methods to be followed, as there is no established custom among municipal engineers with regard to this, and the practice varies materially. There are, however, certain objects to be attained which govern the engineer in designing, and which must be given consideration in arriving at the proper solution of the problem in question.

The form of pavement and drainage at street intersections depends entirely upon the proper arrangement of the grades and is one of the most important parts of the establishment of a system of street grades. In order that the best results may be attained it is necessary to take into consideraton the good appearance of the street, the prompt removal of the surface water, and the convenience and comfort of pedestrians and vehicles.

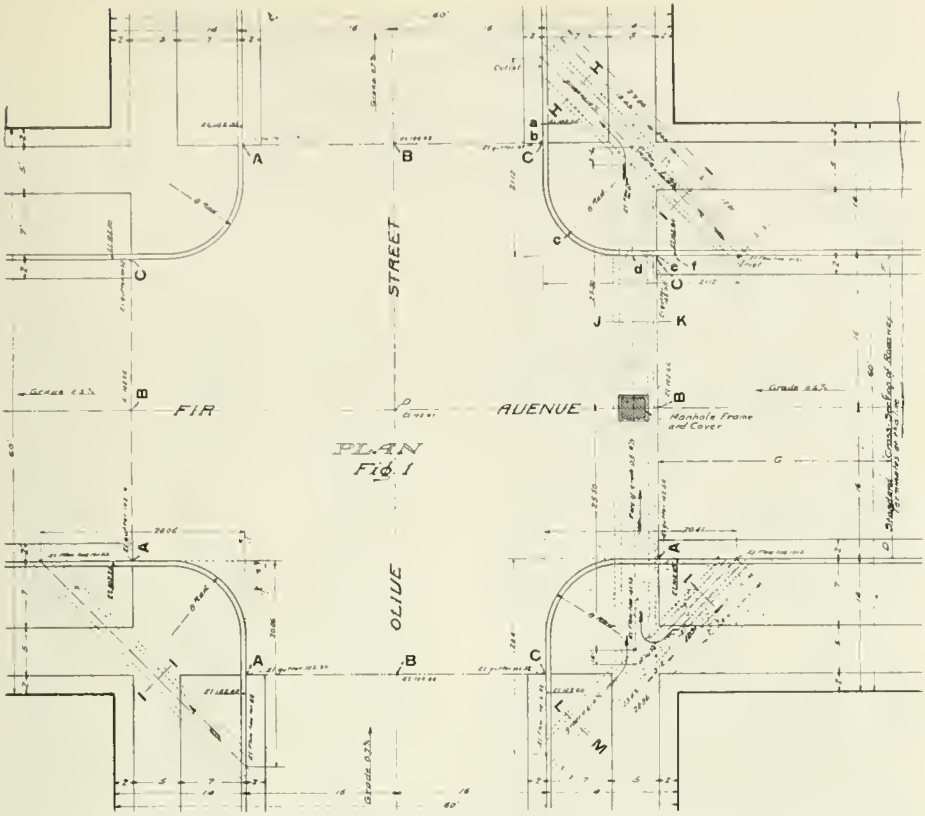
In order that vehicles may pass smoothly over street intersections, the crown of each roadway should be continuous across the intersection. This condition, however, it is not always possible to obtain. Especially is this true where streets have much inclination. I have obtained satisfactory results by continuing street grades of three per cent. or less unbroken across the intersection; when grades are steeper than three per cent., the best method to follow is to break grade at the curb line and continue across the intersection at a grade not exceeding three per cent.

The grade between the property and curb lines should not exceed six per cent.

This arrangement of grades gives a very satisfactory form of pavement, which will not introduce side slopes at the intersections, which are troublesome and dangerous to cross, particularly for vehicles to turn the upper corners of the intersecting streets.

¶ THE CROWNS *across an intersection should not be broken by open gutters running across the streets.*

The crown of either roadway should not be broken by the gutters of the intersecting street. In some cities it is a universal practice to carry the gutters across the intersections. This is objectionable at any season, particularly when the gutters are filled with snow and ice, and when the gutter and approaches to the same are so steep as to cause a violent jar to vehicles in passing over them. In fact any form or shape of gutter carried across a street intersection necessitates slowing up every time that an intersection is approached, which certainly is not very desirable, and the damage resulting to vehicles in crossing them is considerable, especially when drivers are not familiar with the location of the gutters. Another serious objection to these gutters is the rapidity with which the road metal disintegrates adjacent. to the gutters, forming ruts and depressions at the approaches. It has been my experience that



A DESIGN *for an intersection with slight fall across both streets. Note the covered gutter under the sidewalk in the lower left-hand corner to take the water from Olive street to Fir avenue without running around the corner. Note the covered gutter to take the water across Fir avenue on the right-hand side and the inlets to take in the water from Olive street and Fir avenue and discharge it in the gutter of Olive street near the top of the sketch. The arrows show the direction of flow of the water.*

this form of gutter is a source of continuous expense, provided that the roadway is to be maintained in a good and passable condition, which undoubtedly is very important.

The drainage at street intersections in cities which have storm water sewers is more easily taken care of. The catch basin is usually constructed at the corner of the curbs, using inlet with a curved face. This eliminates the necessity of continuing the gutters across the intersection, and the continuous crown can be used, however, making it necessary to ease off the curves of the crowns of the two streets where they intersect, thereby requiring pedestrians to step up and down at the curbs, and follow the crown of the street in crossing. This is not desirable, as a person is liable to fall in stepping up and down at the curb. While the catch basins at the corners serve well to receive the surface drainage, this practice is very objectionable, as the surface water collecting at this point and along the line of the sidewalk and cross-walks usually forms a wide and deep channel, making it necessary for pedestrians in crossing, to either jump across or wade thru the water. This method of drainage at intersections is therefore very undesirable, and not the proper solution of the problem so far as the convenience and comfort of the pedestrians are concerned.

Some cities make better provisions to guard against accidents and discomfort to pedestrians by flattening the crown along the path of travel, and at several feet from the curb a false curb or wall is constructed, usually at the same height as the main curb, from which a cast iron plate bridge spans the gutter to the main curb, thereby leaving a narrow channel thru which the surface water is conveyed to the inlet. This is a good method so far as eliminating the necessity for pedestrians to step up and down curbs, or across water in the gutters is concerned. However, they are objectionable inasmuch as a pedestrian is very liable to step inadvertently to the side of the bridge and fall. Furthermore, as far as the use of the carriage-way pavement or roadway is concerned, such an elevated crossing and bridge is undesirable, as it obstructs the roadway, particularly where there is considerable heavy and rapid traffic, on account of reducing the effective width of the roadway, and the bridge plates are frequently struck by wheels and broken.

¶ NO SURFACE WATER *should be carried in an open gutter across the path of pedestrians.*

The inlet in such cases should always be located at one side of the line of the sidewalk or cross-walk, and provision made that the surface water running in the gutters is not carried beyond the inlet, and into the path of pedestrians. However, sufficient provision must be made to carry away the surface drainage at the intersections. This may be effected by slightly raising the grade of the roadway and sloping the surface of the intersection gradually from the center of the roadway towards the inlet. This method would naturally deviate from the continuous- crown- across- street- intersection method, but this deviation is not noticeable, nor is the elevated intersection an obstruction to travel, provided a sufficient distance is allowed to transform from the standard cross-section of the roadway to that of the special form adopted for the street intersection. This distance depends upon the increase in the amount of the crown at the center of the intersecting streets above the amount of crown for the standard cross-section.

Figure 1 shows the plan of a street intersection, with the arrangement of

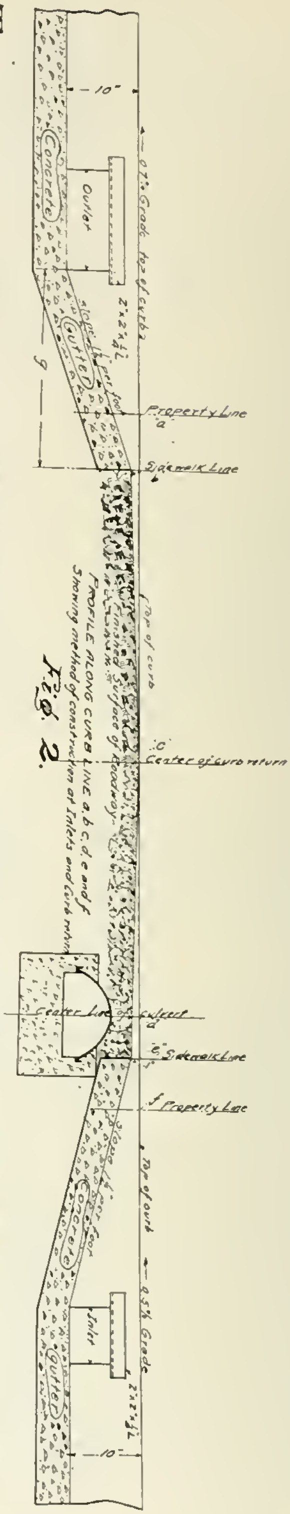
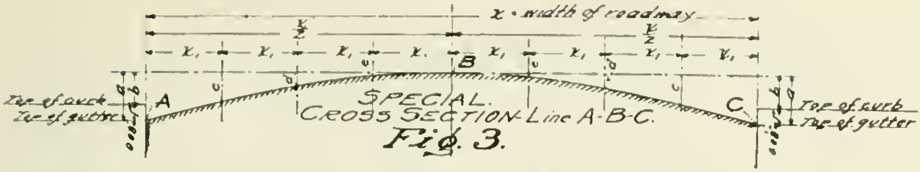


Fig. 2.

THIS SECTION, *running round the upper right-hand corner from the outlet in Olive street to the inlet in Fir avenue shows the care taken to eliminate obstructions to foot travel across the intersection and to reduce the obstruction to vehicle travel around the corner to a minimum, the only obstruction remaining being the rather steep grade, 12½ per cent., from the gutter at the outlet or inlet to the raised surface near the curb, where foot travel is expected.*



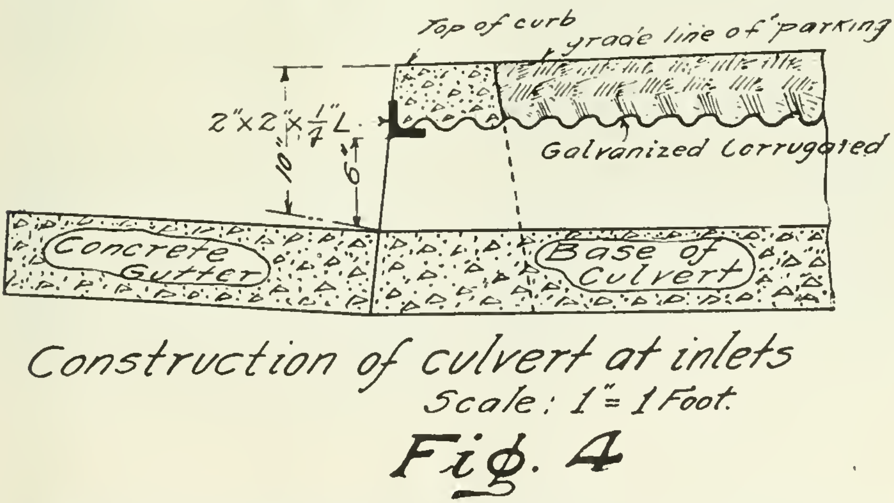
SHOWING *the special raised cross section of the street pavement on the line of pedestrian travel.*

grades, location of sidewalks, form of pavement and method of providing for surface drainage at the intersection, and of carrying the same under the roadway, by means of a corrugated iron culvert. The grades are adjusted so as to provide sufficient drainage, to impart a good appearance to the street, and give a form of pavement surface and culvert which offers the least obstruction and inconvenience to pedestrians and vehicles.

It will be seen by the elevations shown on the plan that the cross-section of the roadway is raised across the intersection, but not so much as to be an obstruction to travel. The line D, E, F, shows the termination of the standard or regular cross-section of the roadway, and the line A. B. C. shows the special cross-section at the end of the concrete gutters, which is shown on the plan to be in line with the sidewalk. Figure 3 shows a cross-section of the roadway along the line A. B. C. the different values being determined by the following formulas: x=width of roadway in feet; $x_1=x/8$; $a=x/200+.08$; $c=a\times.56$; $d=a\times.25$; $e=a\times.06$.

The cross-section between lines D. E. F and A. B. C is a transformation from one to the other, and is formed so as to coinside with the construction of the gutters and roadway surface as shown in Figure 2.

Between the points B—B along the center line of either street the grade is continuous across the intersection to the opposite line A, B, C. This arrangement of the grades of the roadway gives a good form of pavement, and one which efficinetly drains the intersection, without being an obstruction or inconvenience to pedestrians or vehicles. It will be seen in Fig. 2 that it is not necessary for pedestrians to step up and down at the curbs, nor into or across a channel of water, as this is taken care of by the inlets before it reaches the cross-walk. The construction of the gutter at the inlets and outlets is shown in Fig. 2, it being raised with a uniform slope from a point at the



THE CONSTRUCTION *of the inlets to the culverts is shown of concrete, steel and galvanized iron. The outlets are of the same design.*

inlet or outlet as the case may be, to within one inch of the top of the curb in line with the sidewalk as indicated by the letters b and e.

¶ THE DESIGN *of the culverts is one of the unique features of this plan of drainage of a street intersection.*

Sections, I—I, L—M and H—H show the construction of the culvert under the sidewalk and parkways, which consists of a concrete base and side walls, covered with a galvanized corrugated iron sheet of various gages as indicated, over which the cement sidewalk is constructed or the parkway fill made as the case may be.

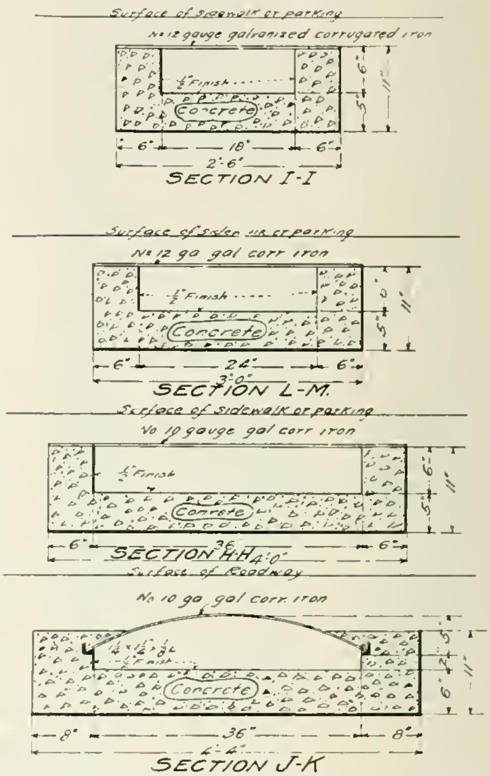
Fig. 4 shows the construction of the inlet at the curb. A 2 by 2 by ¼-inch angle-iron spans the opening, and supports the curb and the corrugated iron sheet which covers the culvert.

Wherever I deem it necessary, I require a light cast-iron manhole frame and cover to be placed at the junction of the inlets to facilitate the cleaning out of the culvert, but this is not absolutely necessary, as they can be easily cleaned with a long handled hoe from the inlet at the curb.

Section J—K shows the construction under the roadway, which consists of a concrete base and side walls, covered with a segment of a galvanized iron pipe, resting on 1¼ by 1¼ by ⅛-inch angle-iron, firmly embedded in the side walls of the culvert.

It is of the utmost importance that the galvanized iron be of the best quality obtainable, and that it should have a small percentage of impurities. There is no question but that the life and strength of this type of culvert depends upon the purity of the iron to resist corrosion. Tests have uniformly indicated that segregated impurities present in iron affect its power to resist corrosion in a marked degree.

The cost of this type of culvert construction naturally varies with different localities, and the size of culvert necessary properly to convey the surface water. I may state that during the years 1912 and 1913, there were constructed in the city of Inglewood, thirty-one culverts of this design, costing complete from \$92.00 to \$275.



B Y REFERENCE *to Fig. 1 it will be seen that the first two of these sections are of the covered gutter under the sidewalk on the lower right-hand corner, and show the differences in dimensions to suit the differences in volume of water to be carried. The first section and the third show the same for the covered gutter under the upper right-hand corner, and the fourth for that under the street pavement.*

Increased Efficiencies in Electric Lamps

The most recent improvements in electric lamps are along two lines: The filling of bulbs having incandescent filaments, metallic or non-metallic, with an inert gas, such as nitrogen, under pressure; and the use of a luminescent gas, such as neon. The advantages and the probable prospects for the commercial use of such lamps are here described.

THE nitrogen-filled tungsten lamp is reported to be about ready for the market. This is a development which was made possible by the elimination of many defects in filaments, in sealing of lamps, in removal of troublesome gases from the lamps, in preventing blackening of bulbs, and of further efforts to increase the efficiency of the filaments without shortening their life. The *General Electric Review* shows the effect of these defects in such statements as that an efficiency of 0.2 watt per candle was possible for a few seconds, that efficiency as high as 0.5 watt per candle resulted in blackening bulbs within a couple of hours.

¶ PERFECT VACUUM *not being attainable, the purpose now is to remove gases affecting filaments.*

The effort has long been to obtain a more perfect vacuum, but the results in this direction have been far from satisfactory. Then a search was made for the gases which might be affecting the filaments and it was found that water vapor is the producer of the objectionable blackening of the bulb, a very small amount of water producing a constant deterioration of the filament and increase of the blackening deposit on the bulb by transfer back and forth thru the cycle of chemical reactions.

Efficiency in the lamps could be increased by introducing gases which would prevent this cycle of chemical reactions, or by forcing the deposit at a definite place on the bulb where it would produce a minimum of damage. Both methods have been successful and the nitrogen-filled lamp is a result of the former line of experiment.

With a gas-filled bulb the filament must be run at a higher temperature than in a vacuum to get the same efficiency, and the rate of evaporation is higher, as well as the loss of heat by convection. But an increase in size of the filament increases the efficiency at the same temperature. Thus a straight filament 0.001 inch in diameter run in nitrogen at atmospheric pressure and at a temperature corresponding to that of a filament running at 1 watt per candle will give an efficiency of about 4.8 watts per candle, while a filament 0.01 inch in diameter will give at the same temperature an efficiency of 1.59 watts per candle. Winding the filaments into the form of a tightly coiled helix produces practically the same effect. Very high efficiencies can be obtained with these nitrogen filled lamps and still give the filament a life of more than 1,000 hours. The blackening of the bulb becomes a slight brownish deposit in the upper part of the bulb where it does no harm, if the bulb is properly designed.

Among the most interesting types of nitrogen-filled lamps that have been made and tested are the following:

1. *Large units of very high efficiency.* (0.4-0.5 watt per candle with a life of 1,000 hours or more.) These take currents of at least 20-30 amperes and (ex-

cept in units over 4,000 candle-power) are therefore best run from alternating current circuits by means of small transformers giving a voltage depending on the size of unit desired.

2. *Smaller units of low voltage.* These take currents of ten amperes or less, at voltages, in some cases, as low as four or five volts. The efficiencies with 1,000 hours life vary from 0.6 to 1 or even 1.25 watt per candle, according to the current used. These lamps are adapted for series street lighting on 6.6 ampere circuits (at about 0.7 watt per candle); for stereopticon lamps, automobile headlights and in general, wherever a source of high intrinsic brilliancy, steadiness and white color is needed.

3. *Lamps to run on standard lighting circuits* (110 volts). Large units of this type (several thousand candle-power) have efficiencies of 0.5 watt per candle or better. With smaller units the efficiency is ordinarily not so high.

¶ HIGH EFFICIENCY, *color, brilliancy, constancy, are attributes of the new lamps.*

Besides their high efficiency, there are certain features of the new lamps which may prove of advantage for certain cases.

1. *Color of light.* The temperature of the filament being several hundred degrees higher than that of ordinary tungsten lamps, causes the light to be of a very much whiter color, so that it comes closer to daylight than any other form of artificial illuminant except the direct current arc and the special Moore tube containing carbon dioxide. The color is almost exactly like that which can be obtained for a few minutes by running an ordinary tungsten lamp at double its rated voltage.

By the use of special color screens it is possible to obtain a true daylight color at an efficiency of about 2 watts per candle whereas with ordinary tungsten lamps the efficiency obtained with the proper screens is only 10 to 12 watts per candle.

2. *High intrinsic brilliancy.* The intrinsic brilliancy is five to ten times that of the filament of the ordinary tungsten lamp. This renders it especially suitable for projection work such as headlights and stereopticons. Altho the intrinsic brilliancy is less than that of the arc, this difference is often more than offset by the fact that the wandering of the crater of the arc prevents as sharp focusing as is possible when the source of light is fixed in position.

3. *Constancy of the characteristics during life.* Because of the freedom from blackening of the bulb in these lamps and because the helically wound filaments may be so designed that the sagging compensates other changes during life, it is possible to make nitrogen filled lamps which maintain their volt-ampere candle-power characteristics practically constant during their whole life. The ultimate failure of these lamps is due to the breakage of the filament. The candle-power is usually well above 80 per cent., even just before failure.

¶ THE NEON LAMP *is a prospective candidate for popular favor, whose practical use is not yet possible because of some technical difficulties in making the light wholly acceptable which have not yet been overcome.*

Another lamp with great promise of high efficiency, which is not so far advanced toward practical operation on a commercial scale was described by George Claude, a French electrical engineer, before the Illuminating Engineering Society. The tube of this lamp is filled with one of the new elements, neon, which is found in small quantities in the atmosphere.

In the course of his experiments with liquid air and in separating these new elements from the air Mr. Claude found that he could so arrange his oxygen apparatus that neon was a residue of the progressive liquefaction of air and a by-product of the industrial manufacture of oxygen. He set about finding uses for this really abundant industrial product, and turned his attention to its use in producing light, on account of its luminescent properties. He found that neon refuses to act in the presence of other gases, one per cent. of nitrogen, for example, causing a production of light due to the latter gas alone. Volatilization of the electrodes also produced trouble when the heat was too great. A charcoal filter used in the manufacturing process removes the one difficulty and large electrodes which will be heated but little by the necessary current remove the other. Tubes 6 meters (about 19 feet) long have a life of 1,000 to 1,200 hours before the neon is absorbed beyond the limit of efficiency and longer tubes with greater supply of neon have still longer life. This life is very favorably comparable with that of incandescent lamps. The illuminating power is 200 candles per meter of length of the tube, and the efficiency for the long tubes is 0.5 watt per candle. The lamp is ready to use when it leaves the factory and needs no adjustment or attention during its life.

The light is red and apparently the principal difficulty in the way of the use of the lamp for illumination is that of correcting the color. One method of correction is to use in conjunction a neon tube containing some mercury, the blue of the latter combining with the red to produce an acceptable white light. The mercury tubes have an efficiency of about 1 watt per candle, and the energy consumption of the combination of mercury and neon tubes averages 0.8 to 0.9 watt per candle.

Smaller tubes can be bent into any desired form for special illuminating effects and some of them have shown life of over 1,400 hours at rate of 30 milli-amperes and corresponding luminosity.

No commercial development of this lamp has been attempted as yet.

RECORD OF STREET CLEANING SERVICE

By C. R. Hebble, Chief Inspector, Cincinnati, Ohio.

This brief article gives a recent development of the excellent accounting service which was put in operation by the administration which is just going out of the offices in Cincinnati, O., a full description of which was given in MUNICIPAL ENGINEERING *for September,* 1913. *Mr. Hebble gives evidence in this article of the interest which city employes take in the efficiency of their departments when they can show results from their efforts to make improvements.*

SEVERAL months ago the writer made a survey of the street cleaning department of the city of Cincinnati. In examining the business procedure of the department, it was found that the district foremen, thirteen in number, were losing much valuable time because of the practice of bringing their time books to headquarters once each week, and several days later calling for them. It was also found that an office clerk at headquarters spent two days each week (payrolls were made up weekly) copying these time books into his permanent payroll record.

As Cincinnati covers 69.8 square miles, the foremen came long distances to reach the office. Instead of at once returning to their work after completing their errand to the office, many of them loafed there for an hour or two, and this was the case whether upon the occasion of bringing in their time books or calling for them. The result of this practice was that each foreman spent two half-days each week—one-sixth of his time, acting as an errand boy, and the office clerk spent two days each week—one-third of his time, in copying the time books.

A simple expedient was adopted whereby these conditions were corrected. A time book was devised with substantially the same ruling as that in use, but with perforated pages, so that when filled out by the foreman, the pages are torn out of the book, and mailed to the office. This method has made the semi-weekly half-day excursion by the foreman unnecessary.

The law provides that each department shall keep on file a time record showing certifications that the employes had been on duty as there indicated. To avoid having the clerk copy the time books each week into such a record, the perforated pages were punched, so that after being received and checked up at the office, these pages are simply filed in a post binder. Thus, instead of having an office record copied from the time books, the *original* certified time book sheets of the foreman are on file.

Some of the foremen follow the practice of retaining every other page in their time books as a carbon copy. If desired, alternate pages can be made imperforate and of a different color, thus providing for such retention of carbon copies by the foreman.

These time books are made $8\frac{1}{2}$ by $10\frac{1}{2}$ inches in size, and are provided with a flexible, detachable cloth cover, in order that they can be folded over and easily carried in the pocket, and the body of the book renewed from time to time without expense of further binding.

The results of the use of the new form may be set forth as follows:

Old Way.

Thirteen foremen spent each week, one-half day bringing time books to office; one-half day calling for them. Total, one day in six.

Clerk spent two days each week copying from time books to office record.

Value of foremen's time........	$2,028.00
Value of clerk's time...........	398.33
Car fare	416.00
Total yearly waste	$2,842.33

New Way.

Foremen use new time books with perforated and punched pages, mail sheets to office.

Clerk spends no time copying time books.

Former cost	$2,842.33
Present cost (postage only).....	13.52
Value of time and car fare saved	$2,828.81

CITY OF CINCINNATI

*TIME FOR WEEK ENDING*________________*191*

DEPARTMENT OF STREET, SEWER AND CATCH BASIN CLEANING

*District*________________

No.	NAME	Occupation	WED.	THURS.	FRI.	SAT.	SUN.	MON.	TUES.	No. of Days	Rate per Days	Amount

The undersigned hereby certifies to the correctness of the names, the work done, time devoted to the work, and amount due, as set forth in the above payroll; and hereby further certifies that each of the above named employes of this department from result of work performed and the personal knowledge of the undersigned, devote to the work of this department the amount of time as set forth in the above payroll.

____

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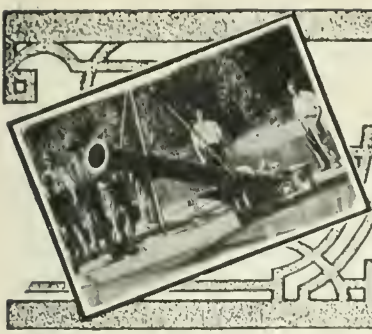


EDITORIAL

NEW YORK STATE HIGHWAY SPECIFICATIONS

The chaotic condition in which the New York state highway department has existed ever since the first $50,000,000 bond issue became available does not seem to be in any danger of improvement, if one may judge from recent developments.

It is true that there have been competent men in charge of the department at times, and that attempts have been made to establish efficient systems of management, but the attractions to the politicians of the job of spending $100,000,000 have been irresistible and the overthrows of systems and changes of managers have been frequent and complete.

So far as can be ascertained without inside information the percentage of graft has been small and the prospect of uncovering graft by the present investigation seems slight, but the waste of money by all these changes in system, in plans, in men, in materials, has been enormous.

The acute difficulty at the present moment is with the asphalt specifications, which, by classifying the asphalts to be used, have excluded some asphalts from certain classes tho including them in others.

The chaos which the present reorganization under Highway Commissioner Carlisle is attempting to reduce to order is not materially enlightened by the numerous propositions made to modify the specifications, especially since these are made by official and semi-official boards, committees and commissions of engineers and contractors, not working in harmony, but evidently working in opposition to each other.

The highway department appointed a board of consulting engineers nearly a year ago to prepare new specifications and methods of testing materials and to advise the department on questions arising in this field.

These specifications have been attacked by means of an inquiry following an accusation of graft in connection with the application of the specifications, which accusation has not yet been sustained.

Meanwhile the New York Department of Efficiency and Economy, an advisory body, has employed a firm of consulting highway engineers to add still another set of specifications to those already in existence. These specifications cannot be used, of course, until they are adopted by a commission of which Mr. Carlisle is a member.

It is perhaps not surprising that Mr. Carlisle, who is an attorney and not an engineer, should fall back upon the old plan of guarantee of the pavement for a term of years, for which plan the first American asphalt company was originally responsible. But this should not be permitted without a protest from the engineers who, after more than forty years of study of asphalt and its use in pavements, have learned from sad experience that this is not the way to get good pavements, and opens ways to favor contractors without danger of graft inquiries, and, indeed, with honesty of purpose. Such reversion to the discredited practices of the early "dark ages" of the asphalt industry is wholly inexcusable and cannot last longer, if adopted, than has any other plan, good or bad, which has been adopted at any time by the New York state highway department, by whatever name it may have been known.

HIGHWAY MAINTENANCE IN INDIANA.

The last Indiana legislature passed a law governing the maintenance of county highways which had behind its preparation a definite plan for a patrol system under competent county management and state supervision, but in its passage thru committees and the legislature itself, not to mention the hands of the invisible (tho apparent) control, all of the specifications for qualifications and checks upon competence and honesty of work were carefully removed. The result is a law by means of which a capable and honest board of county commissioners, thru the appointment of a technical expert on road maintenance, who is at the same time a competent superintendent and an honest man, can secure good results in the maintenance of the existing highways at as low cost as the character of their construction and the amount and kind of traffic over them will permit.

On the other hand, the new office of county road supervisor can be used simply as the means of distributing political patronage, thru the appointment of the patrolmen and the purchase of tools and supplies.

The compensation of the county road supervisors is low, $4 or $5 a day, and one board gave as a reason for not considering the appointment of an engineer that a competent engineer could not be obtained at this rate. This was disproved by the applications received in response to an advertisement published by a good roads committee, but still leaves the appointment to be made from the ranks of the political workers rather than the expert road workers.

The appointments will be made early in January, 1914, and promise to show the real need for the provisions for competence and safeguarding of expenditures so carefully eliminated in framing the law. The first year of operation under the law will provide the evidence of the necessity of materially revising the law in these respects.

THE QUESTION DEPARTMENT

City Planning in the United States

Will you please furnish me, if you have the information available, a list of the cities of the United States of more than 100,000 population which have undertaken city planning in one form or another. I should also be pleased to have any references you can give to any publications on this subject.

D. R. LYMAN, Chief Engineer,
Louisville, Ky.

Philadelphia, Cleveland, San Francisco and Washington have large plans for improving and beautifying their cities, on which they have made material progress.

Chicago, St. Louis, New York have such plans, which are still in the formative state.

New York, Pittsburgh, Seattle, St. Paul, Brooklyn, New Orleans and some others have large ideas in mind and whenever more or less extensive improvements are made they take into consideration the principles of proper city planning in deciding upon the plans for such work.

This list does not include the numerous smaller cities which are doing much planning and some work in carrying out plans for beautifying themselves on a scale commensurate with their sizes and importance, nor does it include such cities as Gary, begun with bare land and intended to attain a size much above 100,000, nor additions to large cities, such as Roland Park, Baltimore.

The annual reports of the Conference on City Planning are excellent sources of information; Flavel Shurtleff, secretary, 19 Congress street, Boston, Mass.

Books of more or less interest in this connection are: Robinson's "Width and Arrangement of Streets" ($2); "Improvement of Towns and Cities" ($1.25); "Modern Civic Art" ($1.25), and his several reports on plans for city improvements in such cities as Denver, Los Angeles, Oakland and smaller cities, not included above because no very appreciable progress has yet been made toward extensive work upon them; Zueblin's "American Municipal Progress" ($1.15); Marsh's "An Introduction to City Planning" ($1); Solotaroff's "Shade Trees in Towns and Cities" ($3); Howe's "European Cities at Work" ($1.65); Nolen's reports on plans for individual cities, four of which he has gathered into one book.

The "Town Planning Review" is a quarterly published under the auspices of the University of Liverpool, Eng., which keeps pace with the advances, particularly in Europe.

Articles in MUNICIPAL ENGINEERING of some note are: "City Planning in Vienna," vol. xli, p. 21; "The Relation of Technical Men to City Planning," vol. xli, p. 453, giving a list of cities and towns considering the subject and the names of persons particularly connected with the projects; "The Chicago Plan Commission," vol. xlii, p. 135; "Making and Correcting City Plans," p. 169; "City Planning Congress at Duesseldorf, Germany," p. 183; "A Problem of the Growing City," p. 212.

Municipal Garbage Reduction and Destruction Plants

We would like to have a list of the municipal garbage reduction plants in this country, and also of the municipally owned garbage destruction plants in the country.

R. G., St. Louis, Mo.

Most of the garbage reduction plants are owned by private parties. Cleveland and Columbus, Ohio, are the only cities owning and operating their garbage reduction plants, while there are nearly 100 cities which let the reduction of their garbage or dead animals or both by contract.

On the other hand the garbage destruction plants are nearly all of them owned and operated by the city. Following is a list of the plants in cities of 30,000 population or more which incinerate garbage alone or in combination with dead animals or rubbish, or both:

New York, 6 plants in Queens and Richmond; Buffalo, N. Y.; San Francisco, Cal., new system under construction; Milwaukee, Wis.; Minneapolis, Minn.; Los Angeles, Cal., new system under discussion; Seattle, Wash.; Portland, Ore.; Atlanta, Ga.; Scranton, Pa.; Memphis, Tenn.; Richmond, Va.; Grand Rapids, Mich.; Lowell, Mass.; Spokane, Wash.; Trenton, N. J.; Camden, N. J.; Dallas, Tex.; Salt Lake City, Utah; Yonkers, N. Y.; Youngstown, Ohio; Duluth, Minn.; Houston, Tex.; Waterbury, Conn., owned by city and operated by contract; Evansville, Ind.; Norfolk, W. Va.; Erie, Pa., new plant just put in operation; Ft. Wayne, Ind.; Johnstown, Pa.; Jacksonville, Fla.; Covington, Ky.; South Bend, Ind.; Allentown, Pa.; Canton, Ohio; Lancaster, Pa., owned by city and operated by contract; Sacramento, Cal.; McKeesport, Pa.; Wheeling, W. Va.; Macon, Ga. Additions are made to this list each year.

Small Cities Having Water Works Plants

Can you give me a list of towns in Illinois and nearby States that have water works plants? M., ———, Ill.

The following list of water works is reasonably up to date for the two States named for small cities, towns and villages, additions being made from year to year:

Under Municipal Ownership.

Illinois—Batavia, Beardstown, Braidwood, Clinton, Collinsville, Du Quoin, Geneseo, Granite, Harlem, Havana, Hoopeston, Jerseyville, LaGrange, Maywood, Mendota, Metropolis, Morris, Normal, Olney, Paxton, Princeton, Savana, Sycamore, Taylorville.

Wisconsin—Berlin, Ft. Atkinson, Grand Rapids, Hudson, Kaukauna, Platteville, Port Washington, South Milwaukee, Sparta, Stoughton, Two Rivers, Waupun.

Under Private Ownership.

Illinois—Carbondale, Carlinville, Edwardsville, Effingham, Galena, Mt. Carmel, Pontiac, Shelbyville.

Wisconsin—Antigo, Beaver Dam, De-Pere, Menomonee, Monroe, Prairie du Chien, Rice Lake, Ripon, Whitewater.

Grouting Brick Pavement in Cold Weather

We are putting in some brick paving with grout filler, and the grouting is a rather hard proposition to manage at this time of year. Will you please tell us the most practical way of protecting the work from the effects of freezing? Would be pleased to pay a reasonable price for a good set of specifications. P., ———, Ill.

Brick pavement should not be laid in freezing weather, but if it must be laid in cold weather the grouting should be done during hours when the temperature is well above freezing and no more grouting should be done than can be protected properly from freezing during the night. The area grouted should be covered with sand as soon as the cement has set sufficiently to permit. For this reason grouting should be stopped some time before the lowering temperature as the sun sets reaches the freezing point. It may be necessary to put an inch or even two inches of sand on to protect the cement thoroly. Some contractors go to the expense of spreading tarpaulins and thus further protecting the cement until it is beyond injury from frost.

The standard specifications of the American Society of Municipal Improvements, including those for brick pavements, can be obtained from the secretary, 702 Wulsin building, Indianapolis, Ind., for 25 cents. The specifications for brick pavement of the National Paving Brick Manufacturers' Association can be obtained of the secretary, B. L. E. building, Cleveland, Ohio, upon request.

These sets of specifications are much alike except as to a few details and both represent standard methods of construction.

Tapping Water Mains Under Pressure

I understand that there is now on the market a machine for inserting gates in water mains without shutting off the water. This city contemplates the purchase of such a machine, if one can be secured which is thoroughly practical. We will appreciate any information along this line, with names of manufacturers of such machines. W., City Engineer, ———, Mich.

Information about machines for tapping water mains under pressure and modifications of some of them for inserting gate valves can be obtained from Hays Mfg. Co., Erie, Pa.; Lennox Machine Co., Marshalltown, Iowa; A. P. Smith Mfg. Co., East Orange, N. J.; Coldwell-Wilcox Co., South Water street, Newburg, N. Y.

Form of Electric Light Franchise

Would you send me form of franchise for electric lighting plant? This city is about to put in a plant and would like all the information it can get on the subject. B., Mayor, ———, Ill.

In Municipal Engineering, vol. xliii, p. 322, will be found the portion of a franchise covering the public utilities for a small Illinois city, which refers particularly to electric lighting. It has some provisions which are not common, tho they are used elsewhere, and which safeguard the interests of both parties to the contract at the same time that they do not give any undue advantage to either party and give frequent opportunities to bring requirements and rates down to the conditions developing in the future.

Maker of Elk Portland Cement

Kindly furnish us the name and address of the company manufacturing Elk portland cement. J. L., ———, Wis.

Elk brand of portland cement was manufactured by the Elk Cement and Lime Company, Elk Rapids, Mich. The latest report at hand indicates that the plant is closed and has been closed for some time. The British Columbia Portland Cement Company, Vancouver, B. C., Canada, is a new company which is now or shortly will be ready to supply cement for which it proposes to use Elk as the name of the brand.

Durability of Sidewalks

Can you give me any information as to the relative cost and durability of the so-called permanent sidewalks, such as cement concrete, tar concrete, brick, crushed stone, etc.?
G. C. B., Winter Harbor, Me.

A properly constructed cement sidewalk on a street of any but the heaviest traffic is practically indestructible. Very few streets have such heavy traffic that the cement sidewalks must be renewed within perhaps a hundred years, except at such points of excessive wear as the entrance to a well-patronized and large store or office building or a street crossing. If a cement sidewalk goes to pieces it does so ordinarily within the first few years after it is laid and because it was not properly designed or constructed or the materials were poor, all of which reasons can be eliminated by proper engineering design and supervision.

Tar concrete sidewalks on streets of lighter traffic have lasted perhaps fifty years, with evidence of further long life. The tar is not so permanent as cement in its characteristics and repairs must be made more often. It is also harder to get good materials and good workmanship and so the proportion of good and permanent walks is less than if cement concrete is used.

The durability of a brick sidewalk depends directly upon the hardness and toughness of the brick used and is indefinitely long or very short, according to whether vitrified brick similar to street paving brick or soft building brick are used, with the many other grades of brick and of durability between.

The only other difficulty in laying a permanent brick walk is in making the foundation permanent so that the brick surface will remain smooth and the edges of the bricks will not be thrown up to receive undue wear. Indeed, the main expense of laying a permanent brick sidewalk, granted hard, tough brick is used, is in supplying a permanent foundation.

Crushed stone makes a good park walk when the foot traffic is very light, but the main walks in a park should be made of harder material. Such walks require more frequent repair, and it is difficult to prevent slight muddiness or development of slight depressions holding water. Such material should be used on streets only where the traffic is very light.

In cold climates, where frost goes deep into the ground, foundations must be thoroly drained and protected from the infiltration of water or from the effects of swelling of adjacent soil as the frost goes out, otherwise walks of any of the materials named will be unsatisfactory at times.

Cost of Moving Stairways

I desire to obtain information regarding the cost of installation and the cost of operation of moving stairways, particularly those operating outside, taking the place of lifts for carrying pedestrians from a lower to a higher elevation. Will you kindly advise me of firms handling this class of equipment.
L., City Engineer, ———, Can.

The moving stairways seem now to be mainly under the control of the Otis Elevator Co., Twenty-sixth street and Eleventh avenue, New York, and they can give full information. The Reno Inclined Elevator Co., 553 West Thirty-third street, New York, is also listed as manufacturing escalators.

Area Calculator of Large Capacity

We have Smoley's Tables, which run from zero to 50 feet, but we want a calculator which runs from zero to 100 feet, advancing by thirty-seconds of an inch. Is there such a calculator or book of tables?
W., Warren, O.

The writer knows of nothing of the capacity mentioned. Can our readers refer our correspondent to anything in print or in manuscript which will meet his needs? There are tables in Smoley running to 100 feet.

Automatic Exhaustion of Air from Summit of Water Works Siphon

Some time since an article appeared in MUNICIPAL ENGINEERING relative to a device for automatically tapping or taking care of any air that at times accumulates at the apex of a syphon. I wish you would give me the number of the issue of your paper in which such article appeared.
F., Houghton, Mich.

A method of automatically taking care of the air collecting at the summit of a 16-inch water works siphon is described by Howard A. Dill in a paper on "A Large Water Works Siphon" in MUNICIPAL ENGINEERING, vol. xxxiv, p. 340. It consists of an air compressor operated by a 2-h.p. electric motor, which is switched on and off by a float in a 40-in. by 12-ft. boiler shell in which the air from the summit of the siphon collects, thus changing the level of the water in the boiler shell. The compressor exhausts the air from the boiler shell when the motor is turned on by the lowering of the water level, and stops action when the water level rises to the top of the boiler shell.

Specifications for Vitrified Sewer Pipe

Will you kindly give us your specifications involving the use of vitrified sewer pipe for drainage and sewerage purposes?

THE VITRIFIED CLAY INDUSTRY,
JNO. L. RICE, Secretary,
Columbus, Ohio.

The American Society of Municipal Improvements is now working upon the subject of specifications for sewer construction. The sub-committee on sewer specifications is composed of E. J. Fort, chief engineer of sewers, Brooklyn, N. Y.; Rudolph Hering and A. J. Provost, consulting engineers. They presented a report at the Dallas convention, which was printed in the volume of proceedings for 1912 ($2). This report is now under discussion by the society and was amended somewhat at the Wilmington convention, the proceedings of which are not yet published.

The specifications concerning vitrified pipe as they stand at present are given below, but they are subject to still further amendment before adoption by the society, and the sub-committee desires criticisms of these specifications in time to present to the next convention to be held in Boston in October, 1914. Such criticisms should be sent to Charles Carroll Brown, secretary A. S. M. I., 702 Wulsin building, Indianapolis, Ind.

VITRIFIED PIPE SEWERS.

Vitrified Pipe.

Vitrified pipe sewers shall be built of shale or clay hub and spigot pipes with deep and wide sockets. The pipes shall be manufactured at a suitable temperature, to secure a tough, vitreous material, without warps, cracks or other imperfections, and shall be fully and smoothly salt-glazed over the entire inner and outer surfaces, except that the inside of the hub and the outside of the spigot may be unglazed for two-thirds the depth of the hub. On all other portions of the pipe the glazing shall completely cover and form an integral part of the pipe body. If not left unglazed the inside of the hub and the outside of the spigot shall be scored in three parallel lines extending completely around the circumference.

When it is broken, vitrified pipe shall show dense and solid material, without detrimental cracks or laminations; it shall be of such toughness that it can be worked with a chisel and hammer, and when struck with a hammer it shall have a metallic ring.

Identification Marks.

Each pipe shall have clearly impressed on its outer surface the name of the manufacturer and of the factory in which it was made.

Shape and Dimensions.

The sizes of the pipes are designated by their interior diameters. Each pipe shall be a cylinder with a circular section, and shall have a uniform thickness.

The minimum lengths, thicknesses, depths of hubs and annular spaces for the respective sizes of vitrified pipes shall be as follows:

Size, inches.	Length, feet.	Thickness, inches.	Depth of socket, inches.	Annular space, inches.
6	2	5/8	2½	5/8
8	*..	¾	2¾	5/8
10	*..	7/8	2¾	5/8
12	*..	1	3	5/8
15	*..	1¼	3	5/8
18	*..	1½	3½	5/8
20	*..	1 2/3	3½	5/8
22	*..	1 5/6	3¾	5/8
24	*..	2	4	5/8
27	**..	2¼	4	¾
30	**..	2½	4	¾
33	**..	2 5/8	5	1¼
36	**..	2¾	5	1¼
42	**..	2½	5	1¼

* Not less than 2 feet. ** Not less than 2½ feet.

Curves, Bends, Etc.

Where curved pipes are required they shall be furnished in either one-eighth or one-quarter bends of their respective sizes. Curved pipe, bends, siphons and special pipe of the sizes and forms shown on the plan shall be furnished and laid, and unless otherwise provided they will be paid for at the contract prices for the corresponding sizes of vitrified pipe sewers.

Samples for Testing.

Any or all of the following tests may be applied to samples selected by the engineer from the pipe delivered on the work. For the purpose of making such tests as may be required the contractor shall furnish and deliver, where directed, and at the place required, one length of pipe for each 200 feet of pipe sewer to be laid.

Crushing Tests.

When supported at the bottom upon a knife edge one inch in width in such manner that an even bearing is provided thruout the whole length, exclusive of the bell, and pressure is applied at the crown uniformly thru a similar knife edge, the various sizes of pipe shall withstand the following pressures:

Diameter, inches.	Pressure, lbs. per lin. ft.	Diameter, inches.	Pressure, lbs. per lin. ft.
6	900	22	1750
8	900	24	1950
10	1000	27	2150
12	1050	30	2350
15	1250	33	2500
18	1400	36	2800
20	1550	42	3200

Drop Weight Test.

When supported on a dry sand bed 2 inches deep, all pipe shall withstand without cracking the impact from two blows of a cast iron ball weighing 8 pounds falling 18 inches. Spurs shall resist without fracture the impact from two blows of such a ball falling 6 inches and striking on the extreme end of the hub of the spur.

Hydrostatic Test.

When subjected to an internal hydrostatic pressure of 10 pounds per square inch, vitrified pipe shall show no percolation.

Absorption Test.

After having been thoroly dried and then immersed in water for 24 hours, sample pieces of vitrified pipe about 10 square inches superficial area with all broken edges shall not absorb more than 5½ per cent. of their weight of water.

Factory Rejection.

The entire product of any pipe factory may be rejected when, in the judgment of the engineer, the methods of manufacture fail to guarantee uniform results, or where the materials used are such as produce inferior pipe, as indicated by repeated failure to comply with the tests herein specified.

Cost of Operation of Water Works Plants

I need reliable statistics on the cost of operating water works, especially which is more successful, private or municipally owned plants, and why? The cost of reading meters and of collections is another piece of information needed. O. E. N., Chicago, Ill.

The comparison of the cost of operating water works plants under public and under private ownership is difficult on the one hand because of the lack of information regarding the cost of operation of private plants, because of their objection to making public their financial matters; on the other hand, few municipal plants keep records in such shape that the information desired can be obtained from them, tho the general results can sometimes be found even if the details are lacking.

A large number, tho by no means all of the municipal plants, publish annual reports from which the information can be derived by careful study supplemented by information as to appropriations made by the city or taxes collected or bonds sold for the benefit of the water works which are accounted for in some city office other than that of the water works.

Again, comparisons can not be made because the conditions in plants are not the same and the results of equally competent management may not be equally favorable.

Some help may be derived from the following articles in MUNICIPAL ENGINEERING:

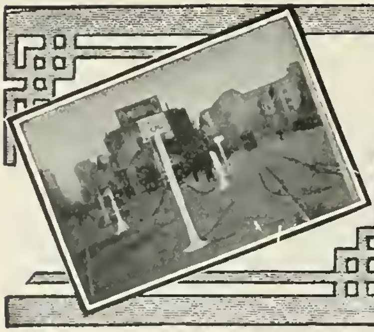
In vol. xlv: "Municipal Light and Water Plant at Fremont, Neb.," p. 119; "Water Works for Marceline, Mo.," p. 160; "Advantages of the Meterage System," p. 161; "Classification of Water Consumption," p. 283; "Water Meters as Handled by the Water Meter Department," p. 369; "Pumpage Reduced One-Half by Meters," p. 390.

In vol. xliv: "The Meterage System," p. 252; "Failure and Success in Municipal Ownership," p. 299; "Municipal Lighting Plant Operated by Oil Engine," p. 311; "Sewage Disposal and Water Supply at Duluth, Minn.," p. 347; "A System of Water Works Accounts," p. 354; "Municipal Plants in Small Towns," p. 371; "Efficiency in the Pumping Station," p. 405; "Eugene, Ore., Municipal Light and Water Plant," p. 427; "A Logical System of Meter Rates," p. 440; "Pasadena Municipal Lighting Plant," p. 504, because it gives a method of investigating the figures given in reports; "Water Works of Daytona, Fla.," p. 550; "Seattle, Wash., Municipal Light and Power Plant," p. 556; "Selling Water at a Profit," p. 580.

In vol. xliii: "Price of Electricity for Pumping City Water Supply," p. 180; "Statistics of Water Supplies," p. 390, giving references to other articles and books, some of which treat the subjects here considered.

These articles will give also suggestions of places to find still fuller information regarding any points not completely covered. There are many more in earlier volumes.

The annual reports of the cities using the standard form of water works reports should be of some assistance in studying these questions and in finding sources of fuller information. The form of the report and a statement of the names of cities using it can be obtained from the New England Water Works Association, 715 Tremont Temple, Boston, Mass.



WORKERS IN THE FIELD

Unreliability of Cost Report

The Editor of Municipal Engineering:

Sir—Amplifying your editorial answer to inquiry under heading, "Cost of Various Kinds of Pavements," page 448 of your November issue, in which you point out the unreliability of figures unless accompanied by full statement of local conditions, I beg to call special attention of your readers to the unreliable, although correct, quotation given as the cost in Southern cities of bitulithic pavement, which is given as "$1.65 to $2.36" per square yard. These simple figures mean nothing to the reader more than to probably give the impression to those who are paying the normal, proper price, that they must be paying too much, because some other unnamed city is receiving presumably the same construction at materially less cost. The fact is that no city in the South or elsewhere has ever secured bitulithic pavement, including foundation, at a price nearly as low as $1.65 per square yard. Assuming your record and report of the "cost per square yard" to be correct, the lower price named must be for surface only—perhaps surfacing macadam. Doubtless the low prices quoted as to other kinds of pavement are subject to some similar explanation, and the high prices caused by other extraordinary conditions. Such brief quotations, therefore, are worse than useless, mystifying instead of enlightening. It would generally take a full page or more of your magazine to intelligently differentiate between the "cost per square yard" in any two cities, or sometimes even on two streets of the same city. How futile and useless, therefore, is the attempt which is frequently made by government reports and engineering periodicals to tabulate costs in various cities under widely varying conditions.

Take item of grading, for instance. In some cases this is paid for at a price per cubic yard and sometimes included in the price paid "per square yard of pavement," and varies in depth from 6 inches to 6 feet, in case of excavation from stone to hardpan, in length of haul from one block to three miles, and in cost of teams from $4 to $8 per day. Under such varying conditions a quotation either "per cubic yard" or "per square yard" is worse than meaningless to one who receives the quotation, unless accompanied by much more detailed and intelligently collected reported information than would be of interest to the general reader, and therefore more minute than any journal can be expected to collate and report. So with every other item—foundation, surface, etc.—the costs vary very widely with variation in character of work, depth, length of haul, local cost of labor and material, terms of the payments and a multitude of conditions varying not only in every city, but, to a less degree, in different streets of the same city.

George C. Warren,
Boston, Mass.

Incinerating Plants Producing Power

In further reply to the question under the above heading, on p. 448 of the November number, letters have been received from which the following are taken:

The Editor of Municipal Engineering:

Sir—We wish to inform you that the incinerating plant of Minneapolis has been furnishing light and heat for a number of years in a satisfactory manner, as outlined in our booklet. It is needless to say that the Minneapolis plant is equipped with the Decarie incinerators, and we can send you a number of reports showing economy in operation.

Decarie Incinerator Co.,
Minneapolis, Minn.

The Editor of Municipal Engineering:

Sir—In regard to inquiry in your November number regarding incinerating plant producing power, we have now in several bids for the construction of plants using my incinerator and steam generator, on which our guarantee reads, "When fired to capacity with the ma-

terials named in specifications, we guarantee this boiler to generate 150 h.p. of live high-pressure steam at 100 lb. pressure, and to drive a General Electric turbo-generator, run condensing, capable of lighting 150 to 175 street lamps of 500 watts," and this guarantee has full financial backing. J. B. HARRIS, M. D.,
Nashville, Tenn.

Cities with Commissions and Business Managers

The Editor of MUNICIPAL ENGINEERING:

Sir—I note in the article on "Commission Government," on p. 502 of the December number, you mention Forest Park as under the commission plan, and also the city manager plan. Evidently the writer has confused the names of River Forest and Forest Park.

Forest Park has commission government, but no manager. River Forest has a city manager, appointed by the village board. KARL M. MITCHELL,
General Superintendent,
River Forest, Ill.

Mr. Bradford, the author of the article referred to, has sent corrections of the list of cities, showing that Forest Park, Ill., Millville, N. J., Spokane and Tacoma, Wash., have the commission form of government, but do not have city managers, and that Phoenix, Ariz., should be added to the list of cities with commission form of government which also have city managers.

Pasadena's Electric Light Plant

The sixth annual report of the municipal lighting works department for the year ending June 30, 1913, has been issued and shows the same excellent results of operation which have already been published in articles upon this plant in MUNICIPAL ENGINEERING. Increases have been general and are in the neighborhood of the figures of 12.3 per cent. increase in receipts from street lighting to 20 per cent. increase in kilowatt hours sold, outside these general limits of increases being the increase in commercial light sold of 3.13 per cent. and in commercial power sold of 69 per cent. The gross receipts increased 12.5 per cent. but the net receipts increased 22.3 per cent., showing a material increase in profits.

The net value of the plant after allowances are made for depreciation is now $504,564.98. The average rate of the depreciation allowed is 4.034 per cent., a very reasonable allowance. About 23 per cent. of the cost of the plant was raised by taxation but this is carried as a book indebtedness of the plant and is fully considered in computing the results of operation. The surplus of the year's operations after allowing interest on the total average investment and the depreciation for the year is $23,558.09, making the total surplus $41,749.16.

New construction during the year cost $55,968.56.

The private company operating in the city owns plants in a number of other cities in Southern California, including Los Angeles, and has been reducing rates in Pasadena at intervals to keep them below those of the municipal plant, which in turn have been reduced far below those charged by the private plant before the municipal plant was built, so that a saving to the citizens of $600,000 more or less, according to the method of computation used, is claimed as a direct result of the lower rates obtained by the construction of the city plant.

Very properly the city would not reduce its rates below a figure at which the income would meet the demands of the outgo, and the citizens generally were sufficiently mindful of these facts to support the municipal plant notwithstanding the lower rates offered by the private plant. However, the city went to the legislature with the plea that the purpose of the company was to run the city plant out of business, paying any necessary deficiencies in the operation of the Pasadena plant from the profits on its plants in other cities. The legislature saw the point and passed a law preventing a corporation from selling any commodity at a lower price in one community than in another when done for the purpose of exterminating a competitor. Rather than reduce its rates in other cities to the Pasadena rate (consideration being given to the difference in cost of service in the various communities) the company has raised its rates and now has the same schedule used by the city.

This has resulted in a material increase in the number of customers of the municipal plant, the addition of new consumers from July 1 to October 1 being 423, which is 70 per cent. of the total increase for the last fiscal year, ending July 1. The reduction in rate for power purposes made last year has helped and the income has increased largely. Reports for July and August, 1913, show the first results of the removal of the only obstacle to progress and indicate that the public will soon reap the benefit and may soon have their rates reduced to or below those by means of which the private company attempted to throttle the municipal plant. It is the fixed policy of the management to reduce rates to the lowest figure compatible with safe, conservative management.

Notwithstanding the increase in business, the cost of operation in August was less than in July, so that the surplus is being added to from both directions.

The effect of larger business upon the unit cost of current is shown by such figures as the following for August, 1912, and August, 1913:

	August, 1912.	August, 1913.
Number of meters	4,207	4,977
Output, k.w.-hr.	238,600	550,100
Manufacturing cost, cents per k.w.-hr.	1.006	0.696
Dsitribution cost, cents per k.w.-hr.	1.024	0.596
Total operating cost, cents per k.w.-hr.	2.030	1.292
Interest and depreciation, per k.w.-hr.		0.753
Total cost per k.w.-hr.		2.045

If the cost is computed on the amount of current sold it will be about one-third larger for each item and the total cost of current sold in August, 1913, becomes 2.734 cents per k.w.-hr. The corresponding figure for the month of August, 1912, is not at hand, but for the year ending July 1, 1913, the total cost of current sold was 3.656 cents per k.w.-hr. The receipts for August, 1913, were 3.021 cents and for the year ending July 1, 1913, were 4.402 cents per k.w.-hr., so that the reduction in cost to the consumer has been greater than the reduction in cost of current sold to him. This is doubtless due to the larger use of current for power purposes, which brings down the average receipts per k.w.-hr. from consumers, even without taking account of the reduction in rates for power.

The unfair attacks made upon this plant have had one excellent result. They have induced a thoro study of the subject of proper accounting and have brought out the fullest reports of the operation of the plant, thus presenting it as a model in this respect and showing what can be done in a municipal plant under competent financial and technical management.

Cook County, Illinois, Roads

Cook county, Illinois, has started on a hard-road construction era by letting a contract for 4,240 feet of concrete road on an extension of Church street, between Evanston and Niles Center, a road which carries a heavy truck-garden traffic and provides an outlet for automobilists starting on trips to the northwest of Chicago and Evanston. The township, county and the Evanston Commercial Club share the expense equally.

The road will be 16 feet wide, 6 inches thick at the sides and 8 inches in the center, laid on a flat, rolled sub-grade. The concrete is to be made of a 1:2:3 mixture with washed sand and washed $\frac{1}{4}$ to $1\frac{1}{2}$-inch gravel. Shoulders, 4 feet wide, are to be of crushed rock or gravel. M. Foley & Company, of Evanston, the low bidders, have contracted to complete the road by November 1, including all grading, for $2.83 per lineal foot of road, which is equivalent to $1.59 per square yard.

The routes selected for improvement by the Cook County Board of Commissioners are as follows, all starting at the city limits: Milwaukee avenue to the county line; Twelfth street to the county line passing thru Hillside; Halsted street to Chicago Heights; Western avenue to Homewood; Archer road to Lockport via Summit.

It is the present plan to make the roads 20 feet wide instead of 16, as is the average in Wayne county.

Advantages of the Outside Installation of Water Meters.

The Editor of MUNICIPAL ENGINEERING:

Sir—How many waterworks engineers realize the cost some customs entail? A vast amount of time, money and energy are consumed annually thru the pursuit of unnecessary and unprofitable customs.

It would be difficult to find an almost universal custom more costly in effect or which is responsible for creating more unsatisfactory conditions than the custom of winter water waste. Many years ago, before the advent of the water meter, it was a practice to open faucets and allow them to remain so as long as there was any danger from freezing during the winter months. The idea of protecting the plumbing from frost was seldom regarded seriously by the consumer, for the reason that to accomplish this would cost money; whereas, faucets could be opened and an unlimited quantity of water wasted without any charge. Thus, thruout the country, this practice prevailed, and the wasting of water during winter months was simply stupendous, compared to the quantity that was used for legitimate purposes. The serious and often desperate condition in which many communities each winter found themselves demanded that some economical and permanent remedy be instituted, which would be the means of preventing both the water from freezing in the services and at the same time eliminate the enormous waste of water. Both waterworks and consumers suffer acutely from this practice of winter water waste. In many localities it was found impossible to maintain adequate pressure for fire-fighting purposes. On account of the tremendous consumption, waterworks are often taxed in winter months to their utmost capacity.

The universal water meter system represents the modern, up-to-date method of causing plumbing to be protected during the winter, and eliminating consumer water waste. Thruout the country it has superseded all other preventive measures, if such they may be called.

Wherever the water meter system is thoroly investigated and its far-reaching benefits are understood, it is invariably adopted. Wherever meters are in use, the plumbing will usnally be found to be in sound condition, and protected from freezing during the winter months. The custom of allowing water to run constantly in order to protect the plumbing from freezing, has proven to be an expensive habit and is therefore no longer a custom. Now attention is directed toward the proper outside housing of the meter itself in order to prevent freezing and consequent expense, as well as to insure its constant accessibility to the inspector, at the same time eliminating all expense accruing from tampering.

The more efficient and modern the plant and meter equipment of a waterworks the more economically it should be operated. Superior equipment is only the first adjunct of a successful plant. Administration will decide whether the plant will prove profitable or otherwise. The reasons why so many waterworks plants show a yearly loss can be traced to high cost of meter maintenance, due to freezing caused by insufficient and improper housing of meters, as well as to insufficient rates, unlimited quantities of water furnished certain institutions, etc. It seems evident that many waterworks companies are not fair to themselves, not only in the enormous amount of water waste revealed by the high daily per capita consumption in the standard of meters installed, etc., but in measures adopted to protect their investment in the meters themselves.

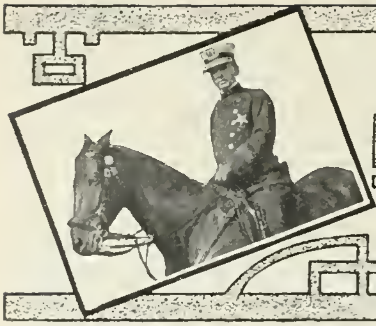
While it is logical to infer that a water meter embracing durability and accuracy in the highest degree would also possess a low cost of maintenance, it may prove interesting to note that a large proportion of the best meters are subjected to high maintenance costs occasioned by damages incurred thru frost. There is no article connected with the equipment of a modern waterworks which is more vital to its success than the water meter, yet this article is constantly subjected to unfair treatment and abuse unless proper protective measures are taken by the waterworks company. Proper outside housing eliminates all troubles occasioned by such tampering as well as the consequent cost of repairs. Outside housing also has its advantages in saving of needless inspection expense. It is not always that some member of the family is at home to the inspector, and we have frequently known of instances where consumers have dumped a load of coal on a meter, so as to prevent the department from reading the dial.

In this connection our experience as to results secured in the outside housing of meters may prove of interest, as in view of the fact that approximately 300 of our meters, inside installations, froze during the past two winters, we favor the outside installation of meters wherever possible. We now have about 100 20-in. meter boxes installed for outside housing ⅝, ¾ and 1-in. meters.

In March, 1912, about 200 of our meters, inside installations, froze. On the same date we made an examination of a ⅝-in. meter, installed in an outside housing, and found that the temperature inside the box registered 40 degrees, while the temperature outside the box was considerably below zero. These meter boxes, which are owned by the company, were furnished by the H. W. Clark Company, of Mattoon, Ill., and are installed complete at about $5.00. To date, we have not purchased forms for the making of concrete bodies ourselves, although this crete bodies ourselves, although this process lessens the cost. The meters are installed 18 inches below the surface and 2½ feet above the frost line, the bottom of the box extending to about the frost line. Our experience has been that the partial burying of the cover with paving or other material, combined with the dead air space and radiating surface of warm earth at bottom of box, insures absolute protection of the meter from frost damage. We have only experienced one case of freezing of meters so installed and investigation clearly showed that above directions as to setting of meter in box had not been closely followed.

Meters so installed are always accessible for repairs and reading. All meddling and tampering on part of consumer is not only eliminated, but considerable money is saved in inspection.

THOMAS E. IRWIN,
Supt. Waterworks Co.,
Huntington, L. I.



LEGAL DECISIONS

Decisions of the Higher Courts of Interest to Municipalities

Repavement — Removing Posts and Hydrants. Where a street has been paved for a part of its width, subsequent pavement of those parts which have never been paved is not a "repavement," as affecting liability for the expense of an improvement. A street paving assessment properly includes items of cost for removing lamp posts and hydrants. People ex rel. Keller et al. v. City of Buffalo, 137 N. Y. Supp. 464.

Injuries to Persons on Streets—Notice of Defect—A municipality is not an insurer of pedestrians against injuries from defective streets, and is not liable for such injuries in the absence of actual or constructive notice; and hence a municipality is not liable for injuries caused by a broken flagstone over a culvert, where the break was a fresh one, and the stone in its original condition was a sufficient protection. City of Corbin (Ky.) v. Benton 152 S. W. R. 241.

Invalid Contract for Fire Apparatus—City Liable for Rent—Const. art. 11, sec. 5, provides that no debt shall be created by any city unless at the time provision is made to assess annually a sufficient sum to pay the interest thereon and to create a sinking fund of at least 2 per cent. Held that, where a contract for fire apparatus was made without complying with such provision, it was void, and the seller was entitled to recover the apparatus so sold from the city. The city's use of the property so purchased raised an implied promise to pay the reasonable rental value thereof and rendered the city liable for rent, which, being an ordinary debt, payable out of current revenues, was not within such constitutional provision. Fabric Fire Hose Co. v. City of Teague (Tex.) 152 S. W. R. 506.

Right of Milwaukee to Build Street Lighting Plant Affirmed—The use of the proceeds of a bond issue authorized by the voters of a city for the purpose of erecting and maintaining an electric light plant to install machinery at the city's refuse incinerator plant for the purpose of utilizing surplus steam which would otherwise be wasted, and using so much of the power generated as is not necessary for lighting purposes to operate the city's flushing station, the value of such power to be charged to the sewerage fund and credited to the lighting fund, is not an unlawful diversion thereof. Since St. 1898, section 926—11, expressly authorizes cities to light streets, public buildings, and grounds, they necessarily may use the streets for the accomplishment of such purpose. A city which prior to the passage of Public Utility Act (Laws 1907, c. 499) issued and sold bonds for the erection and maintenance of an electric lighting plant and bought a site for that purpose, could construct its plant and use the streets for distributing the electricity generated by its plant without obtaining from the Railroad Commission under that act a certificate of convenience and necessity, especially in view of the provision of St. 1898, sec. 1797m74, subsec. 4, that nothing in that act should prevent the construction of a municipal plant, where the existing public utility was operated without an indeterminate permit. Neacy v. City of Milwaukee (Wis.) 139 N. W. R. 409.

Liability of public water supply company for damage by fire.—A public water company is not liable to an individual for loss by fire resulting from an insufficient supply of water at insufficient pressure at fire hydrants to extinguish a fire, unless there be a contract between the parties for a sufficient supply at sufficient pressure. There is disclosed no contractual relation between the plaintiff and defendant, and therein this cause differs from Middlesex Water Company v. Knappman Whiting Co., 64 N. J. Law 240, 45 Atl. 692, 49 L. R. A. 572, 81 Am. St. Rep. 467, where a company incorporated to supply water entered into a contract to furnish water to the owner of a factory with pressure sufficient for fire purposes, which factory was destroyed by fire by reason of the failure of the company to perform its agreement, and it was held that the company was liable for the damages sustained. The case at bar is more like the recent one in this court of Hall v. Passaic Water Co., (Sup.) 85 Atl. 349. In that case a water company was sought to be held liable for damages resulting to a mill through fire under a contract alleged to have been made between the owner of the factory and the superintendent of the water company for a supply of water of a certain pressure at the various openings of standpipes and water pipes in the factory. The testimony failed to establish the making of the contract sued on, and the court held that the defendant company was not liable.—Baum v. Somerville Water Co., (N. J.) 87 Atl. 140.

Assessment for sewer on property adjacent to abutting property.—Code, section 810, requiring the preliminary resolution necessary for construction of a sewer to designate "what" adjacent property is proposed to be assessed therefor, is satisfied by the resolution providing for assessment of abutting and "adjacent property," where the general sewer ordinance defines "adjacent property" as such property not abutting on the sewer, and not otherwise assessed for its cost, as shall lie within 150 feet of it and can be connected with it and use it.—Dunker v. City of Des Moines, (Ia.) 142 N. W. 207.

Items to be considered in assessing water company for taxation.—In the assessment of a special franchise there is no hard and fast rule by which assessors are bound in fixing the value, and, while in some cases the net earnings rule is a convenient and fair way of determining value, in other cases it would not be. In reviewing the action of the tax board in making an assessment, the presumption is that in some way the board has arrived at a fair result, and the burden is on the party claiming to be aggrieved to satisfy the court that the assessment is unjust; and whether the board acted upon sufficient data or not is immaterial if the result is just. In valuing the property of a water company by the net earnings rule, the physical property both in and out of the street, including pumps, engines and pipes employed in performing a contract with the city, is to be accorded a fair return upon its value before any value is attributed to the intangible part of the special franchise. In fixing the value of the franchise of a water company, the board of tax commissioners was not confined to its earnings prior to the assessment, but might consider its receipts under a contract, by which, prior to the date of assessment, the company began to furnish water to a city, altho compensation therefor was not then due, but was received during the year, and to determine how much of the amount received was actual profits. Under the law creating the board of tax commissioners, the duty of the board as to the business of a water company is solely to determine the value of its property as a going concern. Lands purchased by a water company from time to time, aggregating 435 acres valued at $347,000, acquired in good faith under the advice of its engineers and to secure a proper drainage area which would place its supply beyond liability of a failure, prevent others from interfering with it, and provide for the probable future needs of the company, should be allowed as a part of the value of its physical property in determining the return to be received therefrom. Expenses of a water company for the protection of its water supply and to keep its land from becoming unsightly and detrimental to its interest should be allowed in assessment as an expense of its business. In determining the net profits of a water company for the year 1904 as a basis of assessment for the succeeding year, taxes levied for that year were not to be disallowed because not then paid. In determining the reproduction cost of laying the pipes of a water company in streets paved after the pipes were laid, the cost of relaying the pavement was allowable as a part of the reproduction value, the fact that it cost the company nothing being immaterial; and the cost of engineering and supervision was also an item necessary for consideration.—State ex rel Queen County Water Co. v. State Board of Tax Comrs., (N. Y.) 142 N. Y. Supp. 180.

Limit of time to bring suit to enjoin sewer contract.—Cities and Towns Act (Burns' Ann. St. 1908, section 8959), section 265, prohibiting a suit by a property owner to enjoin the construction of any improvement, unless brought within ten days from the letting of the contract, would apply to a suit to have a contract for constructing a sewer declared void and all records affecting title to plaintiff's land canceled and the cloud upon title resulting therefrom removed, so that such suit could not be maintained unless brought within ten days from the letting of the contract.—Anheier et al. v. Fowler et al., (Ind.) 102 N. E. 108.

Insurance company must pay judgment against city for injury due to contractor's negligence.—A judgment against a city employing a contractor to construct sewers in favor of a pedestrian injured by the negligent failure to guard open sewer trenches is binding on the contractor liable over to the city, tho not made a party to the action, but actually defending it, and is on his insurer against loss who, though not a party, employed counsel to defend the action, and the judgment is admissible in an action by the contractor against the insurer to establish the liability of the insurer.—Kibler et al. v. Maryland Casualty Co., (Wash.) 132 Pac. 878.

FIRE AND WATER

The Water Supply of Troy, N. Y.

During the summer of 1913 a high rate of water consumption in the city of Troy, N. Y., following a protracted period of exceedingly dry weather, resulted in an extreme lowering of the water level in most of the reservoirs connected with the system. There was sufficient supply in the Tomhannock reservoir thruout the period, but the Quackenkill was only sufficient to supply the high service, so that it was necessary to depend almost entirely upon the Tomhannock system to supply the low service and to prevent a total emptying of the Upper Oakwood reservoir, which feeds the middle service. This required the operation of various gate valves and somewhat reduced the total amount obtainable thru the Tomhannock conduit, the capacity of which was less than the normal consumption demands; it therefore was necessary from June 10 to November 23 to curtail consumption by reducing the pressure.

The engineers of the National Board of Fire Underwriters have made an investigation of the conditions and in a report dated December 6, 1913, detail the facts and make certain recommendations.

Under normal conditions, the average day pressure at a gage in the water bureau office, at elevation 47, is 42 pounds, with 52 pounds at night. From the commencement of reducing the consumption, the average on this gage was 35 pounds during the day and 29 pounds at night; for short periods of time the night pressures were frequently drawn down to 20 pounds and in a few instances as low as 14 to 18 pounds. Charts from gage at elevation 36, in No. 3 fire engine house, give pressures averaging about 2 pounds greater than those recorded in the Water Bureau office, but the pressure curves in the two cases are strikingly similar.

This reduction of pressure affected sprinkler supply, especially to those plants without tanks. Men were kept on duty at the various gate houses to open the valves in case of fire. This, with the other arrangements made, was sufficient to ensure fire flow for serious fires, but as the storage in the Oakwood reservoir was reduced at times to about 13,000,000 gallons, conditions would have been very serious in case of an accident to the Tomhannock conduit. Conditions similar to this may be expected during any long-continued dry spell, unless steps are taken to increase the supply from Tomhannock watershed.

The city council has authorized by ordinance the laying of an additional conduit from Tomhannock reservoir. Upon completion of the surveys at present under way, pipe will be purchased for delivery during the coming winter, so that the laying may be commenced early in the spring. A section on the city end at least 3 miles in lingth will undoubtedly be finished before the beginning of the next dry season. Several plans are being considered. The one that will probably be adopted is for a single 30-inch line, provided with the necessary valves and specials for a complete duplication at some future date, preferably in a separate trench.

This additional conduit fulfills, in the main, the recommendation made in 1912. Other improvements have been as follows: Excellent maps and nearly all important records are now properly filed in duplicate. A storm-water conduit is being built, to care for flood conditions on the Piscawan kill. Installation of measuring devices on the supply lines and the equipping of services with meters are authorized or strongly favored, but will not be carried out until more important work is completed. Recording gages have been installed. The combining of the two upper services is not considered feasible at this time, but after completing the Martin-Dunham reservoir, will likely be acted on favorably. It is probable in the near future that demands for water on elevations practically level with, or above the Vanderheyden reservoir, will eventually mean a new reservoir at a higher elevation, feeding an extra high service. The use of the Oakwood receiving reservoir as a distributing reservoir for the low service, is strongly advocated by the superintendent; and plans are now being prepared for a diverting canal around the upper and the low service receiving reservoirs. A new 12-inch extension is contemplated for the near future. Eventually, the Lansingburg supply works will be done away with entirely. Funds are provided for new hose couplings and hydrant nipples, with threads conforming to the National Standard, the contracts for which will be made before January 1, 1914.

Small Town Water Works System

The city of Brawley, Cal., has in operation a very inexpensive water works system. The water, which is obtained from an irrigation canal, is clarified in settling basins and then pumped to a very simply-constructed steel water tower by means of an oil engine.

In the spring of 1911 a depth of 2,000 feet was reached in a well put down by the hydraulic process, which started with an 8-inch casing and ended with a 4-inch casing. The only water struck was found to be brackish; no artesian flow was encountered, nor any strata that would have made pumping feasible.

The plan finally adopted was as follows: Canal water was to be settled in two settling basins of 300,000 gallons capacity each, from which it was to be pumped into a 50,000-gallon steel tank, the bottom of which was 50 feet from the ground. The pumps were direct connected to the mains, and only the surplus over the consumption would flow into the tank. While it had been the intention to erect a larger tank and of greater height, it was found that funds were not sufficient for this purpose.

The system as now constructed covers about one-half square mile of area and comprises two settling basins, a pumping plant, an elevated steel tank and the distributing system. The settling basins, located three-quarters of a mile from the center of population, are 80 by 150 feet, 5 feet deep, with flat slopes. They are intended to be operated in alternation and cleaned by scraping after drying for several days in the sun. They are connected by a system of vitrified pipes with the pumping sumps. Water is settled for twenty-four hours before being used. Their cost was approximately $1,500.

The pumping plant consists of two units, one being a 20-h.p. distillate engine, belted to a No. 4 centrifugal pump of the United Iron Works of Oakland, with a capacity of 500 gallons per minute, 75-ft. head; the second unit, a 40-h.p. Westinghouse electric motor, direct connected to a 2-step, 4-inch centrifugal pump with a capacity of 500 gallons per minute against 160-ft. head, sufficient for two fire streams. The first unit is used for the pumping of domestic supply, the second unit as a fire pump, pumping directly into the mains with the tank shut off. In order to increase the fire pressure, an arrangement has been provided whereby pump No. 1 may discharge into pump No. 2, thus delivering a combined theoretical head of approximately 230 feet. This pressure was utilized for testing the distributing system. The general arrangement and operation of the fire pump were made as simple as possible, so as to enable members of the volunteer fire department to operate the pump in the absence of the mechanic.

The cost of machinery was $4,150. This amount may appear high, but it is to be considered that the whole water works system was let on one contract, and the figures at which the contractor was paid for various items may not in every instance represent cost plus an equal percentage of profit.

The pump house is a substantial timber building with galvanized sheet iron walls and roofing. The roof trusses were designed for being used in mounting and dismounting machinery. The building is well ventilated, screened and painted, and was let for the sum of $1,889.

The steel tower and tank are of the hemispherical bottom type, using a 4-post tower, which style of structure is now being used almost exclusively for water storage purposes. This tower and tank were built in accordance with the standard plans and specifications of the Des Moines Bridge and Iron Company. The capacity of the tank is 50,000 gallons, the diameter being 18 feet and the height of the cylinder 24 ft. 4 in. The tank shell is made of ¼-in. plates thruout, except the lower ring of cylinder, which is 5/16-in. The supporting tower is 50 feet to balcony line and consists of four columns, being in two sections. The columns are made of 10-in., 15-lb. channels, latticed, and the struts are made of four angles 2½ by 2 by ¼-in. The bracing rods are 1-in. rounds thruout. On account of variations in temperature existing at Brawley, special provision was made to take care of the difference in expansion and contraction of the riser pipe and the water tower columns. The cost of the tower was approximately $3,900 complete, including foundations. This cost is considerably higher than usual, on account of the very high cost of foundation materials and transportation charges.

A Novel Method of Sterilization of London's Water Supply.

From Our London Correspondent.

The insuring of an adequate and pure water supply for London is a subject which must always be of importance. The supply is drawn from the Thames and the Lea, both of which rivers run thru populous districts where artificial contamination is very liable to occur. There are, of course, stringent regulations forbidding the discharge of impurities into the river, whether manufacturing or otherwise. But regulations can often only be effective in enforcing punishment after an offense, when the damage has been done.

The experience of the Metropolitan Water Board has shown that even highly impure water is purified from bacteria by storage over a sufficient period of time, but coloring and oxidizable matter are not destroyed thereby. The best conditions, if the water is to be cured by storage, would be for those in charge of the pumping plant to have absolute discretion to take the water at the bacteriologically best time, and to have sufficient storage capacity to hold this water for a very considerable period before use. In order to store sufficient water at the best times, pumping plant would be required much in excess of the average demand, which would be idle for a large part of the year. Experience further shows that the water is purest in time of drought, when, however, objection is naturally taken to the abstraction from the rivers of huge quantities of water.

Large increased storage and pumping facilities coupled with the board's unrestricted right of abstraction are liable to arouse alarm as to possible draining of the river in hot seasons. Accordingly in 1911 the board laid before Parliament proposals in the nature of a compromise. They asked for largely increased storage facilities in the form of eight new reservoirs and a new intake. In return they offered to give up their unrestricted right to take water at will. The advantages claimed were that drought was secured against, and that their storage policy would be efficiently developed. The water would be able to stand long enough to insure purity. It was further claimed that the scheme for bringing water from Wales could be dropped, with consequent saving of enormous cost. The bill, however, was severely handled in Parliament. Three reservoirs were granted, three rejected, and two withdrawn, as was the new intake. The unrestricted right of abstraction was annulled, but the concessions asked for in the conditions of abstraction were only partly granted. The principle of a progressive storage scheme was conceded, by which the board is to construct reservoirs in view of an increase of population up to 1941. But the paucity of tangible results and the evident reluctance of Parliament to sanction extensive new works in the future has left the board still face to face with the problem of insuring the purity and continuity of the water supply.

Dr. A. C. Houston, the board's director of water examination, urged for some years that specially impure water should be excluded or else treated in some way before entering the reservoir. Dr. Houston in his eighth research report devotes his attention to a novel inexpensive method he has discovered for purifying the water.

Lime has been used for many years to soften water. Now, hardness is due to two causes. The permanent hardness (relatively small) is due to dissolved sulphates of calcium and magnesium. The temporary hardness (removable by boiling) is due to bicarbonates dissolved, the bicarbonates being formed by combination of carbon-dioxide present in the water with the ordinarily insoluble carbonates. In the Clark water-softening process quicklime or slaked lime is added. The lime at once combines with excess carbon dioxide present, as well as reducing the soluble bicarbonates. The result in both reactions is insoluble carbonate, which is precipitated. Great care is taken in the process to avoid excess of lime being added. Such an eventuality leads to rehardening, and, of course, would give a supply of lime-water instead of pure water.

Dr. Houston has evolved a modification of the process which proves to be a certain method of treating bacilli. He adds one part of quicklime to 5,000 parts of raw (unstored) Thames water. After chemical reactions are completed 0.007 per cent of free lime is left in the water. After a wait of five to twenty-four hours it is found that this excess has killed the B. coli germs present. The 0.007 per cent excess of lime is then neutralized by the addition of not less than 25 per cent of stored water, which is softened by the lime.

Dr. Houston points out the curious fact that for years we have been deliberately avoiding the use of this beneficent quantity of lime. By always adding just less than is necessary to soften the water we have simply produced carbonate of lime, which is insoluble and bacteriologically inert. Whenever, accidentally, an excess of lime has been allowed, a useful bactericidal action has been taking place and it has at once been stopped.

The aim of the experimenter was to use the minimum amount of lime necessary, allowing ample time for action. With a specimen of ordinary Thames water, after one hour 42 out of 43 B. coli were still alive. After five hours 26 out of 43 were dead. After twenty-four hours 42 out of 43 were dead.

Considering only its bactericidal action within twenty-four hours, to achieve the above effect, 15 pounds of quicklime should be added to 7,500 gallons of raw water, 2,500 of stored water being afterward added. The cost of lime would be three cents for the 10,000 gallons of pure water thus produced. Reckoning the demand at 200,000,000 gallons daily, the cost of lime to treat three-quarters of the amount drawn from the river would be about $625, or $212,500 per annum.

The added stored water is proved by experience to be quite sterile of disease bacilli. Not more than 75 per cent of the bulk may be treated if the natural alkalinity of the other 25 per cent is to be relied upon to neutralize the 0.007 per cent of lime, but any smaller proportion may be treated with corresponding reduction of lime consumption.

This excess lime process seems to meet all the difficulties mentioned earlier in the article. It is particularly suitable for flood water (which is most abundant, and, unless treated, is most dangerous), for such water is usually less hard and the lime process has a clarifying as well as bactericidal effect. It is claimed that the cost of lime treatment brings a considerable return, even a net profit, by economizing soap and fuel thru softening.

The treatment increases the source of supply in effect by rendering the water always fit to be drawn on. It postpones the construction of new reservoirs, for the lime-treated water direct from the river is bacteriologically as good as adequately stored water. By reducing the strain on the storages it prolongs the possible period of storage. Thus, using the basis of 75 per cent of treated water and 25 per cent water from storages, the period of storage for that 25 per cent would be increased from 30 to 120 days. Or, if the 30 days' storage period is adopted, the existing reservoirs would have much greater capacity, thus postponing the expense of new works to meet the expanding demand. The process is quite innocuous, for it only leaves lime compounds behind which were there before. It would raise the London water supply to an undreamt of level of purity. All epidemic water-borne diseases, such as cholera and typhoid fever, would be absolutely eliminated.

Mortality Rates in Relation to the Water Supply

In a paper before the New England Water Works Association, John A. Vogelson, chief of the Bureau of Health of Philadelphia, outlined the history of water purification and its effects in that city.

Philadelphia was engaged in improving its water supply by construction of filtration plants and re-arranging its water supply distribution system from 1900 to 1911. The typhoid fever rates of such districts as received filtered water in the early development of the improvements began to decline immediately after the introduction of filtered water, and following the completion of the last of the five filtration plants in 1911, the typhoid death rate for the entire city shows a consistent decrease from 72.4 per 100,000 in 1906 to 12.5 per 100,000 in 1912. Isolated sections of the city, notably West Philadelphia, with a population of 267,840, had a typhoid rate of 5.9 per 100,000 in 1912. A large percentage of the typhoid which formerly scourged Philadelphia was undoubtedly water-borne, and the marked reduction of typhoid in this city is a notable sanitary achievement, due in by far the largest part to the filtration of the water supply.

The average total mortality rate for nine years, 1862-70, was 2,291 per 100,000 and consistently declined to an average rate of 1,792 for the decade 1901-10, and still further declined to 1,522 per 100,000 in 1912, the lowest record rate in the history of Philadelphia.

The time elapsed since the entire city water supply has been filtered is too short to give periods for comparison for before and after filtration. A city of 1,600,000 people presents most complex conditions which bear directly on its total mortality rate. Tuberculosis, infant mortality and better housing and sanitation campaigns have been waged before, during and after improving the water supply. The notable reduction in mortality rates occurs in the age period under one year, and dates its downward trend from 1892 with intervening fluctuations. Improved milk supply and the use of diphtheria antitoxin are also strong factors for reducing mortality. They have influenced the changes in Philadelphia. One isolated section of the city shows changes paralleling in the main the changes for the entire city. Another shows marked declines in total mortality and from typhoid fever, tuberculosis of lungs, pneumonia, diarrhoea, enteritis, diphtheria and croup, heart disease and kidney diseases, for which diseases the entire city rates also declined, except in heart disease and kidney diseases. This isolated section was largely influenced by an institutional factor, having within its limits many hospitals, asylums, houses for aged, etc.

The improved water supply undoubtedly was by far the largest factor in reducing typhoid fever, and it will also prove of great hygienic value and be of benefit in reducing total mortality, other than thru the typhoid component, in what ratio the future will decide, if it can be determined.

From the minority report on the proposed Jerome Park filters for the New

York city water supply, on which the postponement of the filtration of the Croton water supply was based, the following figures are taken, showing the effect of methods of water treatment upon the typhoid fever death rates in various cities of the country.

The notations in the table are explained as follows:

M. Mechanical filtration.

S. Slow sand filtration.

P. Preliminary filtration.

H. Hypochlorite used.

*Marks date of installation of water purification system; purification plants installed prior to dates in table not so marked.

† Changes made in source of water supply.

TABLE SHOWING EFFECT OF WATER PURIFICATION ON TYPHOID FEVER DEATH RATE PER 100,000 POPULATION.

City.	1900-05.	1906.	1907.	1908.	1909.	1910.	1911.	1912.
Birmingham, Ala., M	....	....	....	....	59.7	51.3	43.4	....
Oakland, Cal., M	....	....	....	....	8.2	14.0	12.1	....
New Haven, Conn., S	....	....	....	....	20.3	18.0	23.5	....
Washington, D. C., S	....	....	....	....	36.0	24.5	20.9	....
Atlanta, Ga., M	....	....	....	....	58.1	42.6	56.3	....
Indianapolis, Ind., S. P	....	....	....	....	19.4	28.7	26.2	....
Louisville, Ky., M	....	(58		average.	)	*30.8	22.0	18.0
New Orleans, La., M	....	....	....	....	29.3	31.6	30.7	....
Paterson, N. J., M. H	....	....	....	....	5.1	6.4	6.2	4.6
Albany, N. Y., S. P. H	*24.8	20.3	20.0	10.9	18.8	14.9	17.8	17.8
(Hypochlorite treatment at intervals added in 1910.)								
Amsterdam, N. Y	22.2	24.8	15.9	0.0	11.9	†22.1	9.0	11.6
Auburn, N. Y	23.8	12.1	6.0	46.6	17.5	8.6	7 9	11.2
Binghamton, N. Y., M	*25.6	9.1	18.2	15.2	13.1	12.4	4.0	17.8
Cohoes, N. Y., M	92.9	57.8	78.2	62.0	82.2	86.8	*108.5	48.0
Elmira, N. Y., H	45.5	44.7	28.0	30.7	33.5	26.9	*13.3	15.9
Lockport, N. Y	47.8	†67.6	50.1	60.7	49.7	†11.1	22.0	16.6
Middletown, N. Y., M. H	*24.1	18.8	18.8	42.1	18.1	26.1	59.1	H26.5
(Hypochlorite treatment added in 1912.)								
New York City	18.6	15.5	17.4	12.8	12.7	11.6	11.0	9.7
Manhattan, H	....	....	....	....	11.3	*11.5	10.7	7.9
Bronx	....	....	....	....	19.2	*9.5	8.1	5.2
Average of two	....	....	....	....	12.3	11.2	10.3	7.4
Niagara Falls, N. Y., M. H.	141.5	154.5	126.0	87.1	74.9	97.9	187.0	*71.5
Ogdensburg, N. Y., M	52.8	67.3	47.1	26.8	26.8	37.5	30.8	*36.7
Oswego, N. Y	47.5	58.0	66.0	62.2	26.6	†51.2	12.7	21.0
(Hypochlorite treatment added in 1910.)								
Peekskill, N. Y., M	22.5	15.2	14.0	202.3	12.9	*26.2	19.0	0.0
Poughkeepsie, N. Y., S. H.	*42.4	39.4	112.0	34.5	23.0	H17.8	14.0	13.7
(Hypochlorite treatment added in 1910.)								
Rensselaer, N. Y., M	*67.5	18.6	58.3	30.0	29.9	28.0	H18.7	9.4
(Hypochlorite treatment added in 1911.)								
Rome, N. Y	21.6	28.1	17.0	26.4	16.0	19.3	9.4	22.9
Cincinnati, O., M. H	....	....	....	....	13.2	5.8	11.3	....
Cleveland, O	....	....	....	....	13.0	18.7	14.7	5.8
Columbus, O., M. H	....	....	....	....	21.3	16.5	13.8	....
Toledo, O., M	....	....	....	....	29.9	36.2	22.5	....
Philadelphia, Pa., S. P	....	....	....	....	21.8	17.5	14.1	12.5
Pittsburg, Pa., S. H	....	....	....	....	13.0	13.1	14.1	....
Providence, R. I., M	....	....	....	....	11.5	17.4	11.7	....

ROADS AND PAVEMENTS

Concrete Trolley Poles in Cleveland

In certain sections of Cleveland, Ohio, a city ordinance prohibited further erection of wood poles and required also that all poles be removed within two years and wires placed below ground. There were already about 50 octagonal concrete poles in service in the city and these had attracted so much favorable comment because of their uniform drab color and straight lines, that the company obtained permission to leave wires above ground providing concrete poles were installed.

After two years of use, there are now 750 concrete poles in service largely replacing wood poles in outlying districts and being used in practically all new work.

The standard concrete pole is 28 feet long, 11 inches in diameter at the butt and 6 inches at the top, and is octagonal in shape starting 6 feet from the square butt. The weight is 1,700 pounds and when set 6 feet in the ground withstands 500 pounds pull at the top. The cost of manufacture is $12.00. Porcelain insulators safe for 6,000 volts are used in order that no electrolysis effects may occur.

The reinforcement consists of eight ⅝-inch square twisted bars placed so that the center line of the steel is 1 inch from the concrete surface. A very rich and wet mixture is used and the aggregate is proportioned for maximum density, being tested frequently during construction. The poles are kept continually and uniformly wet thru a period of 28 days.

The forms consist of two steel channels pressed from heavy sheets with a varying width, which are held by eight U-shaped rods passing thru the flanges. The forms rest on a wood pallet and wood strips are inserted to obtain the bevelled edges. The upper surface is trowelled smooth.

The poles are superior in every way to wood poles, are cheaper than tubular steel poles, require little or no maintenance and are received favorably by the public. Their use is now standard practice in Cleveland.

Street Maintenance in Chattanooga, Tenn.

The city of Chattanooga, Tenn., is governed by a commission of five elected members. The latest number of *Municipal Record*, which gives periodical inforamtion concerning the city government, is devoted to the annual reports of the departments. Among these reports is that of A. N. Sloan, the commissioner of streets and sewers, who has charge of construction, maintenance and control of streets, sewers, bridges, viaducts, subways and sidewalks, including savenger service and street cleaning. On his staff are the city engineer, the superintendents of street repair and street cleaning and the chief sewer and sidewalk inspectors.

Some details regarding street cleaning, effect of automobiles on streets and automobiles in the department are of general interest. Concerning these Mr. Sloan has the following to stay, in part:

During the year we dispensed with the old method of street sweeping, and instead washed the streets, which has been much more satisfactory, and has practically abrogated complaint from our citizenship as to dirty streets. In fact, a complaint coming to the department in this regard is almost unknown.

The increase in automobile travel has been so marked that a better grade of streets is demanded than ever before. The complaints that come to the department are almost entirely from those who drive machines. A street that is sufficiently smooth for ordinary wagon or buggy travel is often considered very bad for automobile traffic. The low wheels and high rate of speed magnify the inequalities in surface as compared with other traffic. In this connection, permit me to say that we find it impossible to keep chert streets where there is much automobile traffic in anything like good condition. Nothing will withstand the suction created by rubber tires save a bituminous-filled or brick street. We are experimenting with one block of chert street where we have used a preparation that appears to cement the street so as to better withstand the automobile traffic. We may during the year find it expedient to treat some other streets in the same manner, provided we can be as fortunate in saving money from other departments that we may expend it on street repairs. I believe that a vehicle tax for the maintenance of roadways ought to be enacted in Tennessee. It is doubtless safe to say that one-half of the automobile owners are not property taxpayers, and there should be some way of making them bear their proportion of the expense of keeping up roadways.

During the year we did not buy any wagons, having built in our shops all the additional wagons used. We find them better adapted to our purposes, and they will outwear any wagon bought from dealers; besides, the character of wagon built is obtained much cheaper, as the shop force puts in all its extra time on this work. The saving to the department from the shop alone has had more to do with the surplus that we used on street repair work than any other one cause. The rolling stock is kept in good shape and in commission all the time. This was impossible under the old system of sending the wagons to outside shops for even the slight repairs. All wagons are examined after each day's work, and any repairs needed are made before the hour of starting them out the following morning. So it is with the shoeing of stock. In our opinion the blacksmith and repair shop has increased the efficiency of the scavenger department 20 per cent.

During the year we found it necessary to buy one additional automobile, for the street superintendent. The increase in his work on account of the extension of the corporate limits of the city, and the vast amount of work being done in that territory in the installation of a sewer system, made it necessary that he have some quicker means of transportation, or that he be given an assistant. His horse and buggy both being worn out, we bought a Ford runabout for $420, which was not much more than a new horse and buggy; besides it enables him to do three times the work that he could have done with a horse and buggy. In this conection, I beg to state that the automobile equipment of this department, which consists of four machines, has not only enabled us to give better service, but the saving made by the large truck alone is more than the entire up-keep of all the equipage for the entire year. By actual figures that truck has saved $1,200 above what it would have cost to do the work with wagons and teams. The total outlay for up-keep for all machines was $992.10. Without figuring the additional work secured through the other three machines, and the more perfect supervision, which means the saving of money, we consider this showing most creditable. I know there is a disposition with those not acquainted with the facts to criticize any department of the city that spends money for automobile machinery. If one of our leading merchants or factories dispenses with wagons and teams and buys gasoline trucks and automobiles he is called "progressive," but if a commissioner of the city, using the same intelligence in the conduct of the city business, finds it economical to make the change, how quick the criticizing tongues begin to wag. If anyone questions the figures presented as to the total up-keep of all four of the machines, and the fact that the saving on the truck alone more than pays for the upkeep of all, I would be glad to have him examine the records in the office. I admit that automobile machinery is often expensive, but my personal experience is that it is usually caused by inefficient or careless handling. All machinery of this character in the department is examined daily and kept in first class repair. If a driver is detected carelessly operating a car, he is dismissed. This has happened twice during the past year.

Of the one hundred thousand dollars set apart for the use of this department for the last fiscal year there was returned to the general fund $89.98 after all bills contracted during the year had been paid. Whatever is given to this department will be expended to the best advantage possible, but not one cent will the department over-draw the budget allowed. If more work is expected, a larger appropriation must necessarily follow. The commissioner has no legal or moral right to exceed the budget apportioned to his department. Besides this balance of $89.98 there was collected and turned over to the general fund $1,709.35, for the sale of manure and other refuse.

Stone-Gravel Road Costs

By K. I. Sawyer, County Road Engineer, Menominee County, Michigan.

The following information is founded on experiences encountered in the construction of the Bay Shore Road. The southerly seven miles is thru a considerable settlement. In the summer time, it is subjected mainly to a pleasure traffic, but in the fall it must stand heavy and continuous teaming. A load of 60 packages of fish on a common 3½-inch tire wagon is not unusual; this would weigh about 5 tons. This southern seven miles of road was built as one job.

The main construction crew was equipped with a No. 3 Austin gyratory crusher and appurtenances, two Port Huron traction and hauling engines, one Port Huron roller, ten Port Huron traction and hauling engines, one tank wagon, road machines, etc.

A synopsis of the specifications under which the road was built is as follows: Road ditched 24 or 30 feet between ditches, depending on depth of ditches and of sand; subgrade of native sand; 3-inch layer of crusher screenings (clay loam and pebbles) laid on a sub-grade worked into sand clay bed and rolled when dry with 12-ton roller; 5 inches by 12 feet clear crushed stone slightly bound and rolled; then 4 inches by 18 feet clear crushed stone bound with little excess of screenings rolled dry, in puddle, and then dry; repeat as necessary.

wagon from the bin. The engines handled two to four wagons to a train according to climatic conditions. The usual practice, however, was to haul three wagons for the good of the road.

Owing to the fact that the steam haulers were a new part of the county plant the last season, a comparison was worked out to show the advantage of using this equipment. This comparison was taken directly from the schedule of actual costs of the road. In the work 1,277 cubic yards of stone were handled by the engines and 1,912 cubic yards by teams. This work was under identical conditions and gives a good basis of comparison. The team haul rate was 53

Cost of Hauling With Tractor and Teams

Steam Haul.

	Labor	Coal Oil, Etc.	Cost	Av. haul Ft.	Max. haul Ft.	Yds.	Av. Cost 1 yd. Cts.	Rate 1 yd. mi. Cts.
May	$ 16.62	$ 9.16	$ 25.78	Instructing crews				
June	63.65	110.04	173.69	2,300	4,600	1,359	12.7	34.2
July	185.25	139.20	324.51	6,500	10,200	2,826	11.5	9.4
August	257.26	234.30	491.56	13,000	16,100	3,524	13.9	5.7
September	182.14	171.10	353.24	17,800	19,500	1,816	19.0	5.6
October	199.22	123.40	242.62	12,000	19,500	1,860	13.0	5.8
November	36.65	26.88	63.53	2,500	5,100	792	8.7	18.5
Totals and averages	$940.87	$814.08	$1,754.95	9,700	19,500	12,177	14.5	8.6

Team Haul.

	Cost	Mean haul Ft.	Yds.	Av. cost 1 yd. Cts.	Rate 1 yd. mi. Cts.
June	$ 12.00	1,300	42	28.5	74
July	63.88	2,000	168	37.9	97
August	162.85	2,300	710	22.9	53
September	67.30	2,300	328	20.5	48
October	99.75	1,200	614	16.2	72
November	48.48	5,700	50	97.0	91
Totals and averages	$454.26	2,300	1,912	23.2	53

The plant site was wooded when work was started and this increased installation charges considerably. The gravel from the bank was plowed loose, then teamed in wheel scrapers to the crusher the teams driving over the crusher on the feeding platform and dumping the gravel directly into the crusher. Most of the season but two grades were taken by the screen on the bin, but all dirt was removed from the stone by a 3/8-inch dust-screen mounted outside the stone screen. The bins are so built that the engines and cars run under them to receive the contents of two compartments and receive the third from the end. All ports in the bins are on the bottoms which are built horizontal. It took about 3 to 4 minutes to load a 6-yard

cents per yard mile. This would be considered high under normal conditions. The conditions under which the hauling was done were very stern, as is shown by the fact that it was possible to load only about a ton to the load for teams at the start, and even then it was necessary to double the teams over considerable of the road now built. Only good teams weighing 2,900 pounds to 3,400 pounds each were used. The following is a comparison of the costs of the engine haul and the team haul:

Engine Haul.

Engines hauled 12,177 cu. yds. a mean haul of 9,799 ft., as shown in the table, at a cost of $1,754.96

20 per cent. interest aud depreciation on $6,200 plant.......	1,260.00
Water tower expenses..........	140.92
Cleaning and repairs on haul equipment	163.26
Material placed in engine track in excess of amount required by specifications, 1,703 cu. yds. at 47 cts.....................	800.41
Total	$4,119.55

Team Haul.

Team haul at 53 cts. per mile, shown in table, gives average cost for 9,700 ft. mean haul of 53 cts. multiplied by 9,700 and divided by 5,280 feet per mile, or 96 cts. per cu. yd., and the above 12,177 cu. yds. if hauled by team would have cost 96 times 12,177 or.......	$11,689.92
Economy by use of engine.....	$ 7,507.37

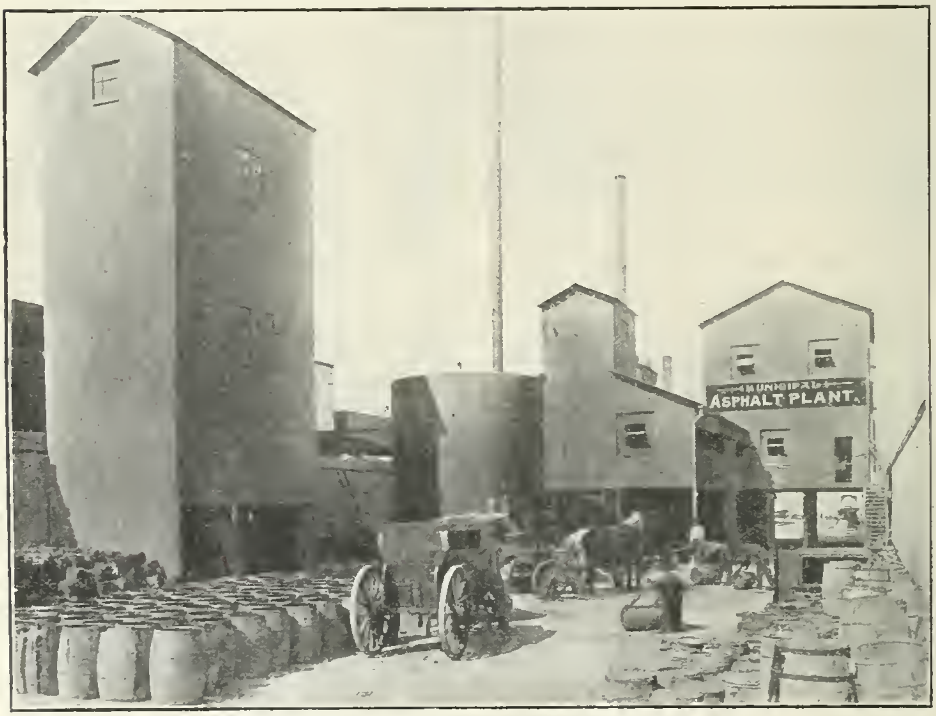
Two rollers were kept at work continually, one on the dump and one most of the time on completed work, rolling the shoulders to prevent movement of the sub-grade. All ditch and sub-grade work was handled by the grade crew under the grade overseer. The major portion of the work of the spreaders was passiug the excess screenings out onto the shoulders and shaping them, as after a little practice the spreading cars dropped the material practically in place.

The Chicago Municipal Asphalt Paving Plant

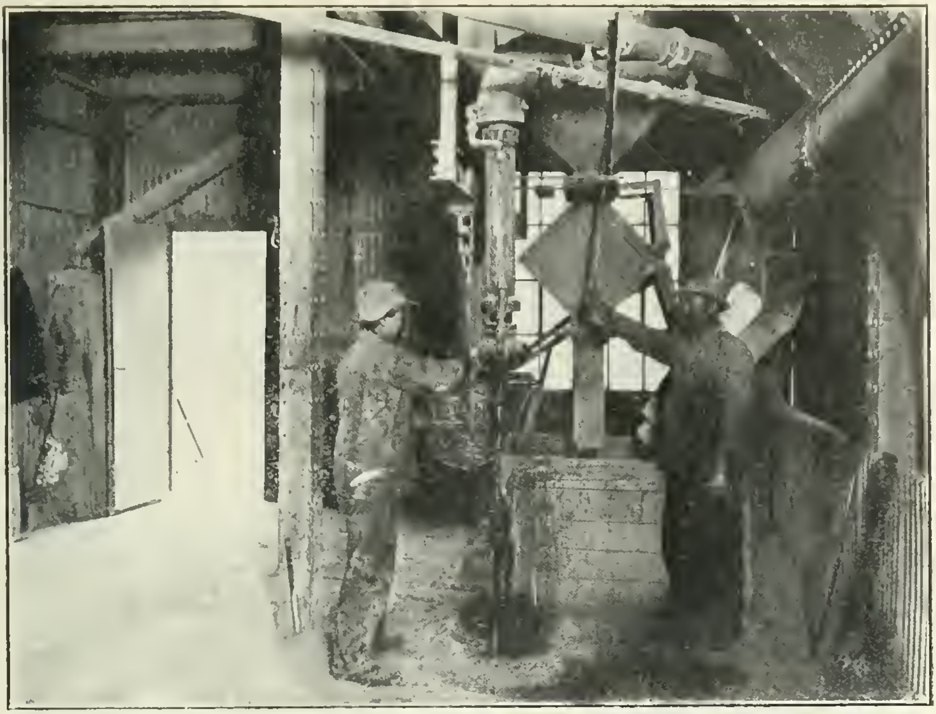
In the midsummer of 1913 there was completed and put into operation for the city of Chicago one of the largest and most complete asphalt paving plants of the United States. This plant was built for the city under contract with Hetherington & Berner, of Indianapolis, and should have been put into practical service earlier in the season but owing to labor conditions in that city, and the delays caused by jurisdictional strife between various trades the completion of the work was unavoidably delayed. The accompanying illustrations show the plant in its finished condition. This plant has a capacity sufficient for the laying of 3,000 square yards of finished asphalt topping per day, 2 inches thick when compressed upon the street, or, as an alternative it will turn out 2,000 square yards of finished work consisting of both binder and topping, in one day.

The principal elements of the plant are as follows:

Four large melting kettles or cauldrons, each having a cubical content of 340



CHICAGO MUNICIPAL ASPHALT PLANT.



INTERIOR *of Chicago's municipal asphalt plant. These two men control the whole mechanical delivery of materials.*

cubic feet. Two of these kettles are fitted for mechanical agitation and two without, for plain melting.

The machinery for the drying and heating of the mineral ingredients consists of one battery of the well known Hetherington double drum sand dryers of the latest improved type, and one single drum dryer. When operating for both binder and topping at the same time the single drum is used for binder material and the double dryer for sand material. When it is desired to work the plant to its entire capacity on topping material alone then both the single and the double dryers may be used for heating sand.

Two standard 9 cubic feet asphalt mixers are installed in the plant and may be operated separately or together as may be desired.

The design of the building is such that there are two driveways for teams, one leading under the binder mixer and one under the topping mixer; thus both binder and topping may be delivered from the plant simultaneously.

In this plant the minimum amount of hand labor is employed. The melted asphaltic material is handled by pneumatic means and the mineral material is handled mechanically from the point in the yard at which it enters the various feeding devices connected with the heating and storing appliances. In the illustration showing the interior of the plant two men are shown at a mixer; these two men alone have control, by mechanical means, of all of the material that enters into the mixer.

In addition to the plant proper and its mechanism, this installation embodies also large storage facilities for fluxing and fuel oils and for crude asphalt.

The plant was especially designed to fit into the only available site that could be provided. This site was made by vacating a street between Ashland and Laflin avenues. This street was bounded at either side by the huge retaining walls of the elevated tracks of two railroads, the Chicago, Milwaukee & St. Paul and the Northwestern. In order that material might be handled from the grade of the tracks down to the grade of the plant yards a large electrically operated platform elevator having a platform 12 feet by 15 feet in size had to be provided. This elevator is inclosed within a steel framed tower which is shown in the foreground of the view of the plant.

The power used for the operation of this plant is entirely electrical. Oil is used as a fuel for the sand heaters and for the melting kettles. Dust collectors are provided as a protection to the neighborhood from dust and smoke from the plant. The entire plant structure is of fireproof construction, the frames being made of structural steel incased with galvanized corrugated iron. The floors are concrete, smooth finished in granitoid.

The contractors' price for the complete installation of this plant was practically $45,000. In reply to an inquiry of the city official of Chicago who is in charge of this plant as to its capacity and efficiency, a letter has been received from which we quote the following:

"In reply to your communication I take pleasure in advising you that the asphalt plant built for the city of Chicago has stood up to all of its requirements. While we have been unable to run this plant to its full capacity every day, because of the fact that the city of Chicago is only doing its own work on streets out of reserve, on several resurfacing jobs on old brick and granite pavements it has exceeded its capacity. On one resurfacing job we have turned out an average of 250 tons per day for six days. The last day's run was 289 tons.

Very truly yours,
WALTER G. LEININGER,
Superintendent of Streets."

Asphalt Pavements in Buffalo

Some interesting data regarding asphalt streets in Buffalo, the traffic over them and the cost of maintaining them have been derived from the last reports of the department of public works and the latest specifications, with the aid of Geo. H. Norton, deputy engineer commissioner, who has special charge of construction and maintenance.

The changes in traffic conditions with the change of season and the tendency to increase in weight as well as number of vehicles is shown by the following table, made by combining the records of traffic over certain streets taken (1) November 30 to December 18, 1909, (2) June 8 to 22, 1910, and (3) June 4 to July 1, 1912; the figures in each case being the averages per 14-hour day of three consecutive days' observation taken between the time limits stated. These streets are all paved with asphalt.

Location.		Width of Pavement.	Av. daily tonnage per ft. of width (14 hours).	Average tonnage per vehicle.	Average No. of automobiles.
Delaware	(1)		70.16	1.03	1,309
at	(2)	40	99.34	1.14	2,077
Chippewa	(3)		112.93	1.26	2,779
Delaware	(1)		14.96	1.47	127
at	(2)	36	24.16	1.52	284
City Line	(3)		28.42	1.40	504
Main	(1)		55.37	1.03	2,164
at	(2)	58	70.33	1.13	2,247
Tupper	(3)		121.07	1.23	4,451
Main	(1)		32.61	1.01	694
at	(2)	58	50.03	1.20	1,275
Seneca	(3)		67.62	1.18	2,108
Michigan	(1)		50.70	1.14	138
at	(2)	42	57.07	0.96	403
Broadway	(3)		39.93	1.02	282

Remembering that (1) is under winter conditions and (2) and (3) are taken in June and that (2) was taken six months after (1) and (3) was taken two years after (2), the following conclusions can be drawn:

a. That summer traffic is materially heavier than winter traffic.

b. That in every case but one there was a material increase in traffic from 1910 to 1912.

c. That there is a marked tendency to increase in weight of vehicles, tho this does not show at all the points at which census of traffic was taken.

d. That there is a very marked increase in the number of automobiles. In fact, the increase in amount of traffic and in weight of vehicles is due to the increase in number of automobiles, there being a slight tendency toward a reduction in the number of other vehicles in use.

Michigan at Broadway shows differences from the other locations mainly because there was a material reduction in all kinds of traffic at that point, the reason for which is not explained.

All these are important points, where the city traffic is heavy, most of them being in the down-town section.

In September, 1912, between the 3d and 23d, traffic records were made at the points in the following table, where the conditions are the average of the outlying sections of the city:

At Intersection of	Direction of travel.	Width of pavement.	Av. daily tonnage per ft. of width (14 hrs.)	Average tonnage per vehicle.	Av. No. of autos.
Ellicott	South	28	5.54	1.04	63
and Riley	East	28	8.25	1.08	102
Wohlers and	South	28	9.25	1.10	55
Northampton	East	28	5.89	1.05	54
Ashland	South	30	5.57	1.07	65
and Utica	East	32	11.00	1.13	181
Prospect and	South	36	14.22	1.10	203
Pennsylvania	East	32	5.19	1.09	42
South Park	South	40	14.10	1.20	138
and Como	East	28	1.71	.92	11
Dearborn	South	30	5.37	1.06	39
and Austin	East	28	2.43	.94	14

In general the average weight of vehicles is less in these light traffic streets than in the heavy business districts, largely because the proportionate number of automobiles is much less.

Excepting Michigan at Broadway, the number of automobiles is from 1¾ to 3 2/3 times as many as the number of other vehicles at the locations listed in the first table of heavy traffic, while the number of automobiles on the lighter traffic streets is from 24 to 40 per cent., with only one case in which the number of automobiles exceeds the number of other vehicles.

These comparisons may give some idea of the reasons for the variations in cost of asphalt maintenance.

The city of Buffalo has kept the most complete continuous record of the cost of asphalt repairs from the beginning of asphalt paving in the city, and can give the cost of maintenance, repair, resurfacing and reconstruction of any street for any period of its life as an asphalt pavement.

About two-thirds of the area of streets under maintenance by the department are asphalt streets and about 80 per cent. of the maintenance funds are expended on asphalt. About 40 per cent. of the area of asphalt under maintenance is over twenty years old, or is older than the average life of asphalt pavements. Of pavements laid more than twenty years ago, 2,268,837 square yards laid bet een 1878 and 1892, more than half (1,200,896 square yards) are still in use.

The average age of the asphalt pavements which were laid more than twenty years ago is 20.97 years on streets without car tracks and 18.22 years on streets with car tracks, being 2.75 years in favor of the former. The average age of asphalt pavements replaced during the twenty years from 1892 to 1912 was 17.85 years on streets without car tracks and 16.06 years on streets with them.

The oldest pavement in use is thirty-two years old, and is on a street with car tracks. The average age of pavements maintained by the city, none being less than ten years old, is 19.07 years on streets without car tracks and 16.20 years on streets with car tracks, about half the area being between nineteen and thirty-two years old and half between ten and nineteen years old.

The average cost of repairing asphalt streets, figuring the streets repaired only, has increased from 4.61 cents a square yard, the average for the whole period prior to 1902-3, to 6 cents per square yard for the whole period prior to 1911-12. Figuring the whole area of streets maintained, i. e., more than ten years old, the cost per square yard for maintenance has increased from 2.89 cents per square yard for the period prior to 1902-3 to 3.94 cents per square yard for the whole period prior to 1911-12. These figures are given in the report to show that the replacement of old pavements is not rapid enough to keep the cost of repair uniform year by year. Whether the economical rate of replacement can be determined is questionable, individual variations being so great. The general rule stated is that repairs should be continued until the sum of the whole cost of repairs and of the renewal of top, divided by the age of the pavement, is a minimum.

The specifications for asphalt pavements are very open and many kinds of asphalt have been used. The only material change in specifications which has been made recently is to reduce the amount of stone, sand or screenings which might be used in the surface. Twenty-five per cent. was allowed formerly, but was found hard to work and not entirely suitable to heavy traffic. The guaranty period has been ten years since 1900, and is so continued.

Trinidad asphalt has been used by nearly every contractor laying asphalt, the total yardage existing and replaced in which it was used aggregating nearly 5,000,000. Bermudez asphalt has been used in about 200,000 square yards of pavement; Sicilian asphalt in 30,000; German rock in about 100,000; Alcatraz in about 190,000; Kentucky rock in 175,000; California in about 42,000; Obispo in 27,000; natural rock asphalt in 19,000, and asphalt blocks in about 6,500 square yards.

Macadam streets have been treated with various asphaltic oils and emulsions to prevent dust. The average cost per square yard of making the applications was 1.12 cents. The lighter grades of Aztec and Indian asphaltic oils, Tarvia and Headley's emulsion have been so used.

Brick Pavements in Buffalo, N. Y.

The city of Buffalo, according to the last annual report, has 28.44 miles of brick pavement. The first brick pavement was laid in 1889, but the area paved increased slowly, 1902-3, 1906-7, 1907-8, 1910-11, and 1911-12 being the only years in which more than ten miles length was laid. All pavements are laid under ten years' guaranty and only about one-third the brick pavements in the city are as yet maintained by the city.

The average age of the brick pavements under city maintenance is 16.07 years for streets without car tracks and 16.75 years for streets with car tracks, there being but two of the latter, one 19 and one 14 years old.

The streets repaired in 1911-12 aggregated 51,906 square yards in area and the cost of repairs being $3,161.17, the average cost per square yard of streets repaired was 6.09 cents. The total yardage of streets maintained being 149,808, the cost per square yard of streets under maintenance was 2.11 cents. The number of square yards of brick surface actually repaired being 3,489.24, the cost of making the repairs was 90.6 cents per square yard of surface distributed.

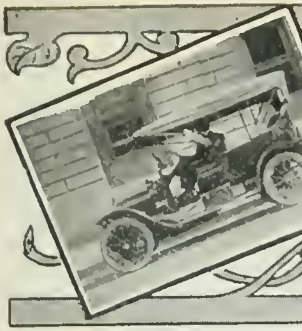
The amount expended for repairs of brick pavements being so small in the aggregate, the economies of repair and resurfacing have not been worked out as they have been for asphalt pavements. The yardage of brick streets maintained is only one-seventh the yardage of asphalt streets under city maintenance. The costs per square yard for the two pavements differ as shown, asphalt costing 6 cents per square yard of streets repaired, 3.94 cents per square yard of streets maintained, and $1.02 cents per square yard of surface actually repaired. The cost per square yard of streets maintained is materially less for the brick streets, and but little different from asphalt when computed by the other two methods.

The cost of brick pavements has varied considerably, beginning with $2.49 a square yard in 1889, increasing to $2.86 in 1892, decreasing rather irregularly to $2.05 in 1901-2 and again increasing with some approach to uniformity of rate to $3.21 in 1909-10. Since that year there has been a decrease to $2.71 in 1911-12.

These figures show that brick pavements are giving satisfaction on economical considerations.

During the past few years the use of brick for the country roads in Erie county outside of Buffalo has increased rapidly, the State Highway Commission having constructed a large mileage of the county roads of brick. These pavements have been described and illustrated in MUNICIPAL ENGINEERING in several numbers recently.

Many kinds of brick are used in these city and county pavements. The records of the brick testing laboratory show bricks from Pennsylvania factories at Kushequa, Calder, Sykesville, Dubois, Reynoldsville, Clearfield, Franklin, Bradford and Youngsville; from Ohio factories at Akron, Conneaut and Collinwood; and from New York factories at Jewittville, Jamestown, Olean, Lockport and Syracuse, the Lockport brick being a sample and the Syracuse bricks old bricks from streets in use.



Automobiles in Municipal Service

Motor Trucks on Street Work

In the work of the Watson Contracting Company, which consists mainly of regulating and grading streets, as well as general contracting work, motor trucks are giving most efficient service. The information presented herewith as to motor truck operation is based on actual work of these trucks as performed on the work of grading several of the avenues and streets in the borough of Bronx, city of New York, on contract calling for a fill of 390,000 cubic yards and a rock cut of 20,000 cubic yards.

All roadbed and paving materials are brought by barges to the dock on the Harlem river at Two Hundred and Seventh street. A floating derrick transfers their contents to a hopper of 30 yards capacity, from which the material is chuted into the trucks standing alongside. The roadbed material consists largely of broken stone, screenings, ashes (purchased from the steamships and power stations) and gravel. Coal, cement, sand, fire brick, asphalt block, flagging and curbing are received at the same dock.

The trucks are equipped with rear-discharge dumping bodies, furnished by the Sior Wagon Company of Brooklyn. They have a capacity of 5 cubic yards. Storage and repairing facilities are provided in a garage on Aqueduct avenue.

Working in two eight-hour shifts, or sixteen hours per day, with two drivers, one of these trucks easily handles 120 yards per day. This is accounted for as follows: The trucks have normal speed of ten miles per hour, but, to be on the safe side, we will figure their average at six miles per hour, or a mile in ten minutes, allowing fifteen minutes for loading and five minutes for unloading (both of which are excessive). This, with the ten minutes running time each way, means forty minutes per round trip, or three round trips in two hours. Therefore in sixteen hours you would have a total of twenty-four round trips, and with five yards per trip, this makes 120 yards per day.

The following is a summary of the operating costs on a daily basis:

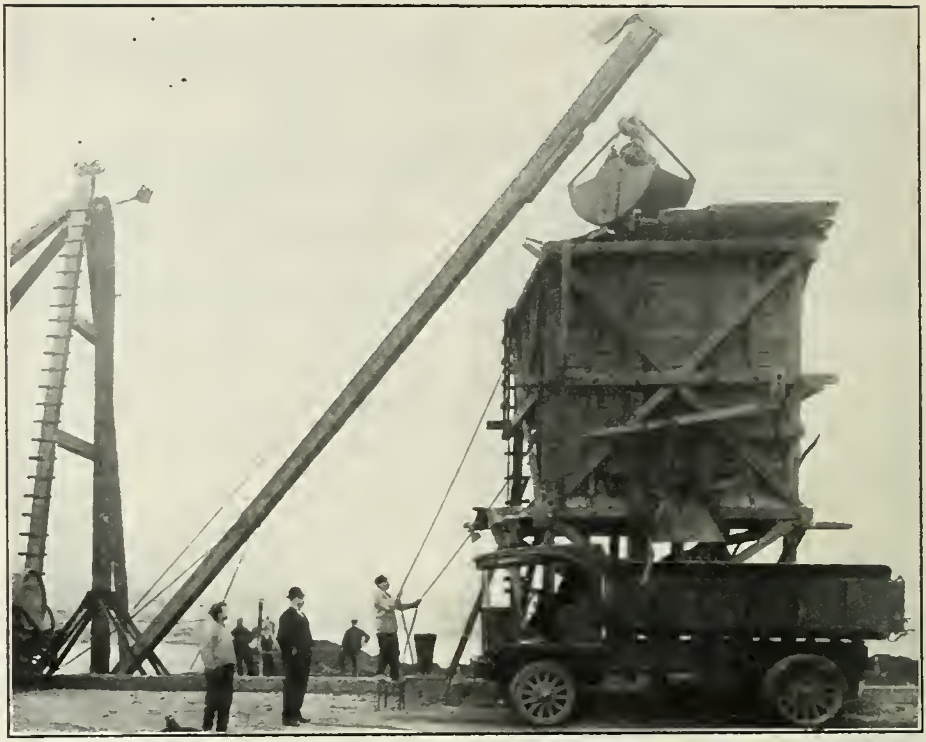
Two drivers at $4.00 per. day......	$8.00
Gasoline (5 miles to the gallon, 10 gallons at 16c....................	1.60
Oil and greases per day............	.25
Tire expense, 50 miles per day.....	2.16
Insurance, fire and liability, per day	1.00
Depreciation (less tires, $650.00) based on your job lasting two years and to charge off entire investment 50 per cent. per annum, per day	8.70
Interest, average per day..........	.75
Repairs (figuring $600.00 in 2 years) per day	2.00

We give the following additional explanation regarding some of the above charges. The tires are guaranteed for 10,000 miles by the tire makers. If you run 50 miles per day for 200 days per year in two years you have made 30,000 miles; deducting the 10,000 miles obtained from the original set of tires on the truck, you leave 20,000 miles to be charged, or two complete sets of tires, cost $1,300, which, distributed over 600 days, makes $2.16 per day. In the repairs we have charged $600, the bulk of which could, of course, come during the second year, and this is probably excessive, but here again we are on the safe side and have averaged the cost over the two-year period.

Thus it may be seen that 120 yards can be hauled daily at an expense of $24.46, or in round figures, about 20c per yard, and we do not see how this can be exceeded.

In the operation of a total number of five six-and-one-half-ton trucks you obtain a six-hundred-yard daily capacity, which, however, is elastic, and when occasion requires your exceeding this amount, it can be accomplished without difficulty. That motor trucks are best for contractor's service is easily demonstrated by the number of contractors who are now using them and the service they are receiving.

Data were obtained from two trips on a five-ton Garford, equipped with a dump-



MOTOR TRUCK *receiving broken stone from bin on dock which is filled from the barge below by means of the bucket and crane.*

ing body of 5 cubic yards capacity, hauling screenings from the dock on Harlem river to Two Hundred and Thirtieth street and Bailey avenue, Bronx. There is a winding roadway from the dock up to University bridge, which makes a hard climb for any fully loaded vehicle. A helper at the unloading point dumped and replaced the body, the chauffeur retaining his seat and shifting the machine once to distribute the load.

First trip.		Odometer reading.	Remarks.	Minutes.
Began loading	10:46			
Finished and left docks	10:47½	2011.5	Loading time for 5 cubic yards	1½
Arrived Bailey avenue	11:02½	2013.2	Running time for 1.7 miles loaded	15
Dumped and left	11:04½		Unloading time	2
Arrived at dock	11:17½	2015.0	Running time for 1.8 miles empty	13

Second trip.		Odometer reading.	Remarks.	Minutes.
Began loading	1:04			
Finished and left docks	1:08	1585.1	Loading time for 5 cubic yards	4
Arrived Bailey avenue	1:22	1586.8	Running time for 1.7 miles loaded	14
Dumped and left	1:25		Unloading time	3
(Delayed 3 minutes by open drawbridge)			Lost time	3
Arrived at dock	1:40	1588.6	Running time for 1.8 miles empty	12

—Synopsis of Two Trips—

	First trip.	Second trip.
Distance from dock to dumping point..	1.75 miles	1.75 miles
Running time, empty..................	13 minutes	12 minutes
Running time, loaded.................	15 minutes	14 minutes
Time required to load.................	1½ minutes	4 minutes
Time required to unload...............	2 minutes	3 minutes
Lost time due to waits................	None	3 minutes
Load carried, screenings..............	5 cubic yards	5 cubic yards
Time for round trip of 3.5 miles........	31½ minutes	36 minutes

MOTOR TRUCKS *dumping cinders in fill for street on work of Watson Contracting Co., Brooklyn, N. Y.*

Weather—Fair.

Streets—Asphalt block. One heavy grade.

Condition of Machine—A-1.

"We operate eighteen Garfords," states Mr. Baisley, a member of the firm. "One of these trucks does the work of at least nine of our best horses. We do a lot of hauling with our machines for other companies. I had always heard that motor trucks weren't profitable on short hauls, and really believed it until just last winter, when we did some work for the New York Catholic Protectory. They had a great amount of coal to be brought up from the dock, which was just a little bit more than a mile away. Our two-horse wagons went to work at it first and could only make nine trips a day. The round trip was 2¼ miles, I think. We decided to try out the machines and soon put the horses in the stable. A truck could make 21 trips a day, hauling five tons, besides having to cover the three miles to our Fordham garage both morning and night.

"The trucks have put the horses out of business except on one or two of our jobs."

A French Motor Tricycle Street Cleaning Machine

The removal of street filth and the cleaning of the wagons, is not at all a small affair, in a city like Paris. The municipality has adopted as a motto "An absolutely clean street at 7 o'clock in the morning," and has made different attempts towards that end, among others the removal of street filth by automobile collectors.

But, manifestly, no motor could withstand the excessive amount of work which it is called upon to perform. It is necessary that the vehicle stop each instant, start up, stop again, etc. The average is 450 stops per night, and it will be understood that such forced labor is very hard on the motor.

Better results have been obtained with another type of electric vehicle and the municipality has decided to employ them on a grand scale.

The street cleaning tricycle, recently experimented with, has given excellent results in the picking up of papers, horse manure, and small filth soiling the street during the day.

By means of a metallic box placed between the two rear wheels, and two rotary brushes, worked by the pedaler himself, the tricycle passes above the matter and makes it disappear; the brushes fold up in the box and the machine passes on, leaving the place behind it clean. The cyclist, seated on his seat, then releases the brushes and continues on his way in search of a new deposit, which he will gather up with ease and rapidity.

A single man can clean up from 10 to 15 miles of street each day.

It is needless to say that the machine has given joy to the Parisian public, for it has proved satisfactory to such an extent that the city of Paris now uses 150 of them.

E. B. Stuart, 36 S. Ashland boulevard, Chicago, Ill., is the American representative of the new street cleaner.

An All-Motor Department

The recent purchase of a triple combination, three combinations, aerial truck and chief's auto gives the distinction of being the first fire department in the country to completely motorize at one time to East Liverpool, O.

They now have one company into the congested district in thirty seconds, three companies in less than three minutes and one company in any part of the city in less than three minutes, thus increasing the efficiency of the department at least 65 per cent.

Motor fire apparatus is three times quicker than horses. This is the secret of successful fire fighting and was the reason why they proceeded from the volunteer to the paid fire department, from the hand to horse-drawn apparatus and finally to motor fire apparatus.

Motor apparatus will get out of the house in from four to eight seconds, while with horses the best time made in this department is twelve seconds. In going up hills they are compelled to walk our horses, as the load is too heavy to drive fast. The motor will make from twenty to thirty-five miles per hour going up the hills. In coming down these hills it is necessary to stop and place a shoe under the wheels and then take it out at the bottom. With motor apparatus it is possible to go down hill at the rate of from ten to fifteen miles an hour without delay and at the same time have better control than with horses.

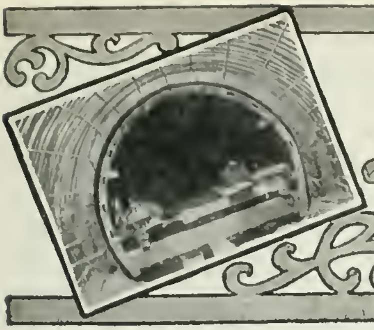
Motor fire apparatus is more reliable than horses. The truck has gone thru mud axle deep and thru thirty inches of snow at the rate of twenty miles an hour, while horses were compelled to walk or go a few yards and then rest. It has gone thru the same mud as the horse apparatus and then pulled the horse apparatus out of the same. It has pulled the horse apparatus out of the snow for over a mile when the latter was disabled. We have gone down 11 per cent. grades, covered with ice, while the horses shod sharp would slide all over the street. Horses, while crossing street railway tracks, will slip and fall, breaking their legs and injuring men. Horses will run away, harness will break, snaps part or come unsnapped. With motor apparatus you have three ways to control these things—one by the foot brake, one by the emergency brake and one by throwing the motor in first or second speed and braking on the motor.

The largest number of accidents with motor apparatus is in turning corners. These have been eliminated by making the driver responsible for any accident. He must turn them slowly, the same as with horse apparatus.

You can train horses every day to come to their harness, and yet they are not reliable. They may come out, turn around and run back in the stall; they may come out and knock down their harness; they may be headstrong and not get under the harness. With the late motor apparatus there are the electric starter, also two separate and distinct ways of ignition. So, if one fails, the other can be relied upon.

The motor-driven triple combination chemical engine, hose wagon and fire engine, which was furnished by the Robinson Fire Apparatus Manufacturing Company, St. Louis, Mo., develops 110-h.p. actual brake test, driving the pump at full capacity with perfect ease and without overload. It also gives abundant power for hill climbing or pulling thru mud or snow. It has vertical-type six cylinders cast in pairs, 6¼-inch bore, 6¾-inch stroke. The pumps are of the latest Robinson design, triplex piston of solid bronze, having a capacity of 1,000 gallons per minute against 120 pounds of pump pressure.

The three motor-driven combination chemical engine and hose wagons, which were also furnished by the Robinson Fire Apparatus Manufacturing Company, St. Louis, develop 80-h.p. actual brake test. This gives abundant power for hill climbing or pulling thru mud or snow. They have vertical-type four cylinders cast in pairs, 6¼ by 6¾ inches.



SANITATION

Sewage Disposal at Chambersburg, Pa.

The electric light plant, the water supply system, the sewer system and sewage treatment plant of Chambersburg, Pa., are owned and operated by the municipality.

Before any work was attempted, council employed an up-to-date boro engineer, who made necessary surveys for the water and sewerage improvements. Consulting engineers were also employed to design the water supply system, sewer system and sewage treatment plants. Plans were made, specifications written, contracts advertised, awarded and carried out on a strictly business basis. Mr. R. M. Huber, the boro's engineer, had immediate charge of all work during the construction period. He had in consultation, for the water supply, the Birkenbine Engineering Offices, Philadelphia, Pa., and for the sewer system and sewage treatment plant, Albright & Mebus, also of Philadelphia.

The water supply is taken from a stream in South Mountain at a point eleven miles from the boro limits. The water-shed lies entirely within the State Forest Reservation, and the water needs no treatment or mechanical lifting. In addition to the main from the mountains, a 2,000,000-gallon storage reservoir and a standpipe were constructed. The cost of the water supply system was over $150,000.

The sewer system presented many difficulties by reason of the fact that the boro is trisected by two creeks, the Conococheague and Falling Spring. These streams have but a slight fall, and their banks are built up to the water's edge. The main outfall sewer, thru the business section, is constructed above the high-water line, on top of a concrete retaining wall at the side of the creek. From a civic improvement standpoint alone, this sewer is worth its cost to the boro, as thereby an unsightly creek bank has been completely transformed and made an attractive feature in the center of the town. The main sewer follows the general course of the Conococheague creek for almost two miles, when it crosses under the creek by an inverted siphon 960 feet long, which terminates in a collecting well, from which the sewage is forced by centrifugal pumps (electrically controlled and driven) thru a force main to the treatment plant, distant about 900 feet.

The sewage treatment plant occupies a side hill position, favorable for placing the several units, which consist of settling tanks, a sprinkling filter, secondary settling tanks and a sand filter for drying the sludge from the settling tanks.

The disposal plant consists of two settling tanks, dosing chamber, sprinkling filter bed, secondary settling tank, and sand filter for sludge.

The settling tanks are of Emscher type, circular in plan, built in pairs, and to be used in series. The extreme depth of each tank is 26 feet 4 inches below the weir line. The diameter of the sludge compartment is 26 feet and the extreme width at the top is 36 feet. The settling compartment is 28 feet wide at the top, has an extreme length in plan of 69 feet, and has a depth below water line of 16 feet 9 inches. The capacity of this compartment is approximately 17,000 cubic feet, or 2 hours 10 minutes flow at a maximum flow of 1,000 gallons per minute.

The sewage enters the settling tanks thru four submerged inlets, passes under a wooden baffle in each tank, over a weir between the two tanks, and out thru four submerged outlets to the channel and pipe line leading to the siphon chamber. The force main leads to both ends of the settling tanks, and is equipped with sluice gates set in a manhole, so that the sewage may be passed in at either end and discharged at the opposite end. The purpose is to reverse the flow at regular intervals, so each sludge compartment will receive the same amount of sludge. The channel between the two tanks may also be opened and only one tank used.

The floor of the settling compartment makes an angle of 45 degrees with the

VIEW *of the Imhoff tanks of the sewage disposal plant at Chambersburg, Pa.*

horizontal, sloping from both sides down toward the longer axis of the tanks. The sloping sides do not meet at the apex, but form an opening of 8 inches next to each side of a wedge-shaped beam, running along the center line of the tanks. The openings allow the sludge settling on the sides to slide down into the sludge well, and the base of the wedge-shaped beam prevents the gases arising from decomposition going up thru fresh sewage, but they are deflected and pass thru the sludge compartment and out thru openings on the sides of the settling compartment.

The floor of each sludge compartment or well is an inverted cone. The sludge is removed thru a cast-iron sludge removal pipe, set in the wall at the apex. The head of water available for forcing out the sludge is 10 feet. The discharge end of the sludge removal pipe is placed in a manhole on a 10-inch terra cotta drain leading to the sand filter for sludge. The sludge wells have a capacity of four months for 12,000 people.

The dosing chamber has a capacity of 9,000 gallons and is fitted with a Miller automatic flushing siphon capable of delivering sewage to the Taylor hexagonal nozzles at the rate of 2,000 gallons per minute for the head, varying from 5 feet to 18 inches above the orifices of the nozzles. Piping and valves are to be provided, so the dosing chamber may be emptied on the sludge bed and the sewage by-passed to the nozzles.

The sprinkling filter bed has an area of 0.46 acre, and is 160 feet 3 inches long and 125 feet wide on top. The bed is of such size that it will be dosed at the rate of 1,700,000 gallons per 24 hours, at a maximum rate of flow. A cast-iron feed pipe, 18 inches in diameter (but terminating in 14-inch pipe), leads from the siphon chamber to and along the upper side of the bed. From the feed main cast-iron lateral distributing pipes, beginning with 8-inch and ending with 6-inch, are laid thru the body of the bed about 3 feet below the surface of the stone. Each lateral pipe has a valve inserted near the feed pipe, so any line of nozzles may be cut off at will. The spacing between the lateral pipes is 11 feet 3 inches, center to center, and the spacing of the riser pipes which feed the nozzles is 13 feet, center to center. There are 126 full and 14 half nozzles of the Taylor patent.

The filtering material is crushed limestone, ½ to 4-inch sizes, carefully cleaned and spread to a depth of 6 feet at the upper end and 6 feet 9 inches at the lower, next to the collecting channel. The outside supporting walls on three sides are of rough stone, laid up dry. On the upper side there is a light concrete wall, which acts merely as a dividing wall between the earth and crushed stone. The floor and collecting channels are of concrete. The underdrains are made of cement and sand. The design provides ample openings for ventilation thru the stone, and, in addition, each row of tile is ventilated at the upper end by a 3-inch terra cotta pipe brought to the surface. Flushing may also be done thru these vents.

The effluent from the sprinkling filter is collected by a concrete open channel at the lower side, and is conducted to three small settling tanks having a combined capacity of about 45,000 gallons. The tanks are 15 feet wide, 50 feet long and 4½ feet deep. The floor slopes to sumps, from which the sludge is forced out thru a sludge pipe to the sand filter by the head of water that may be obtained by filling a tank. The top walls of the channel and second settling tank are above the level of high water. The effluent from the sand filter and the secondary settling tanks is discharged in deep water in the creek.

Three-inch riser pipes are set in the

6-inch and 8-inch distributing pipes in the filtering material. Bronze nozzles of the Taylor type for hexagonal areas were used. The sprinkling filter stone varies in size from 1½ inches to 3 inches. This material was properly cleaned and screened. No teaming was allowed over the filter bed, the media being placed from industrial cars and tracks. The top level of the media was fixed at 6 inches below the orifices of the nozzles.

The sand filters for sludge are rectangular in plan and are 60 feet by 90 feet inside bottom dimensions. The sides are earth embankments with slopes of 2 to 1. The soil was removed from the natural surface before the embankments were built in 6-inch layers, which were thoroly compacted by rolling. The floor of the sludge bed is ridged and the 6-inch terra cotta drain pipes are laid in the troughs. The underdrains are laid to grade. A layer of crushed stone, size 1½-inch, was laid over the floor of the sand bed so as to fill the valleys between the ridges. On top of the 1½-inch stone a 3-inch layer of smaller stone, varying in size from ¼ to ½ inch, was spread. On top of this smaller layer a course of clean sand was spread.

Garbage Disposal in Chicago

The question of garbage disposal has reached an acute stage in Chicago, the dispute between the city and the former contractor for disposal and the inability of the city authorities to decide upon new methods of disposal have continued until the old contract expired and have resulted in a refusal of the contractor to continue pending settlement of the question, so that now the property owners are begged to dispose of the garbage as nearly as possible upon their own premises, and the city is treating with chemicals what it must collect before dumping it in abandoned clay holes.

The discussion has resulted in the presentation of much information of greater or less value upon the comparative values and costs of various methods of disposal. The following figures are taken from comparative estimates made by M. de Ronore, of Paris, France, who is the general manager of the French company which has developed the mixed method of garbage disposal which was described in a recent number of MUNICIPAL ENGINEERING.

An assumption of 1,000 tons of material for disposal per day is made, of which, according to the Parisian average, 40 per cent. will be garbage and street sweepings and 60 per cent. dry combustible rubbish. The average cost for incineration of wet garbage is said to be $2 a ton and that of incinerating a mixture of equal parts of dry waste and wet garbage over 50 cents a ton. The dry combustible rubbish has a calorific value one-fifth that of good coal while the mixture with garbage has no calorific value.

The mixed method of garbage disposal produces a fertilizer weighing about 20 per cent. of the garbage treated, this weight being about one-half that of the portion of the garbage reducible to fertilizer. The remaining three-fifths of the mixture is burned and produces electrical energy. The cost of a plant of twelve groups, each group with a capacity for 10 tons per hour is estimated as follows:

Land, 4.5 acres to be furnished by city is not included.

Buildings for the plant......	$ 300,000
Offices and lodgings	60,000
The Mechanical Installations—	
Wagon-loading apparatus.....$	60,000
Sorting, crushing, etc., machinery	80,000
Producer system incinerators..	220,000
Boilers	120,000
Electrical machinery	180,000
Expenses, loading, freight, etc., on construction materials and machinery	30,000
Paving about plant..........	50,000
Conduits and pipes for water and electricity	80,000
Side track	40,000
Miscellaneous	40,000
Contingencies	80,000
Total estimated cost of plant..	$1,340,000

The cost of operation of this plant is not stated, but the amount of labor required is estimated at somewhat less than twice that required in an incinerator plant and about one-fifth that required for a reduction plant of about the same capacity.

The income from the plant using the mixed method is estimated as follows:

The 400 tons of organic matter per day will produce 200 tons of fertilizer or 73,000 tons per year, this is valued at $5 a ton, or $365,000 a year. The combustible waste is estimated to produce 50 k.w.-hr. of electricity per ton and the 600 tons per day (219,000 tons per year) would produce 10,950,000 k.w.-hr. per year. Deducting 2,190,000 k.w.-hr. required about the plant leaves 8,760,000 k.w.hr. for sale, which, at 2 cents would produce $175,200. The total gross income from the plant for year would therefore be $530,200. In addition there would be income from sale of rags, metals, etc., recovered.

These estimates may not fit American conditions exactly but can be modified to fit them and are certainly interesting. Even after deducting an expense of operation equal to that of running an incinerator plant with the addition of the greater labor cost in the mixed method plant, at say $1 a ton incinerated, a handsome profit remains for the mixed method.

MISCELLANEOUS

Settlement in Randolph Street, Chicago

On December 2, 1913, at 10:45 p. m., the Chicago Water Department received an emergency call to Randolph street, between Wabash avenue and Holden court, that a main was broken. It was shut off by 11:05 and examination showed that some of the joints in the 12-inch pipe laid in the street had pulled apart due to the caving in of the excavation made for an addition to the Marshall Field building.

Necessary repairs were made at once and the main was put in service, tho it was necessary to shut it off late while repairs to the sewer, made necessary by the cave-in, were made a day or two later.

Careful examination of the cave-in was made at once by Hugh E. Young and A. B. Callander, representing the city engineer, and H. C. Lummis and H. T. Cooper, representing Mr. Weston, and by a commission consisting of George Weston, John Ericson and John A. Dailey.

This investigation showed that the excavation for the basement and foundation of the addition to the Marshall Field building had proceeded to a depth of about 34 feet below the sidewalk level and had been extended out to the curb line. The columns supporting the building extended down some 8 or 10 feet deeper and supported the basement floor 13 feet below the sidewalk and the sub-basement floor 29 feet below it. Sheet piling made up of fabricated sections composed of No. M-102 and a 12-inch 40-lb. I-beam, had been driven at the curb line to a depth of 48 feet, or about 15 feet below the bottom of the main excavation of the basement, but the excavation had been carried about 9 feet deeper in a trench next the sheet piling, such trench being perhaps 8 feet wide, and the bottom of this trench was only 6½ feet above the bottom of the piling. Footings for the sheet piling to carry the floor loads coming on it were not provided on this Randolph street side of the building, tho they were provided on the Washington street section, the omission said to have been by mistake.

The sheet piling was braced by the sidewalk floor beams at the top; by 15-inch 65-lb. I-beams, reinforced, in the plane of the basement floor, 13½ feet down, by 15-inch I-beam knee braces on each side of the floor beam and supporting a tile floor; and by 15-inch 42-lb. I-beam struts at the sub-basement level, 15 feet farther down. The trench excavation extended below the subway floor line, 14 feet still farther down, but there was no bracing here nor at the base of the sheet piling. This excavation was presumably made for the purpose of building the subway floor from the sheet piling to the columns of the building.

The bracing beams all extend from the sheet piling to the building columns, into which they are framed, being connected to the sheet piling by angles. The beams in the sub-basement floor, which act also as struts, were incased in a 14-inch plain concrete floor, part of which had fallen out after the accident, the remainder being readily picked out.

Between the first two columns counting west from Wabash street the excavation had been made only slightly below the sub-basement floor, and there was practically no settlement at the first column and but little at the second. The trench next the sheet piling had been excavated from about the third column on west to the court, and here the settlement was serious, the sheet piling having moved in toward the building from a few inches to 3 feet at the level of the bottom of the general excavation, which was, as stated above, about 5 feet below the sub-basement floor.

At the level of the sub-basement floor the movement was from several inches to 2 feet, and the floor beams embedded in the concrete had buckled entirely out of line, some of them falling to the plank floor laid on the ground below.

At the level of the basement floor the movement was also toward the building and the floor beams were buckled out of line.

At the sidewalk level the sheeting had moved out from the sidewalk and former curb line.

At the same time it was found that the sheet piling had sunk from some inches to 2 feet along Randolph street, and less than ½ inch along the Wabash street side. The sidewalk along Randolph street had settled from a few inches to 3 feet.

From the conditions shown above and the further assumptions that the angle of repose of the earth fill in the street would be 30 degrees with the horizontal and that its weight was 111 pounds per cubic foot, also that there was no hydrostatic pressure, tho below the city datum, no live loads and no weights of adjacent buildings, it was computed that the sheet piling, unbraced at the bottom, was wholly unable to carry the load, the pressure on the sub-basement floor beams, for example, being seven and one-half times their ultimate strength. After these beams failed the load on the basement floor beams became 1.3 times their ultimate strength, and would have been fully three times that strength if the sheet piling could have transmitted it, not considering the eccentricity of the load.

The bearing value of the sheet piling was only 0.685 of the loads on it, showing that when sheet piling is used to carry floor loads, as in this building, it should have adequate footings, friction on the mud or wet clay found below datum being too uncertain.

The excavation of the trench along the piling without sufficient temporary bracing at sub-basement and subway levels is held responsible for the lateral movement of the earth, and the consequent settlement of the street, the former showing a movement of 265 cubic yards and the latter of 300 cubic yards.

There is a 30-inch brick sewer in Randolph street, with double ring invert and single ring arch, which is 32½ feet north of the south line of the street. After the accident water ran into this sewer from both ends, and thence by some connection thru a chute into the Illinois tunnel. The sewer was dammed off on the day following the accident and the work of relaying it was begun on the next day, the John Griffiths & Son Co., contractors for the building, doing the work or contracting for it. About 170 feet of the sewer was reconstructed, the settlement for about 100 feet of this distance being nearly or quite 4 feet vertically and the maximum lateral movement about 1 foot.

The brick work of the old sewer was excellent and showed no breaks or distortion of cross-section, even after the settlement, the joints being somewhat loosened where the settlement was a maximum.

Neither sewer nor water main were in any way responsible for the break; on the other hand, the settlement and movement of the earth was responsible for the breaks in the water main and the settlement of the sewer.

The pavement was buckled by the moving outward of the upper ends of the piling and was settled out of shape by the settlement of its supporting earth.

An Engineer for the Interstate Commerce Commission.

The American Institute of Consulting Engineers has written a letter to President Wilson giving him a number of good reasons for appointing an engineer as one of the members of the Interstate Commerce Commission, first assuring him that the Institute has no candidate to present. The leading part taken by the engineer in the location, construction and operation of railroads, his familiarity with all the details of the complex problems involved in the economics of railroad construction and operation and in their application to railroad rate determination, his intimate knowledge of all the problems coming before the commission, from safety appliances to rate regulation, are emphasized. It is also stated that in addition to this knowledge and experience the engineer appointed should have a judicial temperament, executive ability and tact.

The New York State Asphalt Inquiry

Inquiry of those mentioned in the investigation of the methods of manipulating specifications for asphaltic materials for use on the roads constructed under the New York State Highway Commissioner has brought a letter from D. T. Pierce of the Barber Asphalt Paving Company, from which the following extracts are taken to show the position they occupy in the controversy:

"The highway specifications in the State of New York cover materials of all kinds, including 'natural solid asphalt' and oil asphalt. For a large amount of work both the oil asphalts and the natural asphalts are specified. This company has never had and never sought a monopoly; and if it did seek it, it has never obtained it, since the awards for oil asphalts far exceed those for natural asphalt, namely, Trinidad or Bermudez.

"Last summer, about June, the Warner-Quinlan Company set up the claim that it should be allowed to supply Montezuma asphalt, an oil product, under the natural solid asphalt specification. It claimed that Montezuma was a solid natural asphalt, although it is admittedly made from Mexican petroleum, which, of course, is a liquid. The attempt to substitute Montezuma for natural asphalt was considered by the Highway Department; some oil asphalt was accepted under the natural asphalt specification, and then the department refused to accept any more of it.

"When the administration changed and Mr. Carlisle became highway commissioner, he notified all contractors that the specifications must be lived up to, and that no oil asphalt would be accepted under the natural asphalt specification. Following this decision the Warner-Quinlan Company brought charges against the commissioner, alleging unfair discrimination, because, as stated, the commissioner refused to accept oil asphalt under the natural asphalt specification; the Warner-Quinlan Company contending that its asphalt, tho made from liquid petroleum, is a solid; that is, that it is as solid as, or more solid than, the natural asphalt.

"I have given the claims of the two sides as fairly as I know how to do it.

"The charges against Mr. Carlisle, heard by a commission appointed by the Governor, developed in the course of the hearings that the Warner-Quinlan Company could have delivered solid natural asphalt if it had desired to do so, but that it preferred naturally to substitute oil asphalts, the cost of which is far less than the cost of natural asphalt, which it had supplied to the State in large quantities prior to obtaining supplies of Mexican oil. It is our intention in due course to present a very full statement regarding this whole matter, as the company's position and the facts of the case have been grossly distorted."

Designers of the Atlanta Sewage Disposal Plants

The photograph of Dr. Karl Imhoff, Superintendent of Construction R. M. Clayton and Assistant Superintendent of Construction W. A. Hansell, Jr., on page 521 of the December number has a caption naming these gentlemen as "The engineers responsible for the Atlanta sewage disposal plnat."

Mr. Hansell writes to say that Dr. Rudolph Hering, then of the firm of Hering & Fuller, was the designer of the plant and that Mr. Clayton and himself are entitled only to credit "for the carrying out of this splendid design." The desire of these engineers to give full credit to Dr. Hering is most commendable, but the article and the statements in it are regarding the construction and the responsibility of the city's engineers for the excellent results obtained, which are due largely to their good judgment in securing the services of Dr. Hering, but are also due largely to their own intelligent, painstaking effort in carrying out the plans obtained as the result of that judgment.

Cameron Patents on Septic Process Owned by Cameron Septic Tank Co.

The Editor of MUNICIPAL ENGINEERING:

Sir—In your December issue a letter appeared under the heading, 'Patents on Springfield Sewage Disposal Details," signed by the Sterilization Company, Newark, N. J., in which the statement is made that the Cameron septic process patent is controlled by that company.

The statement is not true, and as the Sterilization Company, ignoring our written request to retract it, has failed to do so, we ask that you publish this letter as notice to your readers that the statement referred to is entirely unwarranted, and further, that ownership and control of the Cameron septic process patent is vested in the undersigned.

H. D. WYLLIE,
Manager Cameron Septic Tank Co.

New Orleans Water Filtration.

George G. Earl, general superintendent of the New Orleans Sewerage and Water Board, calls attention to the omission of New Orleans from the list of Southern cities filtering their water supplies, published in the December number, and the unintentional slip of memory is hereby acknowledged with thanks to Mr. Earl for his courtesy.

The Road Builders' Convention

The American Road Builders' Association held a very successful convention at Philadelphia, December 9 to 12. Over 2,500 registered, all actually interested in road building, and the attendance at the meetings was large. Nearly a hundred manufacturers and dealers were represented in the exhibits, including the following:

Acme Machinery Co., Frankfort, N. Y.

American Rolling Mill Co., Middletown, Ohio.

Amies Road Co., Easton, Pa.

Art Stone Co., Waynesboro, Pa.

The Autocar Co., Ardmore, Pa.

The Bain Wagon Co., Kenosha, Wis.

R. D. Baker & Co., Home Bank Building, Detroit, Mich.

Barber Asphalt Paving Co., Land Title Building, Philadelphia, Pa.

Barrett Manufacturing Co., New York.

Blanchard & Hubbard, Consulting Engineers, Broadway, New York City.

Bausch & Lomb Co., Rochester, N. Y.

Bucyrus Co., South Milwaukee, Wis.

Buff & Buff, Jamaica Plains, N. Y.

Buffalo-Pitts Co., Buffalo, N. Y.

E. E. Buhler & Co., 103 Park avenue, New York.

The Philip Carey Co., Cincinnati, Ohio.
J. I. Case T. M. Co., Racine, Wis.
Champion Wagon Co., Oswego, N. Y.
Clip-Bar Mfg. Co., 2546 Oliver street, Philadelphia, Pa.
Columbia Wagon Co., Columbia, Pa.
Concrete Form and Engine Co., Detroit, Mich.
The Dolarway Paving Co., 17 Battery place, New York City.
The Dunn Wire-Cut Lug Brick Co., Conneaut, Ohio.
The Dustoline for Roads Co., Summit, N. J.
Eagle Wagon Works, Auburn, N. Y.
A. B. Farquhar, York, Pa.
The Frick Co., Waynesboro, Pa.
Galion Iron Works and Mfg. Co., Galion, Ohio.
Good Roads Machinery Co., Kennett Square, Pa.
W. & L. E. Gurley, Troy, N. Y.
The William Hartranft Cement Co., Inc.
Hassam Paving Co., Worcester, Mass.
Headley Good Roads Co., Real Estate Trust Building, Philadelphia, Pa.
Huber Mfg. Co., Marion, Ohio.
R. W. Hunt Co., Consulting Engineers, Chicago, Ill.
Charles Hvass & Co., 509 East Nineteenth street, New York City.
Ingersoll-Rand Co., 11 Broadway, New York.
Ingraham-Richardson Enameled Sign Co., Beaver Falls, Pa.
Iroquois Iron Works of Barber Asphalt Co., Buffalo, N. Y.
The Jennison-Wright Co., Toledo, Ohio.
Kent Machine Co., Columbus, Ohio.
Kentucky Wagon Mfg. Co., Louisville, Kentucky.
Keuffel & Esser Co., Hoboken, N. J.
The Knickerbocker Co., Jackson, Mich.
Koehring Machine Co., Milwaukee, Wis.
The Lansing Co., Lansing, Mich.
Lehigh Portland Cement Co., Allentown, Pa.
Link Belt Co., Nicetown, Pa., and Chicago, Ill.
Locomobile Company of America.
McAvoy Vitrified Brick Co., 1345 Arch street, Philadelphia, Pa.
Merchant & Evans Co., Arch street, Philadelphia, Pa.
Alexander Milburn Co., Baltimore, Md.
Marion Steam Shovel Co., Marion, Ohio.
National Paving Brick Manufacturers' Association, Cleveland, Ohio.
Oliver Chilled Plow Co., South Bend, Ind.
Packard Motor Car Co., Detroit, Mich.
W. H. Pickett Co., Inc., 214 Harmon Building, Philadelphia, Pa.
Rapid Mixer Co., Grand Rapids, Mich.
Robeson Process Co., Pennington, N. Y.
Rocmac Road Corporation of America, Lafayette Building, Philadelphia, Pa.
J. J. Shannon, 1744 Market street, Philadelphia, Pa., representing Chicago Concrete Machinery Co., and T. L. Smith Co., Milwaukee, Wis.
Standard Oil Co., Broadway, New York.
Steel Protected Concrete Co., Philadelphia, Pa.
Tarrant Manufacturing Co., Saratoga Springs, N. Y.
The Texas Co., 17 Battery place, New York City.
The Thew Automatic Shovel Co., Lorain, Ohio.
Troy Wagon Works, Troy, Ohio.
Trussed Concrete Steel Co., Detroit, Mich.
Waring Underwood Co., Commercial Trust Building, Philadelphia, Pa.
Union Iron Works, Hoboken, N. J.
United Gas Improvement Co., Philadelphia, Pa.
United States Asphalt Refining Co., 90 West street, New York.
United States Wood Preserving Co., 165 Broadway, New York.
Universal Road Machinery Co., Kingston, N. Y.
Universal Portland Cement Co., Chicago, Ill.
Warner Quinlan Asphalt Co., 79 Wall street, New York.
Warren Bros., Boston, Mass.
Warren-Knight Co., Philadelphia, Pa.
Waterloo Cement Machinery Corporation, Waterloo, Iowa.
Watson Wagon Co., Canastota, N. Y.
Wheeling Corrugating Co., 402 Broad street, Philadelphia, Pa.
Wheeling Mold & Foundry Co., Wheeling, W. Va.
Wiard Plow Co., Batavia, N. Y.
Yellow Pine Manufacturers' Association, St. Louis, Mo.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

January 7—Civil engineer student in Office of Public Roads, Department of Agriculture, at $720 a year.

January 7, 8—Topographic draftsman and copyist topographic draftsman at $1,000 to $1,500 and $900 to $1,500 a year, respectively.

January 21, 22—Bureau of Standards, Department of Commerce; laboratory assistant at $900 to $1,200 a year; aid at $600 to $720 a year; laboratory assistant in petrography at $1,200 a year.

January 21, 22, 23—Inspector of mechanical and electrical engineering, office of Supervising Architect of the Treasury, at $2,000 a year.

February 4—Topographic aid under Geological Survey during field season at $40 to $75 a month.

February 5, 6—Junior topographer in Geological Survey at $720 to $1,200 a year.

Technical Schools

The civil engineering department of the University of Illinois announces a short course in highway engineering to be given from January 19 to 31. It is intended as a help to the new county superintendents of highways and is open without charge to all who aspire to positions as county or township road supervisors. Three or more lectures each day, laboratory work in testing and examining road materials, use of road machinery, are included in the program.

The University of Illinois has published a revised and enlarged edition of "An Extension of the Dewey Decimal System of Classification Applied to the Engineering Industries," which it will send for 50 cents.

The College of Engineering of the University of Wisconsin is making tests to determine the rate and amount of flow of water thru concrete with special reference to methods of making concrete water-tight. Some interesting results have already been obtained and studies are in progress of variations in percentages of material, gradations of sizes of rock, gravel and sand, methods of mixing, etc.

The announcements of the Columbia University graduate course in highway engineering show that the courses are given in periods of 2 to 4 weeks each so that men at work can take them during brief leaves of absence. Suggestions of such groups of courses covering various periods of time are made by the department and can be obtained of Frank D. Fackenthal, the secretary of the university. Two winter periods of four months each are required for the master's degree. The Davis library of highway engineering is said to be the most complete collection of books on highway engineering and allied subjects in this country.

Technical Associations

Col. George W. Goethals, chief engineer of the Isthmian Canal Committee, has consented to act as honorary president of the International Engineering Congress to be held in connection with the Panama-Pacific International Exposition in San Francisco, Cal., in 1915 under the auspices of the five national engineering associations. The sessions will be held during the week of September 20-25, 1915, and will be in charge of eleven sectional organizations. W. F. Durand, Foxcroft building, San Francisco, Cal., is chairman of the executive committee.

At the meeting of the New England Water Works Association on December 10 papers were presented by X. H. Goodnough, chief engineer of the State Board of Health, on "Rainfall"; N. W. Akimoff of Philadelphia, "On Flow in Bends"; H. P. Letton of Washington on "Small Water Purification Plants," a plea for their more efficient operation; and there was a topical discussion on methods of locating hidden leaks in underground pipes with special reference to pipes whose actual location is unknown.

The Indianapolis-Lafayette section of the American Institute of Electrical Engineers at its meeting December 5 heard a paper by Richard Fleming on "Applications of Electro-Chemistry to Industry."

The National Conference on Concrete Road Building, to be held in Chicago February 12, 13 and 14, in conjunction with the cement show, has published a long list of prominent engineers, educators and others as members of its advisory committee, of which W. F. M. Goss is chairman and J. P. Beck, 72 West Adams street, Chicago, is secretary.

The National Brick Manufacturers' Association will meet in New Orleans, March 2 to 7, the week following Mardi Gras. A special trip to Panama can be taken at the close of the convention.

The annual meeting of the Brooklyn Engineers' Club was held December 11 and the annual dinner on December 18. E. J. Fort was elected president and Joseph Strachan was re-elected secretary.

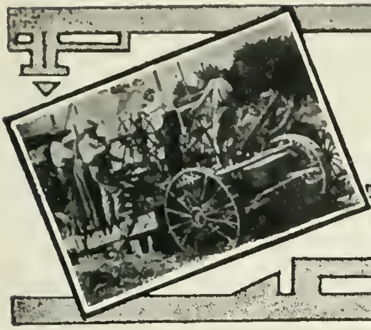
The American Highway Association will hold its next meeting with the American Road Congress at Atlanta, Ga., October 19 to 26, 1914. J. E. Pennybacker, secretary, Washington, D. C.

The American Wood Preservers' Association will hold its convention in New Orleans January 20 to 22.

At the December meeting of the Colorado Association of members of the American Society of Civil Engineers the discussion on the valuation of public utilities was continued. Leonard Metcalf of Boston was present and contributed thereto.

Personal Notes

In August, 1913, J. W. Howard, consulting engineer on pavements, a resident of Newark, N. J., made a report upon the plans and specifications of a wood block pavement proposed for Newark, which was used as the basis of a veto by Mayor Jacob Haussling of Newark, of the ordinance ordering the paving. Chief Engineer M. R. Sherrerd made some remarks at a public meeting of the Board of Street and Water Commissioners following the veto which were published in the daily papers of the following day. These statements are held by Mr. Howard to have caused him to suffer in his reputation and to lose the good will and trade of many persons, cities and officials of cities, and he has entered suit, claiming $10,000 damages therefor.



MACHINERY AND SUPPLIES

Creosoted Wood Block Paving in New York

By H. W. Durham, Chief Engineer in Charge of Highways, Borough of Manhattan, City of New York.

The first creosoted wood block pavements in the borough of Manhattan, city of New York, were laid in 1904 on Warren street, between Broadway and Greenwich streets; Twentieth street, between Broadway and Fifth avenue; Ninety-Eighth street, between Central Park West and Columbus avenue. These three streets were selected as representing a heavy, medium and light traffic, and the pavements were laid with the idea of observing the wear under the three different conditions.

These blocks were impregnated with a mixture of creosote oil and resin, equal parts, about twenty pounds of the mixture being injected into a cubic foot of wood. The size of the blocks was 3 inches wide, 8 inches long and 4 inches deep. They were laid close together, the joints being filled with a cement grout or sand on a bed of cement mortar ½ inch thick, which in turn was laid on a concrete foundation 5½ inches thick of the proportions of one part of cement, three of sand and five stone. Very few repairs have been made on these streets to date, although they have been subjected to exceedingly severe service.

During the year 1910, 3.57 miles of creosoted wood block pavement was laid, as against 2.29 in 1909. The principal work was on Delancey street, from the Bowery to the East river, excepting a small portion at the bridge entrance. A contract

CREOSOTED WOOD BLOCK PAVEMENT *on a New York heavy traffic business street with single car track.*

was let in that year which was carried out early in 1911 for paving with creosoted wood block the extension of Delancey street from the Bowery to Lafayette street, so that when it was completed there would be a first-class pavement the whole length of Delancey street. The work in 1910 cost $3.20 per square yard, as against $3.34 in 1909.

Those pavements completed in 1910 were yellow pine four-inch blocks; foundation 5½ inches, binder ½ inch cement mortar on the following streets:

A committee appointed by the Board of Estimate and Apportionment, consisting of the pavement engineers of the different city boroughs, together with the chief engineer of the board and the chief engineer of the Finance Department, to prepare a standard specification for creosoted wood block pavement, have adopted a specification omitting resin entirely and having the following requirements for the treatment of blocks:

The blocks shall be so treated with an oil elsewhere described that the pine blocks shall contain not less than 20 and the gum blocks not less than 22 pounds per cubic foot. After treatment the blocks are to show such waterproof qualities that after being dried in an oven at a temperature of 100 degrees C. for a period of 24 hours, weighed and then immersed in clear water for a period of 24 hours and again weighed, the gain in weight is not to be more than 3½ per cent. for pine blocks and 4½ per cent. for gum blocks.

The oil with which the blocks are to be treated shall be a stable, antiseptic and waterproofing oil, from which the

Location.	Former Pavement.	Length.	Width Paved.	Yardage.	Price per sq. yd. inc. foundation.
Avenue A, Houston to 24th	Houston-23rd, G. B. 23d-24th, Belg.	5,919	42	22,982	$3.09
Bedford st., Houston to Grove	Granite Block	1,256	20	2,835	3.35
Cannon st., Rivington to Houston	Belgian Block	814	25	2,287	3.50
Delancey st., East to Ridge	Belgian Block	2,215	21 to 60	7,567	3.31
Delancey st., Essex to Chrystie	Granite Block	1,571	81	13,109	3.39
Lewis st., Grand to Delancey	Belgian Block	666	26	1,898	3.50
Washington Sq. S., Wash. Sq. E. to Wash. Sq. W.	Sheet Asphalt	1,010	32 to 27	3,295	3.42
1st ave., 25th to 26th, 28th to 29th	Sheet Asphalt	453	60	3,000	3.03
2nd ave., 23rd to 37th, 48th to 53rd	Belgian Block	4,960	45	25,090	3.50

During the year 1911 4.63 miles of creosoted wood block paving was laid on completed contracts and 1.22 miles on contracts in progress at close of the year, making a total of 5.85 miles laid during 1911. These pavements were laid on streets with slight grades, where the traffic was heavy and a smooth pavement was desired. The average cost per square yard on a six-inch concrete foundation was $3.56, as compared with $3.20 in 1910 and $3.34 in 1909. These blocks, mostly yellow pine, were laid on a one-inch sand cushion on a six-inch concrete foundation on the following streets:

Location.	Former Pavement.	Length.	Width Paved.	Yardage.	Price per sq. yd. inc. foundation.
Avenue B, Houston to 14th	Sheet Asphalt	3,436	30	6,479	$3.58
Avenue C, Houston to 12th	Sheet Asphalt	2,821	30 & 42	7,880	3.53
Delancey st., 83 ft. w. of Chrystie to Bowery	Sheet Asphalt	185	106	1,467	3.53
E. B'dw'y, Scammell to Gouverneur	Sheet Asphalt	278	52	1,135	3.54
Kenmare st., Bowery to Lafayette	Sheet Asphalt	917	42	4,282	3.18
Lafayette st., 129 ft. near Spring	Granite Block	274	48	1,460	3.38
Norfold st., Hester to Houston	Sheet Asphalt	2,202	25	6,088	3.50
Pitt st., Broome to Houston	Sheet Asphalt	1,627	25	4,409	3.48
Sheriff st., Broome to Houston	Sheet Asphalt	1,626	26	4,465	3.48
Sullivan st., Canal to Wash. Sq. S.	Sheet Asphalt	3,702	32-32-24	9,978	3.41
2nd ave., intersection of 28th	Sheet Asphalt	77	60	342	3.74
2nd ave., 74th to 83rd	Sheet Asphalt	2,491	60	12,246	3.45
23rd st., 10th ave. to 11th ave	Granite Block	817	40	2,279	3.18½
34th st. (as widened), Madison to 8th ave.	Sheet Asphalt	3,066	53	12,854	3.54½
111th st., 5th ave. to E. Lenox ave	Asphalt Block	944	30	3,146	3.35

water has been removed by distillation, and which shall have a specific gravity of not less than 1.12 at 38 degrees C. When distilled in a manner hereinafter described the oil shall lose not more than 35 per cent. up to a temperature of 315 degrees C. The distillate between 255 degrees C. and 315 degrees C. shall have a specific gravity not less than 1.02, the said specific gravity being taken at a temperature of 60 degrees C.

The popularity of creosoted wood block as a paving material is illustrated by its present use. The city of New York alone awarded in 1912 contracts amounting to 320,000 square yards, while the amount laid in the United States previous to December 31, 1911, was 10,000,000 square yards, and it was estimated that 2,500,000 square yards was laid in 1912. The cost of this pavement varies according to local conditions and specifications, but it averages from $3.25 to $3.50 per square yard, the blocks being 4 inches deep, laid on a foundation of Portland cement concrete 6 inches thick.

The borough of Manhattan has three streets which have been out of guarantee three years—one of heavy traffic, one of medium traffic and one of light traffic. The heavy traffic has cost 7 cents per yard per year, while the average of all has been 6 cents per yard per year; but it should be explained here, as in the case of borough of Brooklyn streets, that the repairs have been due to wear and tear only on the heavy traffic street, which is a wholesale street in the business section. Repairs on the other streets are due to settlements over trenches, damage caused by fire and practically nothing to wear and tear of traffic.

In the borough of Brooklyn, New York City, the first creosoted wood block pavement was laid in 1902, without any guarantee, and has cost practically nothing for repairs. Some streets have been opened for subsurface work, and the engineer in charge of pavements states that in his opinion practically all of the repairs are due to settlements over trenches and damage caused by fires, and not from actual wear and tear of traffic. In this borough no expansion joints are provided for, and very little trouble has been caused by bulging when the material has been yellow pine and when the absorption test has been maintained. The result of this experience would seem to demonstrate that in the climate of New York City, at least, no expansion joint is necessary.

Our specifications, in brief, provide:

Kind of Wood—Southern long leaf yellow pine.

Size of Blocks—8 inches long, 3 inches wide, 4 inches deep.

Treatment (Character)—Oil to be a stable, antiseptic and waterproofing oil, from which the water has been removed by distillation, and which shall have a specific gravity not less than 1.10 at 38 degrees C.

Treatment (Amount)—20 pounds per cubic foot.

Cushion—One inch of sand.

Joint Filler—Sand.

Following is a tabulation giving lengths and areas of streets in the borough of Manhattan paved with creosoted wood blocks up to and including close of our 1912 contracts:

NAMES, LENGTHS AND SQUARE YARDS OF STREETS AND AVENUES IN THE BOROUGH OF MANHATTAN PAVED WITH CREOSOTED WOOD BLOCK.

Locations.	Length in feet.	Area square yards.
Avenue A, Houston to Twenty-fourth	6,239	22,982
Albany street, Washington to West	198	602
Avenue B, Houston to Fourteenth	3,436	6,479
Battery place, Broadway to West	670	8,200
Barclay street, Broadway to West	1,439	5,272
Bedford street, Houston to Grove	1,286	2,835
Beekman street, Nassau to Park Row	219	650
Bond street, Bowery to Broadway	1,024	4,200
Bowling Green, Whitehall to State	196	1,134
Bridge street, Whitehall to State	290	744
Broadway, Battery place to Vesey	3,083	15,291
Broome street, Centre to Broadway	313	925
Cannon street, Rivington to Houston	814	2,287
Carlisle street, Washington to West	198	338
Avenue C, Houston to Twelfth	2,821	7,880
Cedar street, 150 feet east of William to Pearl	357	754
Chambers street, Broadway to West	1,818	6,904
Church street, Liberty to Cortlandt	344	1,021
Church street, Cortlandt to Day	227	1,100
Church street, Intersection Day street	50	146

CREOSOTED WOOD BLOCK *paving on a New York heavy traffic business street with double car tracks.*

Church street, Day to Fulton	170	830
Church street, Fulton to Vesey	186	323
Church street, Vesey to Duane	1,793	3,949
Cleveland place, Broome to Sprin	528	1,498
Clinton street, South to East Broadway	1,235	3,817
Cortlandt street, Broadway to West	1,117	3,744
Delancey street, East to 112¼ feet east of Ridge	2,405	7,567
Delancey street, 68 ft. east of Essex to 84 ft. west of Christie	1,715	13,109
Delancey street, 83 ft. west of Christie to Bowery	185	1,467
Dey street, Greenwich to West	386	2,371
Duane street, Broadway to West	2,076	7,648
E. Broadway, Scammel to Gouverneur	276	1,135
E. Broadway, Chatham square to Grand	4,162	19,379
First avenue, 25th to 26th, and 28th to 29th	480	3,000
Fourt hstreet, Macdougal to Sixth ave	393	1,173
Fortieth street, 8th avenue to 10th avenue	1,746	5,899
Gt. Jones street, Bowery to Broadway	823	3,594
Greenwich street, Battery place to Dey	2,682	9,861
Greenwich street, Vesey to Chambers	1,273	4,571
Greenwich avenue, Bank to 8th avenue	940	3,582
Horatio street, Greenwich ave. to 8th ave	220	738
Houston street, Eldridge to Bowery	902	2,397
Hudson street, Jay to Worth	201	1,060
Houston street, Macdougal to Bedford	432	2,496
Jay street, Hudson to Staple	150	535
Jefferson street, E. Broadway to Henry	189	627
John street, Nassau to Broadway	359	888
Kenmare street (Delancey), Bowery to Lafayette	917	4,282
Lafayette street, 139 feet near Spring	274	1,460
Lewis street, Grand to Delancey	666	1,897
Liberty street, Broadway to West	1,031	3,046
Murray street, Broadway to West	1,623	6,176
Norfolk street, Hester to Houston	2,202	6,088
98th street, Central Park w. to Amsterdam ave	1,649	5,521
Old Slip, Water to Front	370	1,356
111th street, 5th avenue to Lenox	944	3,146
Park place, Broadway to West	1,541	6,499
Pitt street, Broome to Houston	1,627	4,409
Prince street, Broadway to Wooster	616	1,769
Reade street, Centre to West	2,494	8,802
Sheriff street, Broome to Houston	1,626	4,645
Spring street, Broadway to Sullivan	1,274	3,768
Staple street, Jay to Harrison	212	370
State street, Bowling Green to Whitehall	1,169	6,533
Stone street, Mill Lane to William	118	203
Sullivan st., Canal to Washington Sq. S	3,702	9,978

2d avenue, 23d to 37th, and 48th to 53d	5,155	25,090
2d avenue, intersection of 26th	77	342
2d avenue, 74th to 83d	2,491	12,246
Trinity place, Morris to Liberty	1,419	6,985
19th street, Hudson to West	955	2,659
13th street, 8th avenue to 10th avenue	1,698	6,001
12th street, Broadway to 5th avenue	972	3, 49
20th street, Broadway to 5th avenue	298	988
22d street, 6th avenue to 10th avenue	3,318	10,957
23d street, 2d avenue to 10th avenue	6,474	25,191
23d street, 10th avenue to 11th avenue	636	2,279
34th street, Madison ave. to 8th ave	3,066	12,854
Vesey street, Broadway to West	1,386	2,934
Warren street, Broadway to Greenwich	1,245	4,742
Washington Sq., S., Wash. Sq. E. to Wash.Sq. W	1,071	3,295
Washington street, Carlisle to Albany	232	638
W. Broadway, Dey to 4th	8,425	28,746
Water street, Montgomery to Scammel	524	1,482
Whitehall street, Bowling Green to S. Ferry	1,308	10,093
Worth street, Broadway to Church	492	1,644
2d avenue, 13th to 15th	578	2,670
2d avenue, 17th to 19th	568	3,380
18th street, Broadway to 6th avenue	1,377	4,630
28th street, 5th avenue to 9th avenue	1,676	5,490
Houston st., Lewis to Norfolk, and Manhattan st., Houston to 3d	2,893	11,730
Broadway, Columbus Circle to 78th	5,600	40,530
6th avenue, 42d to Central Park S	4,760	22,780
Hudson street, Barrow to Christopher	481	1,890
Clarkson street, Varick to Hudson	408	1,670
1st avenue, 26th street to 28th street	618	3,380
3d avenue, 116th street to 125th street	2,392	15,050
10th avenue, 50th street to 51st street	221	1,250
Houston street, Varick to Hudson	408	1,550
Pearl street, Broad to Whitehall	365	1,100
Stone street, Broad to Whitehall	401	1,040
Water street, Wall to Maiden Lane	487	1,300
Exchange place, Hanover to New	782	1,730
Washington place, Dey to Albany	906	2,430
Washington st., Battery place to Albany	1,546	4,130
2d avenue, 5th to 7th	496	2,425
Totals	144,308	569,520

A Motor Truck Hauling a Canal Boat

The successful use of a motor truck in hauling canal boats is shown in the accompanying photograph of a LaFrance gasoline hydraulic truck hauling three canal barges at Schenectady, N. Y. The truck has 48 horsepower. The maximum draw-bar pull is 10,000 pounds, and it can develop this pull at any speed from zero up to 2 miles per hour.

This new application of the motor truck, heretofore impossible under the former methods of power transmission, was considered of sufficient interest for Pathe Freres to include it in their weekly record of the most interesting events in the world, shown in the moving picture theaters to over twenty million people.

Regarding the actual experiment made at Schenectady the truck itself was not loaded and therefore, not having traction, it was not possible to get the maximum tractive effort or draw-bar pull, that developed being 4,000 pounds or less.

The photograph shows the truck towing the three canal boats, and it was estimated that the speed was in the neighborhood of four miles per hour. A few hours later, after the camera man had gone home and after the crowd had left, two more boats came along and were hooked on. The truck towed the five boats at a speed of three miles per hour, measured by quarter-mile posts.

The total gross weight of the first three boats was 731 tons and the total gross weight of the five boats was 1,250 tons. From the figures of the experiments it is clearly shown that the truck properly constructed and properly weighted down for traction, will be able to tow from ten to fifteen canal boats at a speed of two to three miles per hour. Three mules will tow two boats at a speed of one and

LINK-BELT

Loading and Unloading Machinery

Cuts down the costs of Making Good Roads

PORTABLE WAGON LOADER

Further Information in Bulletins Nos. 170 and 188, sent on request.

The Link-Belt Portable Wagon Loader

Loads 40 Yards an hour Does the Work of 10 Men

HANDLING sand and gravel in the old hand-shovel way is hard work and expensive. The problem of applying machinery successfully to this class of work has been solved by the construction of the Link-Belt Portable Wagon Loader, in which a steel frame-work, mounted on wheels, supports a strong bucket elevator in such a manner that the foot of the elevator can be pushed right into the base of a pile of material, and the head arranged with suitable discharge spout to deliver material directly into wagons or trucks; or into a screen for separation of sizes before delivery into the wagon, if desired.

The elevator is driven by a 5 H. P. motor, electric or gasoline as required, mounted on the same general frame-work, and the size of buckets and continuous operation furnish a capacity of 60 tons of coal, or 40 yards of broken stone per hour, thus enabling a crew of two or three men to do work which would require at least ten men with shovels. A clear saving of five to ten cents per ton can easily be made in handling materials in any large quantities.

The Link-Belt Gondola Car Unloader

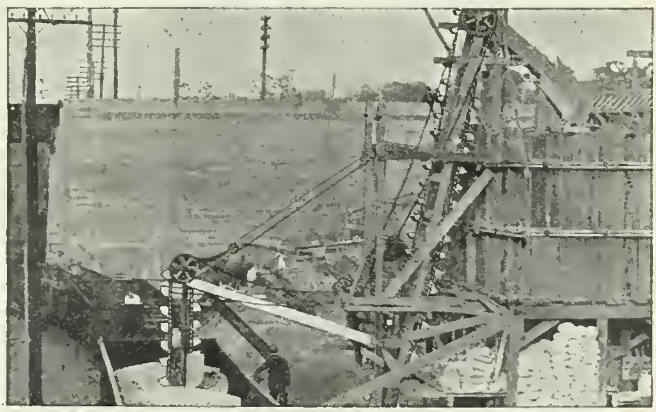
(Built Either Movable or Stationary)

A successful application of machinery for unloading Sand, Stone, Gravel, Coal, Etc.

With this simple outfit two or three men can unload a car of material at the rate of 50 tons an hour.

A comparison of the cost of unloading by this method and the old-fashioned way of using eight or ten shovelers in the car, throwing over the side, will illustrate clearly the value of the unloader, where any quantity of cars must be unloaded in a day.

Unloading cars with hand labor costs from 8 to 10 cents per ton. The Link-Belt Unloader will not only do this same work more rapidly, but in actual operation it has reduced the labor cost to about 1½ cents per ton.



STATIONARY TYPE LINK-BELT CAR UNLOADER

With two men trimming to the foot of the bucket elevator in the car, this outfit replaced six shovelers formerly required to unload the material.

The machinery consists of a heavy elevator on a steel frame, hung on the end of a boom, which may be lowered and raised in and out of the car by means of a wire rope and winch. The material, fed to the buckets by shovelers in the car, is delivered by means of a steel spout to a second fixed elevator which fills the bin. The distinct advantage of using two elevators is, first, it decreases the weight of the hinged part, and second, the material may be spread on the ground at each side of the pocket as a reserve storage, if possible.

Link-Belt Car Unloading Outfits are simple in construction and low in first cost and operating expense. Contractors, especially, will readily see the large savings in the time and expense to be made by their use.

Price, blueprints and all necessary information will be mailed upon request.

LINK-BELT COMPANY,
Nicetown, Philadelphia, Pa.

Without obligation, you may send us booklets and information regarding the Link-Belt Wagon Loader / Unloader

We handle about__________tons of__________a day.

(Name) ____________________

(Address) ____________________

(Town and State) ____________________

a half miles per hour and never in excess of two miles per hour. The truck will handle about as many tons per day as could be handled by fifty mules. It must be remembered also that the boats have to carry extra mules with them in order that a shift of mules may work half the time and rest half the time. Using automobile trucks for this work would enable the boats to utilize the space which is now being given to the housing of the mules.

The ordinary gear-driven truck cannot develop its maximum horsepower unless its motor is running at full speed. This means that the ordinary gear-driven truck cannot develop its maximum drawbar pull unless it is running at whatever speed the low gear gives when the engine is running at its maximum. Therefore if an ordinary truck were used towing canal boats it would be unable to start the boats because the jerk would either break the tow rope or stall the engine of the truck.

MOTOR TRUCK *hauling three canal boats on Erie canal at Schenectady, N. Y.*

The truck used has a hydraulic transmission, which can develop its maximum draw-bar pull of 10,000 pounds at any speed up to two miles per hour. At three miles per hour it will develop a draw-bar pull of 7,500 pounds. The tow-rope pull necessary to haul canal boats at a speed of four miles per hour can be determined very approximately by the following formula:

The gross weight of the boat in tons, multiplied by the square of the speed in miles per hour, multiplied by a constant varying from 0.45 for loaded boats to 0.67 for empty boats.

Waterproofing Hand Book

The Trussed Concrete Steel Company, Detroit, Mich., have just issued a waterproofing hand book containing a large amount of scientific information appearing for the first time.

The Trus-Con Hand Book clearly differentiates between methods of waterproofing and dampproofing, showing the best methods of treatment for specific conditions. Integral waterproofing is covered fully with numerous specifications and directions, explaining clearly how mass concrete can be absolutely waterproofed.

The various methods of dampproofing exposed surfaces of concrete, stucco, brick and masonry are discussed, and various products are indicated to insure the most satisfactory results. The troublesome problem of treating concrete floors which have become dusty is brought up, and the remedy is suggested. Sanitary, washable interior finishes are indicated, both for residential and business buildings. The protection of structural steel is scientifically treated and materials are indicated to provide against various exposures.

A copy of the Trus-Con Waterproofing Hand Book will be forwarded by the Trus-Con Laboratories to those who indicate their business or professional connection.

The Blue Print Department

By Ralph W. Davis, Chief Draftsman, Cadillac Motor Car Co., Detroit, Mich.

One of the most important differences between an automobile factory and the usual manufacturing plant is that the automobile work must be produced at a high speed. This requires that, from the time the first ideas are conceived until the car is in the factory under production, every one must work at high tension. Especially is this true of the drafting and designing departments, and inasmuch as the blue print department is an essential part of the drafting room it becomes absolutely necessary that blue prints be made and delivered promptly and surely to all departments requiring same. In meeting

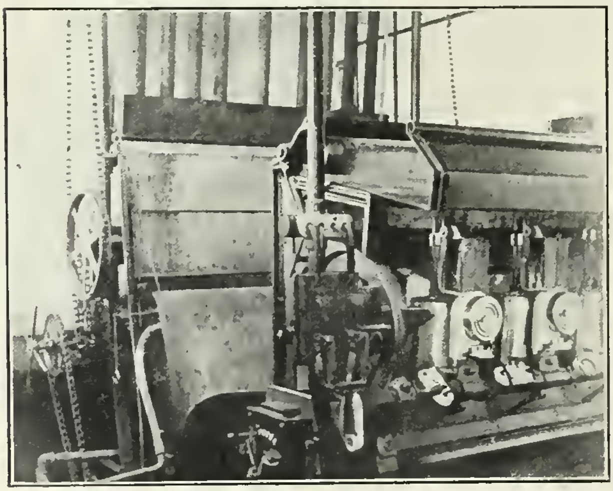
this condition in the Cadillac Motor Car Company we have adopted the machinery and method which are about to be described.

In our tool factory our tool drawings are made so that blue prints are furnished to the factory for the tools instead of the pencil drawings which are furnished to the tool room in many plants. This, of course, adds to the volume of work which must pass thru the blue print room. Our tools are all drawn up on bond paper, so that in printing these the machine must be run at a different speed than we would run it for the tracings. All our car parts are made on the regular tracing cloth.

BLUE PRINT ROOM *of the Cadillac Motor Car Co., Detroit, Mich.*

Our blue print machinery consists of a Pease continuous print blue print machine with six powerful arc lights and capable of taking paper about 50 inches wide. Connected to this machine by suitable gearing we have an automatic washer and drier so that as the prints come thru they are dried and ready for use as fast as they can be cut down.

Prints are ordered by requisition forms. On reaching the chief draftsman's clerk, a triplicate copy is made, one sheet being white, one blue and one red. These, with the requisition, are sent to tracing vault clerk, who gets out the tracing and places the white copy of order in file and passes remainder to blue print room. After prints are made, they go to sorting table, where the original requisition and the red copy are pinned to the print, the blue copy being filed in blue print room files. The prints are rolled up and secured by adhesive paper tape, and delivered by messenger to proper departments. (We formerly used rubber bands for holding prints in roll, but the tape is more effectual and much more economical.) On reaching the party who ordered the print, he signs the red slip and mails same to blue print room, this becoming the recognized receipt for prints. Thus we can follow an order and locate any delays or holdups and each person has an automatic record. In case a tracing is being changed, that fact is noted on original requisition and returned to person ordering. This feature enables us to run our prints at certain definite periods of the day, and thereby facilitate the getting out of work and making the deliveries on specified schedule. Of course for emergency work prints can be put thru in the regular way and washed and dried by hand.



BLUE PRINT MACHINE *showing controlling switches and gearing for washer.*

The accompanying photographs 1 and 2 show the machine and arrangement of the blue print room. Fig. 1 shows the left

hand end of the machine with its controlling switches and the gearing for the washer. For those who are not familiar with this washer, I would point out that the pipes at the upper part of the picture are covered with gauze mesh and that the gas jet under these produces a heat for drying the paper as it runs up over a roll at the top of these pipes. We also have a large tank at the end of the room filled with a potash solution for use on prints which are run thru in small orders, with a small hand washing machine at the right in which the potash is washed off.

Fig. 2 is a view looking at the remainder of the room, and in the distance beyond the partition is found our filing vault. Both of these rooms are under the supervision of the blue print foreman, who is thus responsible for tracings at all times after they leave the drafting room. The drafting room itself is just outside of the long partition at the right of the photograph, and is separated only by means of these glass partitions.

For ventilation purposes we have a large pipe and blower which removes all burnt gas and other odors from the room.

The average force in this blue print room consists of the foreman and three men. The amount of work that they produced in a given period will be of considerable interest.

Since January 1, 1913, up to May 31, we used 16,625 yards of paper, making a total of 73,031 blue prints. The machine was in operation in this period for 303 hours. The standard paper used is 36 inches wide, and on a basis as above, and allowing for depreciation and overhead, we find that it costs us about approximately 8 cents per running yard.

A record is kept of the daily work done in the blue print room, and in the accompanying table will be found the reports from the blue print department for the weeks ending at the dates given and will show the variation in work for various weeks. This variation is, of course, due to the necessity for getting out complete sets of prints for one department or another, or other work of this character, which renders it impossible to predict any given amount of work for any given week, but we have followed this method of keeping records for several years, and are able to estimate very closely on the amount of paper which will be required during the year, and thus get prices in accordance.

The necessity for keeping up-to-date prints thruout the entire plant is, of course, important, and employing as we do, some 7,000 men in the Cadillac factory, requires that the blue print department be eternally on the look-out for any out-of-date prints, and to be sure that the up-to-date prints are in the hands of the proper persons, so that a blue print department forms a very important adjunct to the up-to-date factory and drafting room department.

WEEKLY OUTPUT OF BLUE PRINTS.

Week ending 1913		Hours per Week of machine operator	Total prints per week
Jan.	4	17	3,860
	11	13½	2,610
	18	11	2,405
	25	22½	5,727
Feb.	1	11¾	2,518
	8	11½	2,550
	15	18¾	4,701
	22	18	5,121
Mar.	1	11	2,364
	8	6¾	1,550
	15	19	4,699
	22	10¼	2,594
	29	14¼	3,066
Apr.	5	19	5,511
	12	16	3,329
	19	12¾	2,892
	26	15	3,739
May	3	16	3,836
	10	22½	8,777

Economy of Operation of Motor Fire Apparatus

By A. V. Bennett, Chief of Fire Department, Birmingham, Alabama.

The cost of operating motor fire apparatus is rather difficult to determine accurately as yet, because of the uncertainty of depreciation and necessary repairs due to actual wear and tear. The expense of operation, however, is largely controlled by the ability and care of the driver in the handling of your machine, who will raise the cost to abnormal proportions, or lower it decidedly below that of the horse-drawn machine doing the same work, proportionately as he exercises skill and judgment in his driving.

Tire equipment will necessarily be one of the factors in the cost of operation. The pneumatic tire possesses many advantages, such as resiliency and traction, is less liable to skid and protects the machines against rough driving, but the ever present danger of a puncture of blowout, often putting the machine out of commisison to change or repair tires, and the expense of frequent replacements renders the pneumatic far from being the ideal tire.

The solid tire too has its advantages and disadvantages. The danger of punctures and blow-outs is entirely eliminated, and this equipment is durable and thoroly reliable. With dual tires on the rear wheels, sufficient traction is obtained to carry the machine where you might reasonably expect to go, but the vibration to

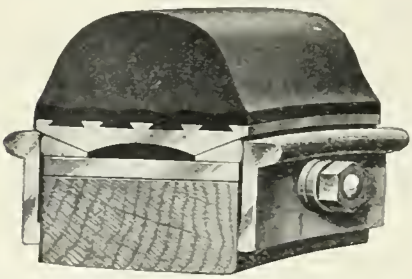
which your machine is subjected while being rapidly driven, especially over rough streets, necessitates many repairs and sooner or later the car to the shop for a general over-hauling.

The cushion tire combines many of the good qualities of both the pneumatic and the solid, but does not possess the durability of the latter, and is correspondingly more expensive.

The actual cost of operating motor apparatus, exclusive of wear and tear and depreciation, is very small as compared with horse-drawn machines.

We have cars in service that the cost of operation has averaged less than $3.00 per month since their installation, which was nearly 3 years ago. We also have machines in service, which during the last 18 months have not required one penny's worth of repairs.

The demountable feature is one of the most valuable of all fire truck tire improvements as it abolishes the need of a tire-applying station and effects a big time, trouble and expense saving to the department. With the demountable tires on fire apparatus, tire breakdowns are almost eliminated. If you wish to replace a tire, instead of removing the wheel and sending it away, one of your men simply jacks up the wheels, unbolts the side flange, slips off the rings and wedges and off comes the tire. A jack, chisel and wrench are all that are needed, and the job is done quickly and the truck hasn't been out of commission one moment.



GOODYEAR *demountable dual tire for fire apparatus and other heavy work.*

If the fullest possibilities are to be realized from motor fire apparatus operation it is essential that an economic tire service be provided.

The tire question is the final one to be solved in establishing motor fire apparatus as an absolutely feasible utility. This is true very largely because tires provide the foundation for the truck, and no matter how much pains have been taken in developing it along other lines, its usefulness does not become apparent until it has been provided with a good and thoroly practical foundation.

The last few months have seen the solid tire industry making greater strides than ever before in history. The best proof of this is the fact that mileage guarantees have been increased 2,000 and in some instances 4,000 miles, and, whereas, up to a short time ago mileage guarantees varied according to location in which tires were used, this is no longer the case. Most solid tires of standard make at the present are covered by a universal guarantee irrespective of road conditions or other matters peculiar to certain localities.

Pavements of Rome, N. Y.

Rome is a small city in central New York which has done much in the way of improvement of streets not alone with pavements, but also with flag and cement sidewalks and beautiful elm and maple shade trees. The city has 13.357 miles of streets. Of these 4 streets are paved with brick, in all 3.087 miles; 9 with asphalt, in all 4.92 miles; and 18 with bitulithic, in all 5.35 miles. The first bitulithic street was laid about nine years ago, and since that time nothing else has been laid, the property owners always petitioning for it. The manufacturing interests along the railroad in East Rome donated a street to the city this year, paving it at their own expense with bitulithic without asking for bids. A wide space was left between curb and buildings and permission will be asked of the New York Central railroad to grade the other side so as to give a strip of grass on each side of the street, enough to make a very respectable little park. About two miles of bitulithic street in all have been laid in Rome this year.

Levee Reinforced with Virtified Pipe

An interesting suggestion for the use of large size vitrified sewer pipe as reinforcement for strengthening and raising levees and dams is made in the new catalog of the Blackmer & Post Company. The pipes are set vertical and close together and are cemented together and the earth is deposited around them. It is claimed that with 250 pieces of 36-inch second-class pipe on hand a levee of this construction 1,000 feet long can be increased 3 feet in height in two hours' time, using sacks of sand only to close the spaces between the pipes left by the projection of the bells.

TWO MONUMENTS

The Mounment in the background is that of Francis Scott Key, author of "The Star Spangled Banner."

In the foreground the ***pavement*** is a monument to the contractor who laid it. That contractor's well-deserved fame is built upon the judgment that employed

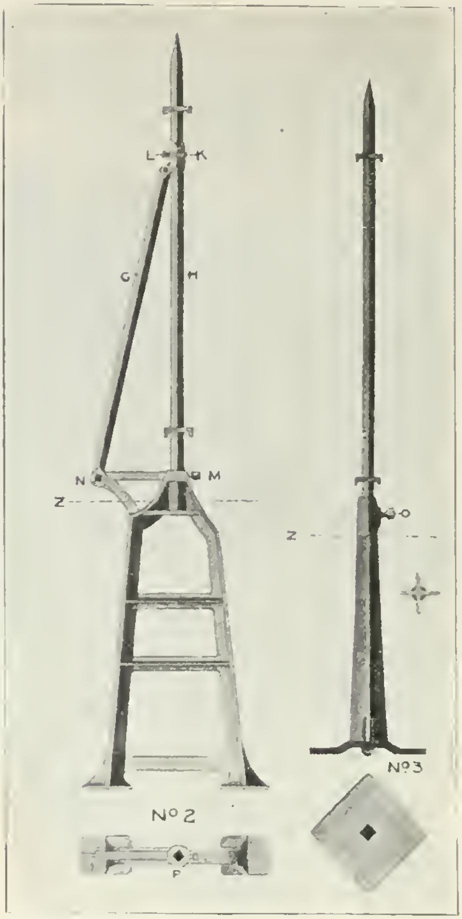
AZTEC ASPHALT

which possess in greater degree than any other asphalt these elements:—**cementing quality, ductility, low susceptibility to temperature changes.**

You, too, may build so that "by their works ye shall know them" will have a proud significance for *you.*

The United States Asphalt Refining Co.

90 West Street NEW YORK.



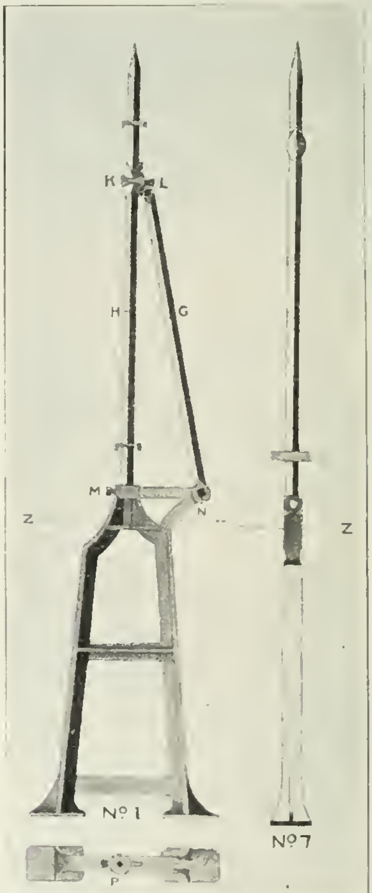
FOUNDATION POSTS *for Van Dorn system of iron fence construction.*

Iron Fence Construction

The illustrations on this page show construction of Van Dorn fencing, which is built in sections not exceeding 8 feet in length, the standard centers for pickets being 5 inches for 3/4-inch square, and 4 inches for 9/16-inch square pickets. The holes are punched in the rail square with the rail. The corners of the picket are reduced to the size of the square hole, the picket passes thru the hole to the notch, and is then given a quarter turn, bringing the corners of the picket diagonally across hole. The notch being shorter than thickness of rail grips the top and bottom surface of rail, thus interlocking the picket and rail. The dog is then driven down, forcing the legs of dog into the spaces at side of picket, the legs of dog being clinched under the rail, thus securing a joint that is solid and immovable, and rendering the sections rigid and strong. This locked joint is used on all Van Dorn regular gates and open posts.

Foundation illustration No. 2 represents a typical cast iron foundation for heavy fence. These foundations are placed under the ends of the sections and extended in the ground to dotted line Z Z, forming a solid brace upon which fence is supported. The bottom of brace post H extends into the sockets of foundation and is held in place by steel set screw M. Brace G is attached to the extended arm of foundation with bolt N, and attached to the brace post by the adjustable sleeve K. This sleeve is made of malleable iron, is cored to proper size to admit brace post H and held securely in place by steel set screw L.

Foundation illustration No. 3 illustrates



LIGHT POSTS *are designed for the smaller fences.*

a cast iron support for Van Dorn heavy fence with cast plate at bottom.

Foundation illustration No. 1 is constructed same as No. 2, but is lighter and used with lighter work.

Foundation illustration No. 7 gives an edge view of both foundations, showing flanges at side and P P a top view looking down from the top, showing the sockets, flanges and base plates. All Van Dorn foundations have the same adjustable features. By this method it is possible any time to raise or lower the entire line of fence and maintain a perfect line; they are also proof against heaving by frost, which is destructive to iron fencing where it is not provided against. Upon the foundation depends the life of the fence and with this perfect adjustment no unsightly sags or crooked joints are seen, and in case of accident, it can be easily repaired and lined up as good as new.

The iron fencing above described is manufactured by the Van Dorn Iron Works Company, Cleveland, Ohio.

Development of Safety Wood Paving Block

The inventor of the safety wood block says that his attention was called to the desirability of a non-slippery wood block when the replacement of an old-style stone block pavement on State street, in Boston, by a modern creosoted wood block pavement was held up for a long time on suit of the Society for Prevention of Cruelty to Animals, alleging slipperiness on the steep grade of the street, over which a large amount of truck traffic passes.

The first blocks were laid in a stable entrance and led to the laying of a small area on Boston street. The plain piece of steel which was then used loosened to some extent and led to the design of the present form of the steel bar, which is beveled so that it locks securely into the block. The Boston street pavement was satisfactory, nevertheless, since it obviated slipperiness in icy weather, and the safety tread blocks were laid last spring on the grades on Washington street, Dorchester district. They were adopted also by the Boston Elevated Railway Company for use between rails on surface lines on grades, to sufficient extent to test them for this use.

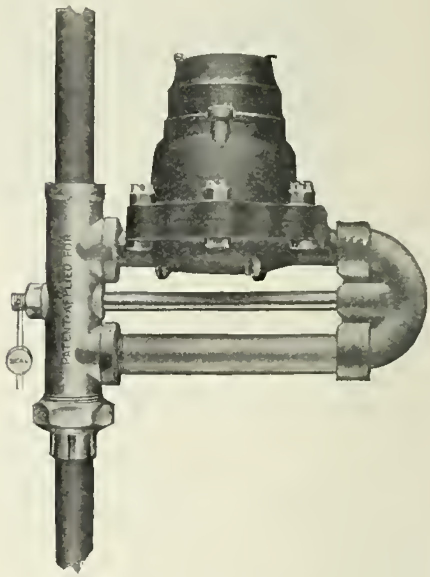
In Philadelphia the safety tread blocks have been laid on one of the piers of the Merchants and Miners Transportation Co., are under consideration for other piers, and have been specified for a small section of Vine street, giving opportunity for further test of the material. The National Safety Wood Paving Company, Real Estate Trust Building, Philadelphia, Pa., will answer any questions regarding the blocks and the methods of laying them.

Vertical Meter Connection

We are illustrating a type of sealable vertical-pipe meter connection as adopted by F. B. Wheeler, manager of the City Water Company, Chillicothe, Mo., and manufactured by the Buffalo Meter Company.

This connection consists of a galvanized iron fitting for attaching a ⅝-inch water meter in a horizontal position on either a perpendicular or a diagonal pipe, and holding both meter and pipe rigidly in place.

It consists of two separate parts with sockets, in which the meter is inserted



WATER METER SETTING *on a vertical pipe, designed by Buffalo Meter Co.*

and held by pressure applied thru the center rod and nut. It saves cost of brass couplings and other fittings, sets meter in the most satisfactory working position, keeps the meters interchangeable, and may be sealed. It is made in two sizes, to hold ⅝ by ½-inch meters and ⅝ by ¾-inch meters on either ½-inch or ¾-inch pipes. The indicator and indicator cap of meters set with this connection should be turned half way around to aid reading.

Conveyors for Sand, Stone and Gravel

The Link-Belt Company, Chicago, Ill., has issued Books No. 189, devoted to conveyors, and No. 194, about the new device for unloading gondola cars. The cut shows the cover of the pamphlet and a continuous elevator handling 300 tons an hour. The illustrations in the booklet show a number of other installations of various designs and the details of chains, sprockets, buckets, carriers, screens, idlers, belts,, etc. The automatic railway, portable wagon loader, locomotive crane, car unloaders and portable asphalt paving machine are also shown. The booklet will be sent to interested contractors on request.

The Largest Street Sign Contract Ever Let in America

The city of Chicago has let a contract for about 12,000 street signs, the gross cost of which will be about $50,000. Each sign consists of two name plates, placed back to back.

A survey of the city was made and a study of the subject of signs was carried on at the same time, occupying about a year. This resulted in the changing of a number of street names, for numerous reasons, but mainly because of duplications of names.

Most of the signs are put up on ornamental wrought iron brackets attached to existing trolley or lighting poles. On boulevards and where there are no existing supports ornamental posts of a standard design like that adopted for street lighting poles will be installed. About 4,000 posts will be required. These posts are mounted on concrete foundations 18 inches in diameter and 30 inches deep and are held in place by 16-inch bolts cast in the concrete.

There is no particular engineering or administration feature in the carrying out of the contract other than the routing of the work so that the gangs working on erection will not duplicate their travels, which means that the materials must reach the places where they are needed in advance of the men, but not so far ahead as to be in danger of theft.

The contract requires about 2,000,000 pounds of metal, three large trainloads, and will be completed in about five months. The Curtis-Ward Company, 26 East Jackson street, Chicago, have the contract.

The specifications call for enameled street signs with 5 by 24-inch plates and 4-inch letters, the plates to be of No. 18 sheet metal of good English charcoal iron grade. The letters are white on a background of blue enamel. Brackets are of flat iron rod of design shown in the accompanying sketch, which shows also the method of fastening. Brackets are painted with one coat of red lead and oil and two coats of black waterproof paint.

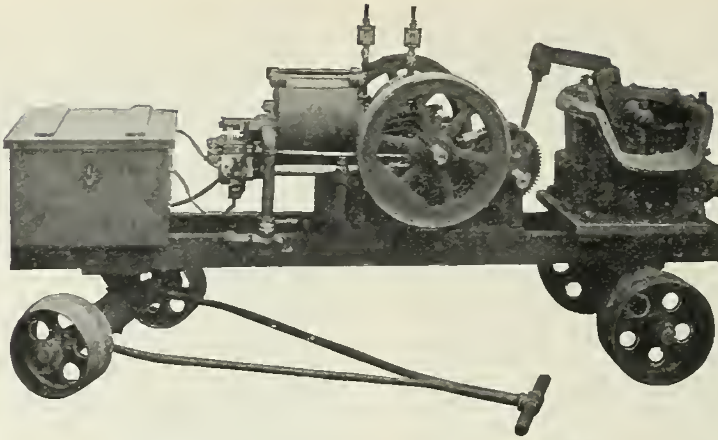
Location of signs is determined by the location of existing poles. Where there is a choice the corners are to be used in preference first of the northwest, second northeast, third southeast and last southwest. New posts are to be erected on the northwest corner if practicable, if not the choice is to be in the same order.

STANDARD STREET SIGN *construction on new Chicago contract.*

Use of Diaphragm Pumping Engines

Among improvements in construction methods which have been made within recent years perhaps none mark more important digression from the old-time methods than the substitution of the modern gasoline-driven diaphragm pumping engine in place of the hand pump. The resulting economy in time, labor and money in all cases which have come to notice has more than warranted the slight initial outlay. These gasoline pumping outfits are now perfected to such a point as to make them absolutely reliable under even the most exacting conditions and are so designed as to be a compact unit machine, easily and quickly portable.

About six months ago the street department of Middleboro, Mass., under the direction of Mr. W. H. Conner, superin-



THREE-INCH ATLANTIC TRENCH PUMP.

tendent of streets, replaced their hand pumps with a modern Atlantic diaphragm pumping engine, which has effected a saving over the old method of 70 per cent., and has pumped on a continuous service test as much as 50 gallons per minute with a 7-foot lift. Mr. Connor advises that his outfit has cost nothing to date for maintenance; that it can be operated by unskilled labor; that the engine requires practically no attention while running, and that the average cost of gasoline per hour is less than 3 cents. In a twenty-four-day service test on the North road from Middleboro the pump lifted water 9 feet at an average rate of 10,800 gallons daily. This test was for the purpose of supplying water during extreme conditions for use in the city, the water pumped by the outfit being delivered to carts and hauled away as desired. The pump worked almost constantly during the twenty-four days, and during the entire time, as Mr. Connor puts it, did not skip a stroke.

The outfit above referred to consists of a sanitary diaphragm pump, driven by a gasoline engine having a cylinder of 4 inches diameter and 4-inch stroke. The engine operates at 400 to 600 revolutions per minute. The cylinder wall is of uniform thickness, with removable sheet iron water jacket, making the engine frost-proof, even when water is allowed to freeze solid in the jacket. The ratio of the pump to the engine speed is 10 to 1 and the normal speed of the pump is about 50 strokes per minute.

Trade Notes

E. J. Cady, consulting accountant, 1812 Harris Trust Building, Chicago, Ill., has become president of The Investigators' Corporation of America, and calls special attention to the efficiency, appraisal and advisory engineering departments of the organization.

The Galion Iron Works and Manufacturing Company is the name of the reorganized Galion Iron Works Company of Galion, Ohio. The capital stock of the new company will be $1,000,000, which is a large increase, to take care of their business, which was increasing too rapidly for the size of the old company.

The Wilson-McKeand Company, specialists in chamber of commerce development, commercial club organization, civic improvement omvements and commission government campaigns, have opened permanent headquarters offices at 1813 Dime Bank Building, Detroit, Mich. The organizers of this company are Mr. Lucius E. Wilson, former secretary of the Detroit Board of Commerce, and Mr. A. W. McKeand, former secretary of the Charleston, S. C., Chamber of Commerce. Associated with these men are several experts in commercial organization work.

The Geo. A. Schardt Company, Empire Building, Pittsburgh, Pa., have been appointed sales representatives in the surrounding territory for the Steel City Electric Company of Pittsburgh, manufacturers of electrical specialties.

The Wemlinger Company, Inc., 11 Broadway, New York City, who are associated with the Wemlinger Steel Piling Company at the same address, have just been appointed New York and New Jersey sales agents for the Waterloo Cement Machinery Corporation, Waterloo, Iowa, who are the manufacturers of the well-known line of Polygon and Little Wonder oncrete mixers. The Wemlinger Company state that they will carry a full stock of Polygon and Little Wonder machines of various sizes in their New York warehouse, as well as a complete line of repair parts, thereby assuring prompt service to their Eastern customers.

Adaptability and Economy + Speed and Power = The Predominant Advantages of

Huber STEAM AND GAS Tractors

"Easy Work for a Huber"

Because → A Huber can haul in FASTER time, TWICE as many HEAVIER loaded carts per unit of power than horses at less cost than expense of feed for horses to do the same work.

Because → A Huber will save the expense of at least ten men per outfit compared with horses and wagons.

Because the Huber is built *right* on *practical knowledge.*

"Grading for a $1,000,000 City" is the title of a folder

SENT FREE ON REQUEST.

The Huber Manufacturing Co.

601 Center Street. **MARION, OHIO.**

Representatives for Eastern Canada, F. H. HOPKINS & CO., Montreal.

CONTRACTING NEWS

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Belle Plaine, Iowa.—Jan. 5, until 3 p. m., for 55,718 square yards of paving and 13,570 feet of cement curb and all appurtenances. Work is in six divisions. Certified check for $500, required with each division. Plans and specifications may be obtained from engineer by depositing $5.00 W. M. Ewen, city clerk. Iowa Engineer Co., Clinton, Ia.

Cincinnati, O.—Jan. 16, until noon, for the following county work: Specification No. 571: For repair of Cleves and Dugan Gap road, between Cleves and Ezra Guard's place, in Miami township. Certified check $500. Under specification No. 568: For the improvement of Snyder road through Kleeman's land in Green township. Certified check $500. Fred E. Wesselmann, president board of county commissioners.

Clearwater, Fla.—Jan. 6, until noon, for furnishing all material and labor and constructing about 12,300 square yards of brick pavement on sand foundation and about 19,000 lineal feet of combined concrete curb and gutter, near St. Petersburg, Fla. Also bids for the same pavement of concrete and of bitulithic. Plans and specifications may be seen at the office of the engineer, 314 Home Security Bldg., St. Petersburg, Fla., on and after Dec. 20, 1913. O. T. Railsback, commissioner district No. 1.

Cleveland Heights, O.—Jan. 6, until noon, for furnishing the material and labor necessary for the improvement of Euclid Heights boulevard, from Superior road to Lee road, by grading; certified check 10 per cent. of amount of bid. H. H. Canfield, clerk of village.

Dayton, O.—Jan. 15, until 10 a. m., for the following county work: All materials and labor necessary to build and complete the embankment for the east approach of the Little York bridge, including the gravelling of the roadway of said approach. Approximate quantities: 4,500 cubic yards of embankment 20 feet wide on top with side slopes 1½ horizontal to 1 vertical, and 125 cubic yards of gravel 16 feet wide, 12 inches in center and 6 inches on the sides. Certified check, $100. Walter H. Aszling, secretary board of county commissioners.

Hartford City, Ind.—Jan. 5, until 2 p. m., for furnishing all material and labor for constructing the Stotler No. 2 macadam road situated in Jackson township and for constructing the Whetsel macadam road also in Jackson township. Bond for double the amount of bid must accompany each bid. Jas. Cronin, Jr., auditor.

Kosciusko, Miss.—Jan. 5, until 11 a. m., for the permanent improvement of approximately 17 miles of roads in said district. Novaculite, chert, gravel or crushed stone will be used for finishing surface, and is to be compacted with roller. Probably concrete will be used in the construction of smaller bridges and large culverts. Bids are asked on all kinds of culvert pipe and will be determined by the highway commissioners when prices are received. Bids are invited for doing the entire work or any division thereof separately, consisting of grading, bridging, surfacing and furnishing all materials necessary to complete the above mentioned roads. Plans, profiles and specifications are on file at the office of the chancery clerk of Attala county, Kosciusko, Miss., at the office of Xavier A. Kramer, engineer, Magnolia, Miss., and at the office of the highway commissioner, Kosciusko, Miss. Certified check, $1,000. W. B. Potts, president; G. Lowenburg, secretary, highway commissioners, district No. 1, Attala county, Miss.

Sioux Falls, S. D.—Jan. 26, until 9 a. m., for the construction of pavements on Prairie avenue, from north line of Third street to south line of Twelfth street. Bids will be received on each of the following kinds of pavements: Bitulithic, Tarvia macadam, asphaltic concrete and Dolarway. Certified check, $1,500, made payable to city treasurer must accompany each bid. The work will consist of approximately the following quantities: 15,000 square yards of pavements outside of street car tracks; 3,000 square yards of pavement along the street car tracks. Specifications in blank form of proposal may be obtained from S. B. Howe, city engineer. Walter C. Leyse, city auditor.

CONTRACTS AWARDED.

Baton Rouge, La.—G. W. Prutsman, Danville, Ill., at bid of $35,979 was awarded contract for recrowning and graveling the highway from Baton Rouge to Hope Villa, a distance of about 14 miles. Other bids were G. W. Garig, Baton Rouge, $38,528; Worthington Construction Co., Brookhaven, Miss., $40,637; Boyd & Bradshaw, Columbia, Miss., $43,360; Lenham Bros., Baton Rouge, $44,058.

Belton, Tex.—The Texas Granitoid Co., of San Antonio, was awarded contract for about 1,700 square yards of paving and 700 linear yards of curbing at bid of $2.24 per square yard.

Dresden, O.—Contract was awarded to George H. Heffner & Son, Celina, O., at about $30,000, for paving of Main street, from canal bank to corporation line, consisting of concrete base.

Elgin, Ill.—Logan & Giertz, local firm was awarded contract for paving with asphaltic-macadam the first district in West Chicago. Contract price, $71,905.

Frankfort, Ind.—The contract for improving a county line highway between Marion and Hendricks county, north from Clermont was awarded to McKinsey & Jenkins, of Frankfort. The successful bid was $7,895. The work must be completed before Oct. 1, 1914.

Gallipolis, O.—Contract was awarded to Jas. L. Betz, of Gallipolis, and Thomas Jones, of Patriot, for paving of 2d avenue, from Court street to Vine street, and Vine to 3d avenue, with vitrified brick, at $1.26 per square yard.

Grand Rapids, Mich.—Contract for 3 miles of the Blackberry-Warba road was awarded to I. M. Dowling, of Duluth, at $5,000.

Lafayette, La.—Contract was awarded to Worthington Construction Co., Brookhaven, Miss., at $47,800 for 16 miles of gravel roads, diverging from Lafayette, by good roads commission.

Lawrenceburg, Ind.—T. F. Wilson & Son, of Brookville, Ind., was awarded contract for construction of the Miller township road, at bid of $13,876.

Medford, Oregon.—Kessel & McDowell Logging Co., of Tacoma, Wash., was awarded contract for grading the Pacific highway over Siskiyou mountains, at $107,534.

Newark, N. J.—Contract for the paving of Broad street, with wood blocks, has been awarded by the board of works to Newark Paving Co., 133 1st street, at $273,473.

Pennsgrove, N. J.—John P. Holmes, Pennsgrove, N. J., has been awarded a contract by the county commissioners for reconstructing several miles of highway near Pennsgrove.

Richmond, Ind.—The county commission-

ers let the contract for the Commons bridge fill, west of the city, to T. J. Connell, of Milton, at 34½c a cubic yard.

San Mateo, Cal.—A contract for the paving of the lower half of San Mateo Park was awarded to Clark & Henry, Stall Bldg., Sacramento, by the board of trustees for $107,000.

South Bend, Ind.—Jerry Donovan, a South Bend contractor, was the successful bidder for the Center township road, St. Joseph county, his contract price being $25,900.00.

Tipton, Ind.—Brown, Hinds & Hinds, of this city, were awarded contract for gravel road construction in Cicero township, at bid of $3,750.

Williamsport, Pa.—Contract for constructing an 8-mile macadam road near Williamsport, has been awarded to Kelly & Brown, of Williamsport.

CONTEMPLATED WORK.

Faribault, Minn.—City contemplates 21 blocks pavements in the spring; creosote block. Frank McKellip, city engineer.

Red Wing, Minn.—Surveys for a road from Red Wing to Zumbrota, 22 miles, are being made by Wm. J. Geisheker, engineer, city, for the State Highway Commission, St. Paul.

Terre Haute, Ind.—County Surveyor Herbert C. Anderson has prepared new plans and specifications for the improvement with vitrified brick of E. Wabash avenue, from 25th street east to the Harrison township line; estimated cost, $58,000.

SEWERS.

BIDS REQUESTED.

Butte, Mont.—(Readvertisement), March 1, until 5 p. m., for a sanitary sewer in Mercury and Diamond streets. Certified check, $1,000. W. A. Willis, city clerk.

Clinton, Iowa—January 13, until 8 p. m., for the construction of a sewer in Eighth street from Tenth avenue to alley south of Eleventh avenue, on Eleventh avenue from point 280½ feet east of Eighth street to Ninth street, and on Ninth street from Eleventh avenue to alley south of Eleventh avenue. Plans and specifications may be seen at office of city clerk. E. M. Howes, mayor. Frank W. Leddham, city clerk.

Montevideo, Minn.—January 5, until 8 p. m., for furnishing the material and constructing 2,142 feet of sanitary sewer. Certified check, 10 per cent. of bid, must accompany each bid. A. M. Parks, city clerk.

New Albany, Miss.—January 6, until 8 p. m., for the construction of a general sewerage system. S. W. Beville, city clerk.

CONTRACTS AWARDED.

Baltimore, Md.—Specifications are being prepared by C. W. Hendrick, chief engineer of sewerage commission, covering four sanitary contracts involving about 88,000 linear feet of intercepters, lateral sewers and house connections, amounting to over $300,000. Contracts will be started the first part of spring.

Clarion, Iowa—Plans contemplated for about 5½ miles sewer work; definite announcement expected about February 1. Address city clerk. Engineer Carrie, Webster City, has plans nearly perfected; cost about $40,000.

Cuyuna, Minn.—James G. Lawson, of Duluth, has been engaged to draw plans and superintend the installation of sewers here.

Douglas, Ariz.—Council has instructed the city engineer to prepare plans, etc., at once for a sewer system in the Clawson addition. J. P. Sexton, city engineer.

Reedley, Cal.—Plans are being made by Engineer Chris J. Jensen, Fresno, Cal., for a sewer system here to cost about $40,000, and to include disposal works and pipe system. Contract will be let about February.

Salem, Ill.—Plans and estimates are being prepared by Consulting Engineer John S. Spiker, of Vincennes, Ind., for the proposed sanitary sewer system and purification plant, estimated to cost $88,000. Bids are to be asked in the spring.

SEWAGE DISPOSAL PLANTS.

Canton, O.—The following bids were received for the construction of the sewage disposal plant: Grant, Sarstedt & Meriman, Cleveland, stone or slag filters, $243,205; gravel filters, $212,810. J. C. Devine, Alliance, slag, $237,382; screened cinders, $251,719; gravel, $260,322. Fletcher & Ule, Akron, slag, $244,876; gravel, $266,096. Larrowe Construction Company, Detroit, slag, $275,187; cinders, $293,826; gravel, $288,091. Pitt Construction Company, Pittsburgh, slag, $261,523; cinders, $298,801; gravel, $298,801. Masters & Mullen, Cleveland, slag, $292,145; cinders, $286,410, and gravel, $272,073.

Tampa, Fla.—The following bids were submitted for the construction of the Imhoff sanitary sewer system (divided into ten sections): G. Jeager, of Rich Hill, Mo., bid on Sections 5, 6 and 7, accompanying his bid with certified checks for $7,500 and $5,000. M. P. Flynn, Chattanooga, bid on Section 9, accompanying bid with two checks of $600 each. Bryan & Co., Jacksonville, bid on Sections 5 and 7, furnishing checks for $2,500, $2,500, $1,000, $1,000 and $3,000. H. H. Snyder & Co., Louisville, submitting checks for $5,000 and $2,500, bid $174,923 for constructing Section 1 and $55,042 for Section 2. A. J. Martin & Co., Augusta, filing a check for $2,500, bid $17,109 for constructing Section 1 or approximately $93,000 less than the first bid submitted for this section. McGucken & Hyer, of this city, filing check for $4,370, bid $129,208 for construction of Section 1 and $43,075 for Section 2. The bid for Section 2 was lowest submitted, and the probability is that this firm will be awarded this part of the contract. The Edwards Construction Company, of this city, filing check for $1,663, bid $28,710 for Section 3, $33,805 for Section 4 and actual cost of labor and material plus 10 per cent. for Sections 1 and 2. J. C. Neil, Tampa, bid on Section 6, submitting a check for $600. Guild & Co., Chattanooga, filing checks for $2,500, $1,500 and $2,500, entered bids for Sections 6 and 7. Bidders, in conformity with instructions, offered certified checks for 2½ per cent. of the total amount of their bid on each section.

WATER WORKS.

BIDS REQUESTED.

Boston, Mass.—(Readvertisement), until January 15, bids will be received for furnishing and erecting electric pumping plant for high pressure fire service in underground pumping station, Charles street. L. K. Rourke, commissioner of public works.

Columbus, Mont.—January 12, until 8 p. m., for construction of a water system; estimated cost, $25,000. George A. Westover, town clerk.

New Bremen, O.—January 10, until noon, for one motor-driven water pump, working head 46 pounds and a maximum pressure of 100 pounds. E. R. Haines, village clerk.

Newport Beach, Cal.—About January 15, for about four miles of water mains at a cost of about $25,000. L. S. Wilkinson, city clerk.

Potosi, Mo.—January 12, until 7:30 p. m., for drilling a deep well 1,000 feet or less. Information, etc., regarding same can be had from H. C. Bell, city clerk, or Monie & Dun-

bar, engineers, 1527 Chemical building, St. Louis, Mo.

Taylorville, Ky.—Until February 7, bids will be received for constructing water works with reservoir pumps and engines complete. J. H. Reid, chairman water commission.

Winchester, Ill.—January 6, until 7:30 p. m., for furnishing material and labor and constructing a municipal water works system. The material and equipment to be installed is approximately as follows: 9,636 feet 8-inch cast iron class E pipe; 3,420 feet 6-inch cast iron class E pipe; 22,116 feet 4-inch cast iron class E pipe; 14,000 pounds special castings; 2,280 feet 2-inch galvanized iron pipe; 6 8-inch gate valves with boxes; 3 6-inch gate valves with boxes; 23 4-inch gate valves with boxes; 3 2-inch gate valves with boxes; 39 fire hydrants; 180,000 gallon steel tank on a 110-ft. 4-post steel tower; 2 motor-driven deep well tube pumps, capacity 50 gallons each per minute against a head of 235 feet; 2 brick buildings 10x12 feet; all concrete foundations for tower and tank, buildings and pumping equipment; 2 8-inch wells, 42 feet deep; all pump house piping. Certified check, 5 per cent. of amount of bid. Dr. H. H. Fletcher, mayor.

CONTRACTS AWARDED.

Cherryville, N. C.—B. F. Roberts, of Macon, Ga., was awarded the contract for water works system here.

Centralia, Wash.—W. H. Mitchell, of Seattle, at $124,759, was awarded the construction of the municipal gravity water system. Work will begin about January 1. Stanley Macomber, city engineer.

Frankfort, O.—Contract for constructing water works is reported awarded to Harper-Rossitor Company, of Bremen, at $13,775.

Minatare, Neb.—The contract is reported awarded to J. S. Schwartz, of Colorado Springs, Col., for construction of water works at $13,472.

Hopkins, Mo.—The Hopkins city council awarded the contract for the building of their water works plant to the Vash & Gray Company, of Joplin, Mo., for $10,151.

Manassas, Va.—Applegate & Son, Bradford, Pa., at $31,438, were awarded the contract for furnishing of labor and material for the installation of a water works system.

BRIDGES.

BIDS REQUESTED.

Cleveland, O.—January 21, until 11 a. m., for the construction of bridge work per report No. 3242, in accordance with the form of contract and specifications to be furnished by W. A. Stinchcomb, county surveyor. Certified check for 10 per cent. of amount of engineer's estimate required with each bid. John F. Goldenbogen, clerk of Cuyahoga county.

Geneva, Neb.—January 13, until noon, for bent and pile steel and wooden bridges required during the twelve months, beginning January 13, 1914. Bert A. Lynn, Fillmore county clerk.

Houston, Tex.—About February 1, for the construction of a reinforced concrete bridge over Buffalo river at Franklin avenue and Louisiana street. The bidder is invited to submit a bid based on either his own design, which must be in accordance with the specifications now on file in the office of the city engineer, or from the plans and specifications prepared by the city engineer. Contractors who are prepared to design the bridge as well as bid on the construction are invited to inspect the site and call at the office of the city engineer for specifications covering the requirements of such design. Contractors who are prepared to bid upon the plans as prepared by the city engineer's office about January 15, at which time the plans and specifications will be completed. The preliminary estimate of the cost of this bridge is $140,000. E. E. Sands, city engineer; Ben Campbell, mayor.

Manhattan, Kans.—January 6, until noon, for the construction of a bridge approach in Riley county, as follows: Ashland Bridge Approach—This is 150 feet long and 16 feet roadway with a reinforced concrete floor. The supersrtucture is 5 I-beam spans each 30 feet long. The substructure consists of a plain concrete abutment and four bents. There are two designs for the bents, one for steel and one for reinforced concrete. Bids will be received on each of the designs. Concrete piling 21 feet long will be required to support the foundation. A deposit of $50 must accompany each bid. Address County Clerk.

Saginaw, Mich.—January 8, until 2 p. m., for construction of a 202-ft. highway bridge over Cass river on East street road. J. W. Ederer, county road commissioner.

Zanesville, O.—January 14, until 11 a. m., for furnishing the material and labor for construction, building and placing of certain new bridge across Crow run, near Stones station, on Malta road, in Harrison township. Bridge to consist of one span 81 feet, 8 inches long from center to center of end bearings, and to have a roadway of 14 feet in the clear. Floor to be creosoted plank and blocks, or a plain 3-inch plank floor. Bridge to have a carrying capacity on floor sufficient to support a 15-ton road roller. All connections shall be riveted. The structure shall be thoroly anchored to abutments at both ends but free to slide at one end in slotted holes. Certified check, 10 per cent. of amount of bid required. Fred C. Werner, clerk of Muskingum county commissioners.

CONTRACTS AWARDED.

Bay Minette, Ala.—Contract for construction of bridge 150 feet long of reinforced concrete was awarded Latimer & Burkett, of Memphis, Tenn., at $3,775.

Caldwell, Idaho—J. H. Forbes & Co., were awarded contract for construction of three bridges in Canyon county at $47,620.

Cincinnati, O.—The contract for the Hopple street viaduct has been awarded to the Kirshner Construction Company, Cincinnati, Ohio, at $413,765.

Macedon, N. Y.—Contracts were awarded to L. M. Ludington's Sons, Inc., Rochester, N. Y., at $94,393 for substructure and superstructure of bridge at Edgett street, Newark, and superstructure of bridge at Peek's, both within contract No. 76, and for substructure and superstructure of bridge at Macedon.

Pittsburgh, Pa.—Booth & Flinn will be awarded contract for construction of the north and south approaches to the Northside Point bridge. Bid, $264,000.

Tampa, Fla.—Contract for construction of concrete bridge on West Michigan avenue was awarded to A. N. Snow for $1,192. R. L. Davis' bid was $1,729; H. W. Cooley & Co., $1,511; Lester & Co., $1,640.50; J. L. Roumillet, $1,412.60, and McGucken & Hyer, $1,250.

CONTEMPLATED WORK.

Houston, Tex.—Plans will soon be prepared for the Preston avenue bridge. It is to be of reinforced concrete and will cost about $150,000. For further information address E. E. Sands, city engineer. Ben, Campbell, mayor.

Grand Rapids, Mich.—Lehigh E. Stevens, city engineer, has estimated the cost of the proposed new concrete bridge at Pearl street to be $138,000.

AUTOMOBILES—FIRE APPARATUS.

Darby, Pa.—Fire Patrol No. 2 plans to purchase a motor combination chemical and hose car.

Yonkers, N. Y.—January 5 bids will be re-

ceived for two combination chemical and hose motor apparatus. Mr. Lennon, mayor.

Washington, D. C.—No. 1301—Automobile Accessories and Novelties—An American consul has forwarded the names of four firms in his district that are anxious to receive catalogs and price lists of automobile accessories and novelties. Correspondence and catalogs must be in Spanish or French. No. 12187—Gasoline motors, plows and traction wagons. A report from an American consular officer states that an European engineering firm wishes to secure the agency for the sale of American gasoline motors, gasoline motor plows and traction wagons. The firm is prepared to submit satisfactory references. Addresses may be obtained from the Bureau of Foreign and Domestic Commerce, Washington, D. C. In applying for addresses refer to file number.

GARBAGE DISPOSAL PLANTS.

Pensacola, Fla.—Following bids were received on the erection of a second crematory plant: Decarie Incinerator Co., Minneapolis, Minn., $7,000; Atkinson-Morse Destructor Co., New York City, $12,560, and Nye Odorless Co., Macon, Ga., $3,500.

Queens Boro, N. Y. City—The following were low bids received in connection with the garbage destruction works on Flushing avenue in Ridgewood: General construction of main building, Peter Cleary, $46,091; stable house, Werner-Bartels Co., $62,287; plumbing and gas fitting main building, J. Braumstein & Co., $1,550; of stable and section house, Altman Plumbing Co., $5,400; and for steam heating of stable and section house, Phillip A. Fox & Co., $3,450.

BUILDINGS.

BIDS REQUESTED.

Chadron, Neb.—Until January 13, for a wing to the normal school here, 3-story, brick, 50x60, cost $30,000, fireproof, work to start next spring; steel frame and beams, tile, reinforced concrete and gypsum fireproofing, lime cut stone, common pressed brick, hollow, steam heat, electric lights, composition roof, patent plaster, metal lath, corner bead, lead and oil paint, P. & L. varnish, wired and figured glass, tile floor, marble baseboard, oak finish; plans by J. C. Stitts, architect, Norfolk, Neb. J. J. Tooley, secretary school board.

Doyon, N. D.—January 13, until 1 p. m., for ventilating, plumbing and heating the school building, according to plans and specifications on file with F. S. Chamberlin, clerk of board, or at office of architect, John Marshall, Devils Lake, N. D.; check for $100 payable to John B. LaRue, president of the board, required with each bid.

Heber Springs, Ark.—Until January 22, for the erection of a brick and concrete fireproof court house to cost $50,000. Clyde A. Ferrell, architect, Little Rock, Ark.

Lodi, N. J.—Until January 14, bids will be received for the erection of a 13-classroom school. Bids will be received as a whole or separately for carpenter work, including sheet metal work, plumbing, electric wiring; ventilating and heating; masonry, including reinforced concrete and iron work. Anton L. Vegluante, architect, First National Bank building, Garfield. John J. Goegbegan, mayor.

Valparaiso, Ind.—Until February 9, for the construction of the Valparaiso Public Library building. Each bid must be addressed to the Public Library Board of the City of Valparaiso, Ind. O. P. Kinsey, president, Valparaiso, Ind., care of State Bank, and marked "Bid for the construction of the Valparaiso Public Library building," and delivered in person or by registered mail to the State Bank of Valparaiso on or before February 9, 1914. Certified check for $800 must accompany each bid. O. P. Kinsey, president.

CONTRACTS AWARDED.

Centralia, Ill.—Contract has been awarded by the board of education to D. S. Peatre & Co., of Centralia, for erecting a high school at $35,000.

Chisholm, Minn.—Johnson & Wayne, of Hibbing, were awarded contract for construction of a municipal detention hospital at bid of $8,122.

Jersey City, N. J.—W. H. & F. W. Cane, Woolworth building, New York City, at $308,488, were awarded construction of Public School No. 24.

Kansas City, Mo.—Contract for erecting a shelter and comfort building at Seventeenth and West, Prospect Place, West Terrace park, was awarded to Alex. Kinghorn, Kansas City, at bid of $17,500, and the heating to Freil & Foley, at bid of $2,700.

Moline, Ill.—C. W. Cline, local contractor, was awarded contract for erecting new bath house at Prospect park. Contract price, $2,360.

Wheatland, Wyo.—Contract for plans and specifications for a $40,000 court house was awarded to Berreson Bros., architects, of Denver, Col.

CONTEMPLATED WORK.

Edwardsville, Ill.—R. G. Kirsch, architect, St. Louis, Mo., will prepare plans and supervise the construction of the $250,000 court house for Madison county, here. The building will be 125x160 feet and 68 feet high.

Elkhorn, Wis.—Van Ryn & DeGelleke, a Milwaukee firm of architects, have been engaged to prepare plans for the proposed new jail building.

Long Island, L. I., N. Y.—Tentative plans have been prepared for a number of city market buildings and a cold storage building to be erected adjacent to the Newtown creek and Dutch Hills canal, Long Island City. Estimate cost, $4,000,000. Cyrus C. Miller, Tremont and Third avenues, New York City, is chairman of the mayor's committee. Maurice E. Connolly, president of Queens Boro.

Lorain, O.—A bond issue for $10,000 has been authorized to provide for the building of a new fire station on the west side. T. W. Pape, mayor.

Pittsburgh, Pa.—Plans are being prepared by Ingham & Boyd, 323 Fourth avenue, for a two-story brick elementary school to be erected on Webster avenue and Watt street, at a cost of $185,000.

Sioux City, Iowa—County commissioners will construct a new 150x150-feet, six-story court house at an estimated cost of $1,000,000. The building, for which rough sketches have been made, will have four acres of floor space. Henry Metz, supervisor.

Waterloo, N. Y.—Plans have been completed for the erection of a new jail. Estimated cost, $32,000. George F. Bodine, counsel for Seneca county board of supervisors.

Waterloo, Iowa—Contract for construction of the proposed new county hospital will probably be awarded during the winter. Estimated cost, $35,000. W. C. Leland, member county board.

MISCELLANEOUS.

Cleveland, O.—January 7, until noon, bids will be received for economizers, fans, etc., for the municipal electric light plant. W. H. Kirby, secretary to director of public service.

Dalton, Ga.—The Manly Jail Works of this city write they are in the market for interlocking sheet steel piling for doing cofferdam work and would like catalogs and prices on same.

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

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Municipal interest is interest in the conduct of the business of the city. Communal interest is interest in the welfare of the city and its inhabitants. Good conduct of city business is a matter of course in a German city and he spends his energy in making his city attractive, especially to the wage-earner, who is the important factor in communal development. American cities need to pay attention to municipal interest and should not allow the demand for the "city beautiful" to over-shadow the demand for the well governed city, administered to give the greatest good to the greatest number.

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PAVEMENTS OF TRENTON, N. J.

By Harry F. Harris, Assistant Engineer of Streets.

In this article Mr. Harris makes some important points. One is the awakening of a staid and conservative small city to the necessity of good paving; another is the effect of the quality of the service obtained under the city's commission form of government upon the character of the streets and their economy; his history of the development of the present system is not uncommon, but it is clearly stated so that the city not yet embarked upon the paving voyage can readily learn from Trenton's experience and escape its mistakes.

TRENTON, New Jersey, has been a laggard in improvements to its streets, as in other municipal enterprises, but of recent years the city has taken a new lease on life. Much of this awakening the writer firmly believes can be attributed to the stimulus created by the adoption of the Commission form of government.

In reviewing the paving history of Trenton it can be treated as a series of epochs.

The early streets were paved with cobble stone, first laid in 1866, according to records of the City Clerk. During the next five or six years a considerable amount was laid.

In 1871 an experimental Nicholson wood block pavement was laid, but it was not a grand success, and a few years later the street was repaved with Belgian block. This street was North Broad, from State to Hanover, and the blocks were procured at a local saw mill.

From about the time the wood block pavement was replaced until 1885 was the era of Belgian block paving, during which many of the principal thorofares were first improved.

During the succeeding period a considerable number of streets were improved with asphaltum (coal tar) block.

The next evolution in paving history took place in 1892, with the introduction of modern pavements. During that year the first vitrified brick pavement was constructed, under the supervision of the present Director of the Department of Streets and Public Improvements, Mr. J. R. Fell, who at that time was City Engineer. This pavement is in use to-day and is in comparatively very good shape after having been in use for twenty-one years, and is good for at least five more years of wear. The pavement was constructed with a brick which was manufactured in East Palestine, Ohio, and was known as the "State Line" brick. The bricks were laid on a concrete base 6 inches in thickness and were grouted with portland cement filler, and the pavement cost complete, including excavation, $2.30 per square yard. No provision was made for expansion either transversely or longitudinally. Immediately after the first brick pavement was constructed a local firm, Oliphant and Pope, began the manufacture of brick for paving purposes, and they succeeded in making a very good grade of brick. A number of pavements laid with such brick are in use to-day and are generally in good condition, altho some have been replaced during the last few years. Brick continued to be laid in considerable quantities until about 1900, when the craze for noiseless pavements began.

A few streets were paved as early as 1896 with sheet asphalt and at spasmodic intervals thereafter. In 1900 the city officials began to repave the principal business streets of the city with this material, using in a great many instances the old Belgian block as a foundation after they had been relaid and the joints filled with sand. This worked quite successfully in a number of instances, but in others it would have been more economical to sell the block and construct a new concrete foundation, probably at no greater cost, and thereby obtain a foundation of greater strength and durability as well as increase the life of the pavement. Lake asphalts were used exclusively until 1907 for constructing the asphalt pavements, with the exception of two streets which were laid with Green River Kentucky rock asphalt, but these showed signs of failure immediately after being laid, and were subsequently repaved with Trinidad Lake asphalt.

¶ IT PAYS *to use good material, even if the first cost is greater.*

Here an interesting point in the story is reached. It is a well-known fact that in the early stages of the asphalt industry the business was pretty nearly all monopolized by one or at the most two large corporations in each city. This was particularly true in this city. Another firm began bidding for work with a material which was claimed to be "just-as-good" and considerably cheaper. The material was a residual asphalt from California, but unfortunately for the asphalt the firm bidding had no previous experience in laying sheet asphalt. They bid quite low and were awarded a number of contracts. In order to compete with these inferior asphalts the original bidder began "skinning" the work and was detected by his competitor, who at once demanded an investigation. The investigation sustained the charge that the wearing surface was not of the required thickness. The two firms were doing work on adjoining sections of the same street. The investigation revealed the fact that in many instances the wearing surface was but 1¼ inches and in some places but 1 inch in thickness instead of 2 inches, as called for by the specifications, and in one case a thickness of but ⅞ inch was found. After tapping this pavement, which was laid with Trinidad asphalt, an examination was also made of the pavement adjoining. This was found to be of the required thickness and in numerous places slightly in excess. Both of these pavements were laid on concrete base 4 inches in thickness. Price complete, including excavation, was $1.67 for the residual asphalt and $1.55 for the lake asphalt, under a five-year guarantee. These prices were below actual cost. But the remarkable part of the tale is this: The pavement laid full thickness shortly after being laid began to show signs of disintegration and wear until at the expiration of the five-year guarantee period the pavement looked like a crazy quilt and had cost a considerable amount each year for maintenance, while the pavement which had been "skinned" has not shown any signs of wear whatever after seven or eight years of traffic and is apparently in as good condition as the first day it was laid, thus showing the superiority of the high-grade asphalt, even tho handicapped by the deficient depth of material.

¶ GOOD PAVEMENT, *laid with good materials, tho not of specified depth, proved the most durable.*

Just prior to levying the assessment for the portion of the street laid with material of insufficient depth, the residents made it known that they would refuse to pay full assessment on the grounds that they were not benefitted to the extent of a pavement constructed of full depth. The city agreed in this contention and sued the company to recover the amount which it would have cost to construct the pavement full depth. The city retained an eminent consulting engineer to assist in preparing the case for the city's counsel and he at that time, after making a thoro analysis and examination, reported that, while the street was not constructed of the required depth, it would, in his opinion, more than outlast the guarantee and that it was constructed in an excellent manner (except for the depth) and with high-grade materials and with an asphalt of exceptional quality. Time has proven that his contentions were entirely correct.

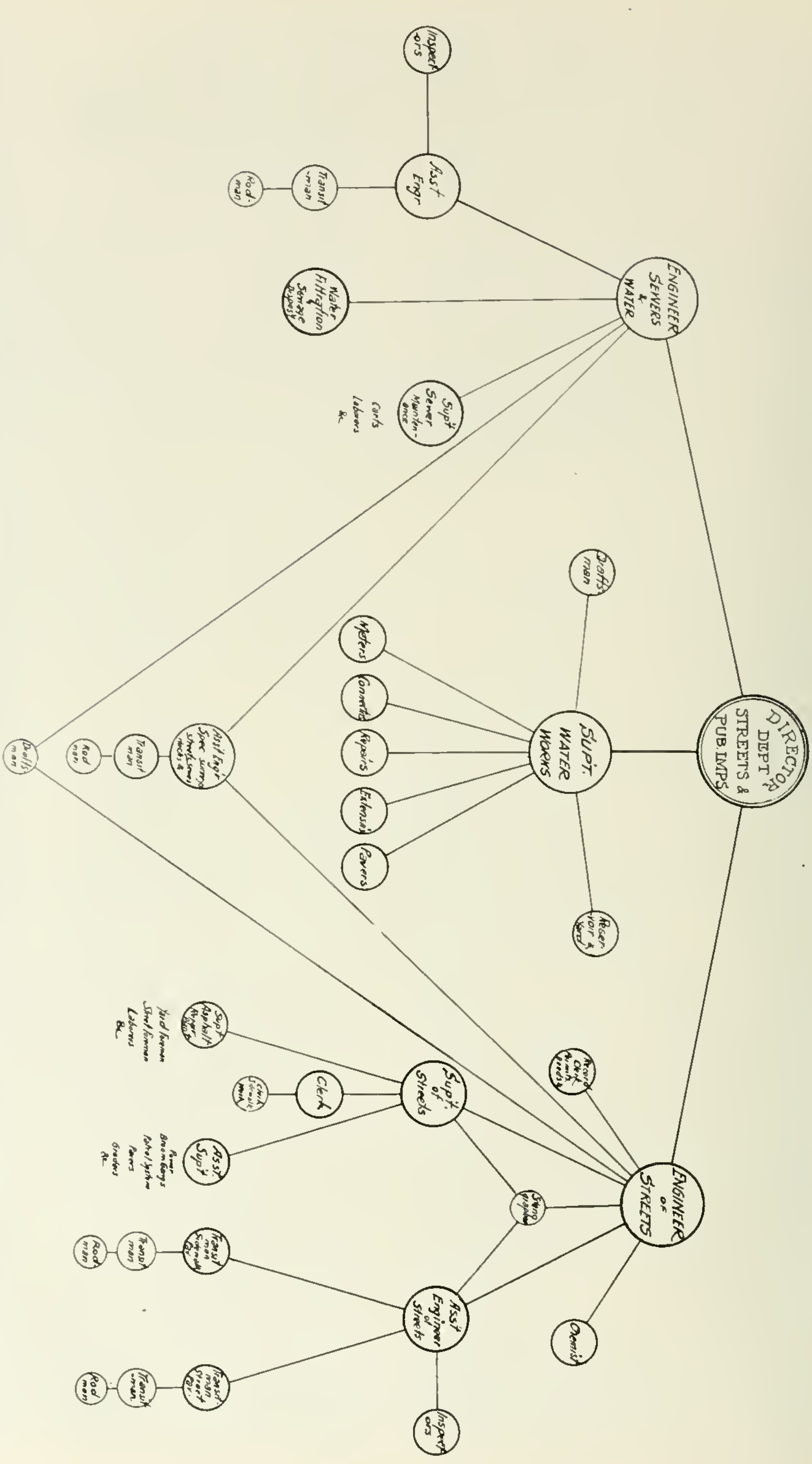


CHART showing the organisation of the Trenton, N. J., department of streets and public improvements. Note the method of showing the interdependence of officers and the division of labor of some employes between two or more such officers.

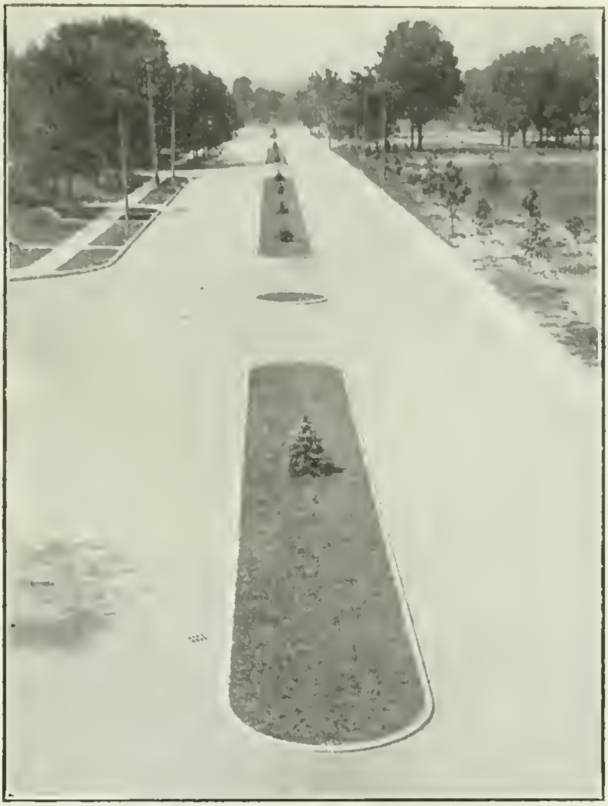
This experience with the two classes of asphalts has had a tendency to somewhat prejudice the city officials in favor of the Lake asphalts, altho we have one very large pavement constructed with "Texaco," which has been down for a period of about three years and is giving excellent satisfaction, as well as one or two with other brands of "California." For this reason the largest percentage of the number of miles of asphalt streets is constructed with Bermudez and Trinidad asphalts.

The next epoch marks a departure in the type of asphalt pavements to bituminous or asphaltic concrete pavements. It is an epoch also by reason of the fact that the city first began to lay pavements of a proprietary nature. The first of these was constructed in 1908, composed of a ¾-inch stone and sand which was bound together with a so-called "waterproof paving cement." Several miles of these pavements were laid in various types, none of which have given entire satisfaction. After three years' use considerable repairs have had to be made under the 5-year guarantees. They were laid upon streets carrying moderately heavy traffic. The city at that time did not employ a chemist and therefore very little supervision was exercised over the quality and kind of ingredients used in the paving mixtures. The cheaper pavements cost, including excavation, a 4-inch concrete base (1:3:6) and 2 inches of wearing surface and a 5-year guarantee, \$1.50 to \$1.58 per square yard, and the most expensive type cost \$2.48 constructed under the same conditions.

In 1911 the city adopted the Commission form of government and fortunately, the people elected a civil engineer as one of the commissioners, who was afterwards selected as director of the department of streets and public improvements. He immediately began to make a detailed inquiry into the workings of the department. After considerable thought and study the department was reorganized in accordance with the chart herewith appended. After this, steps were taken to establish some new policies and departures in the administration of the department. Among the reforms instituted were the following:

The standard specifications were adopted for use in the city, thus insuring open and free competition on all future work.

City paving inspectors were placed on a merit basis and an effort was made to start an educational campaign among them to increase their efficiency.



NEW STREETS *are often designed with parking in the center. This is a view of Parkside avenue, on which filbertine pavement was used.*

Neither patented nor macadam pavements are recommended for any future improvements.

Estimates are made up and bids received in bulk under the alternate bidding plan for the entire year's work with the idea of bringing about the maximum amount of competition, thereby reducing the cost to a minimum.

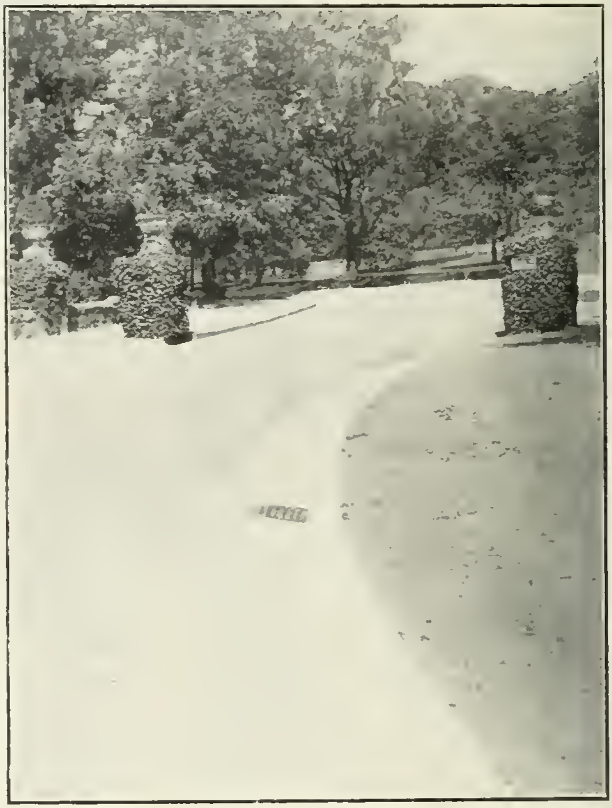
Employment of a city chemist, to supervise especially the asphalt work.

The city returned again to the extensive construction of vitrified brick pavements after a lapse of many years. Notwithstanding the good results heretofore obtained the city had not used brick to any extent for ten years. A brick rattler was installed, and tests are made on each car load of brick received.

The practice of accepting and acknowledging the right of the abutting property owners to select the paving material on each street was rejected. Selection was placed in the hands of the engineering department, subject to approval of city commission, altho due consideration is given to the preferences of the owners.

During the coming season grouted granite block pavements and wood block will be given serious consideration. Two very small sections of wood block, amounting to perhaps 400 yards in all, were laid several years ago under very unfavorable conditions. One was laid on a grade of about 3¾ per cent. and the other on a street where car tracks existed and the transverse grade was found to be 6 per cent. Both of the pavements were of course failures and the blocks have been replaced with other material. During the last two years the city has experimented with concrete pavements to a small extent, using both the one-course and two-course pavements. These pavements have been used on alleys exclusively with varying degrees of success.

Special attention has recently been given to the details in the design of streets. For instance the department has endeavored to combine utility and beauty. Parking of streets, where they are wide enough and the locality suitable, is now a regular policy. Every effort has also been made to eliminate the unsightly and undesirable valley or dish gutters. Where storm water drains do not exist to which to connect inlets and the grades permit it, reinforced concrete trunks have been designed and constructed. One of these is shown in one of the accompanying photographs. Likewise, in several instances reinforced concrete inlets have



REINFORCED CONCRETE INLET *to sewer, showing its adaptability to concrete gutter on curve and without breaking the continuity of the concrete curbing.*

BETWEEN *the inlet in the curb at the extreme right and the outlet at the extreme left runs a reinforced concrete trunk to carry the storm water on the main street across the side street without using the dish gutter, there being no storm water sewers in this district.*

been designed and used in localities where it has been found necessary to place a great number of inlets to intercept surface water. These have been substituted where the use of so many iron inlet frames would have a tendency to disfigure and mar the curbing and general effect. It was found that this type of inlet was readily adaptable to all kinds of curves, without affecting their continuity.

These innovations and departures in administration and public policy, the writer believes, mean much for the taxpayer, not only in increased efficiency but ultimately in vast savings in dollars and cents, for the present system represents a more progressive and business-like method.

The total mileage of all streets and alleys has been computed to be 146.67 miles, of which 46.84 miles are paved. This shows that 32 per cent. of the total mileage is paved, made up as follows:

	Miles.
Asphalt	18.36
Brick	10.82
Belgian Block	4.79
Bituminous Concrete	8.78
Concrete	0.90
Macadam (water bond)	3.19

These figures do not include the pavements laid in 1913, nor the several state roads taken over by act of Legislature.

Good Money in Swimming Pool

The cost of building and operating the St. Louis public swimming pool has been stated as follows by Park Commissioner Davis, who has it in charge. He shows that during the two months the pool was in use last summer 500,000 people used it at an actual per capita cost of 1½ cents each. Interest on the money used in building the pool and depreciation of the property brought the per capita cost to 2½ cents for each bather.

The cost of building and operating the pool is itemized:

For grading and ground shaping, $13,000; for concrete paving, $9,000; sand beach, $1,000; dressing rooms, $16,000; ornamental lighting, $1,860.64; fencing, $925; miscellaneous, $1,200. Total cost, $42,985.64.

The pool was used for two months at this maintenance cost:

Salaries, $5,609; laundry, $500; janitors' supplies, $75; towels, $671; bathing suits, $1,945; electricity, $84.55; water, $1,920; miscellaneous, $1,200; interest and depreciation on the property, $4,444.90. Total, $16,148.85.

Representative Against Concentrated Municipal Government.

By James L. Mayson, City Attorney, Atlanta, Ga.

While Mr. Mayson's view may be influenced too much by the notable successes which Atlanta's citizens have had in securing good results from a form of government notably lacking in closeness of organization, he states some truths which it will be well for all to consider along with those in Mr. Bradford's article in the December number of MUNICIPAL ENGINEERING.

"FOR FORMS OF GOVERNMENT LET FOOLS CONTEST,
WHATE'ER IS BEST ADMINISTERED IS BEST."

IT seems to me that the slightest consideration of government, national or local, would lead finally to the conclusion that that government is best which is best administered, without regard to form.

Certainly no form of government can be devised which by some sleight of hand will universally eliminate either real evils or imagined evils. I use the latter terms advisedly. There are frequently more evils imagined, by more or less of the citizens, as existing in the local government, than there are real evils. At any rate, the fact that the commission form of government works well in one city is no reason why it would work well in another. To say this would seem to express the simplest truth. Yet the advocates of the commission form of government present that form as a patent medicine, namely, as a form that will cure all municipal evils. The error is so apparent that any one except an enthusiast would discover it.

It is claimed there are about three hundred municipalities, of varied sizes, which are operated under the commission form. This commission idea appears to have been in existence for about twelve years. Now it is surprising that a form of municipal government which is a universal cure and which will bring to all municipalities relief from all municipal evils, has only been accepted by three hundred cities during twelve years of effort. It is, furthermore, surprising that this limited result has come to pass when this idea has captured the ear of the municipal and daily press. It has been dinned into the ears of dissatisfied citizens for this long time, and the result has been so exceedingly small as to be startling when we consider that the American citizen is so quick to realize the use of improvements. For instance, a patent which has in itself much good is readily taken up by corporations within much less time than twelve years. So this patent-medicine scheme for curing municipal troubles would certainly have been more generally accepted within twelve years if it had in it the virtue claimed by its progenitors.

Again, it is amusing to see that the advocates of a commission form of government do not agree upon the essentials thereof. Surely a discovery of this importance would have some central truth about which all minor differences would gather and crystallize. Yet we find as many varieties of the commission form of government as there are modes of medicine, each one contending that it is the only simon pure article, and all others are frauds and mistakes.

For instance, in one form a board of commissioners, of a limited number, is elected by the people and given supreme power over municipal matters. Of course, the fact that there are only five elected as commissioners, instead of a board of aldermen of twenty or thirty, makes all the difference in the world. Where the people elect a small number of men there is no politics in it at all. Where they elect twenty or thirty there is a great deal of politics. At least this is what the gentlemen who are exploiting this municipal doctrine tell us.

¶ THE COMMISSION APPOINTED *by the Governor and the single headed commission are both undemocratic.*

Again, the governor sometimes appoints six or seven commissioners. Now, we all know that politics is a thing foreign to any governor of any state. He would never, for anything in the world, appoint his friends commissioners as a reward for faithful services. We know that this is never done, beginning with the greatest states, like New York and Pennsylvania, and coming down to the smallest. The fact that the governor does the appointing hedges the thing around with a divinity which should bar all criticisms. At least this is what the advocates of this particular form claim.

But the third and last form of the so-called commission government served out to the American citizens is that form which selects one man to run the town. This is so foreign to a republican form of government, local as well as national, that it is difficult to see how any man could seriously insist that this method be adopted. Look over the citizens of your own town, whether it be a big or little one. Put your finger on any one man to whom you would be willing to give all power in your particular municipality. If there be such a man, I undertake to say he would never serve in that capacity; he would not accept the responsibility. The fact that he is acceptable is the very fact which makes him decline to accept the position. Therefore we fall back upon the man who will take the job, the politician, the delight of the daily press and cartoonist. We presume the giving of all power to any one man makes this one man a better man than he would be if he was one of twenty or thirty. At least this is the argument back of the suggestion.

So we submit that there are so many forms of commission government, whose advocates cry "lo here!" and "lo there!" that our minds are confused and we are undecided whether to take the allopathic form of the single commissioner or the homeopathic form of a board of commissioners elected by the people. Its advocates and the press, strange to say, are unable to see the ridiculous absurdity presented by these confused forms of government supposed to be remedial of every evil.

We are told that the fact that only a few men are elected to take charge of city matters makes the selection of the few men more important, and, therefore, causes better men to be elected. But this is untrue, as shown by the fact that where commission government has been established many of the former officials have been elected commissioners. In other words, the change of the form of government has not changed, in a majority of instances, the men who control.

¶ MANY SPECIAL FEATURES *of modern city government are claimed by the advocates of the commission form which have been in use with other forms for many years.*

Again, the doctrine of recall and referendum is set forth as peculiar to the commission form of government. It does not appear to these advocates that this is unfounded. For instance, the same principle can apply to the aldermanic form of government. In our own city of Atlanta it has recently been incorporated as a part of the charter of the city and it is just as workable in the aldermanic as it is in the commission form of government.

We are told that more careful attention is given to streets, water supply and other pubilc works under the commission than under the aldermanic form of government. Of course, this is a mere assertion by one friendly to the former as opposed to the latter. The statement could be as easily reversed and just as emphatically made.

In Atlanta we own our water works system, as opposed to Birmingham, a city governed by commission form of government, where the water works system is owned by a private corporation. How is it that the aldermanic form secures for the people its own water works in one city and the commission form does not secure for the people its own water works in another city, if the commission form has the power so extensively to revolutionize local situations and produce results remarkable for progress and general betterment?

¶ RETIREMENT *and prevention of floating debts and revenue from interest on city funds are not special prerogatives of the commission form.*

Special emphasis is put upon the fact that floating debts have been retired in Galveston and other cities. This is mentioned as resulting peculiarly from the form of government adopted. That this does not follow is shown in our own city of Atlanta, where floating debts were abolished as far back as 1874, under a charter which provides for an aldermanic form of government. Since that time floating debts have been unknown in this city. The same thing doubtless exists in many municipalities governed by council or board of aldermen. It is unfair to claim that a simple change of a form of government from the aldermanic to the commission form will pay off floating debts or prevent same from being incurred. A simple examination will show that one or two cities, under the councilmanic form, have done these things. This was caused not by the form, but by the officers. The same thing could happen under the commission form if the same character of officials were elected.

Again, this article says that funds on deposit in banks have been made to yield a revenue. Now, this statement is made for no other purpose than to say that it results from the adoption of the commission form of government. In the city of Atlanta this has been done for many years, so long ago that few people could now tell the particular year in which it was begun. Yet it is here set forth as peculiar to the commission form of government. On the contrary, it has been done, in many instances, by cities under the aldermanic form, and that long before the idea of commission government in cities was ever thought of.

Again, the method of accounting is said to be improved in cities adopting the commission form of government. It seems childish to say that the method of accounting will be good under a commission form and must be bad under an aldermanic form of municipal government. It is opposed to all experience. These things depend upon the character of the officials rather than upon the form of local government. However, if some simple fact is needed which will destroy this impression, I refer to the fact that the most scientific and modern form of accounting ever conceived is that adopted by the United States for municipalities, and that this form has been in use generally in many municipalities and is in use in my own city of Atlanta, where the aldermanic form prevails. A city can have a good system of accounting under one as well as under the other form of government. This is not a statement by a zealous advocate, but an examination of the census reports in Washington will disclose this fact.

¶ VICE AND CRIME *can be and are suppressed as well or better under other forms of municipal government.*

Again, we are told that crime is suppressed better and vice has been restricted more under the commission than under the aldermanic form of municipal government. Let us see. In none of the cities governed by a commission have the houses of ill fame been closed. Yet in Atlanta and other cities where the aldermanic form of government is maintained this has been done. Now, I do not maintain that this was done because of aldermanic form of government. I know it was done because of the officials in the city rather than the form of the city government. Yet it is conclusive evidence that vice can be restricted under either form of government when I mention one city where it has been done, which has not a commission form of government, even when I challenge the production of a city under the commission form which has done it.

So on down the line. The bold declarations made in favor of the commission government, "glittering generalities," said to attach to this form, leaving the impression that these very desirable things will not arise under an aldermanic form, are all idle vagaries and unsupported by fact.

The present discussion is old. When man began looking around for a form of government this discussion arose. At first the kingly form was deemed best. Yet history shows that all power, national or local, cannot be given to one man. It took the race many years to find this out, but it has found it out, and that fact is now generally accepted. Yet we are now told that one man can best manage a city and that is the particular form of government to be commended. We insist that this is simply returning to a worn-out error and that very few cities will try it long.

After man found out that the "one-manager" idea would not do, he decided that two or three "managers" would be all right. Thus the oligarchy came into existence. It took some governments many years to find out that this was not only a weak form, but a very vicious form. It was rejected many years ago, and has not even been discussed as a desirable form of government until of late years, when this worn-out plan has been held up as the model form for municipalities. History will simply repeat itself. The old idea of board or commission will last for a while, but will become weakened. Concentrated power will bring corruption and the commission form of government will explode just as the old oligarchy passed away and is now buried beneath years of contempt.

In the progress of time it was ascertained that while a republic was not always the strongest form of government, yet in the end it was the most honest form. At last, it is better to have honesty in the individual, as well as honesty in public matters, than it is to have too much shrewdness. Bacon was said to be the "wisest, brightest, but meanest of mankind." No one holds him up as a model. The commission form may be bright, but it is not republican. It is opposed to the march of events. It will pass away in a few years. Coming generations will dig around its ruins and wonder at the credulity of the Americans of the present day who undertook to model their cities around a form of government rejected by their progressive ancestors before America was discovered.

WINDOW BOXES IN A BUSINESS BLOCK

Beautiful effects may be obtained by combinations of foliage plants giving contrast and color. Dracenia, Vinca, English Ivy, Coleus, Boston Fern, Dwarf Canna, Coben Scandieus and many others known to florists may be used. Bay trees or urns at building entrances give beautiful effects. The ingenuity of the citizen will doubtless develop many rare and individual decorations.

Hydro-Electric Development at Stevens Creek, Ga.

By George G. Shedd, Supervising Engineer, Augusta, Ga.

Many of the problems in this structure are the same as those of the municipal water supply engineer. This is from one of the papers provided by the Engineering Section of the American Association for the Advancement of Science, which is now taking high rank among the technical societies.

AT the present time there is perhaps no section of the country that is being so rapidly developed as the South. Contributing in a large measure to this is the development of its water-power resources, and the consequent attractive inducements that are being made to manufacturers to locate here.

A development of 31,000-h.p., ultimate plant capacity, known as "the Stevens Creek Development," is being built for the Georgia-Carolina Power Company, on the Savannah river, about eight miles above Augusta, Ga., to supply the power market centering about that city.

Drainage Area—The drainage area of the Savannah river, including that of Stevens creek, is about 7,200 square miles, at the site of the plant, and is to a large extent rolling country, the upper part being rough and largely covered with forests, while the lower part is cleared and under cultivation.

Run-Off—The lowest daily flow recorded during the period 1892-1912 was 1,610 cu. ft. per second, on October 12, 1904, and the highest 316,000 c. f. s., August 27, 1908. The lowest average monthly discharge during the period from 1884 to 1912 occurred in October, 1904, and was 2,080 c. f. s., and the highest average monthly flow, 46,360 c. f. s., in September, 1888.

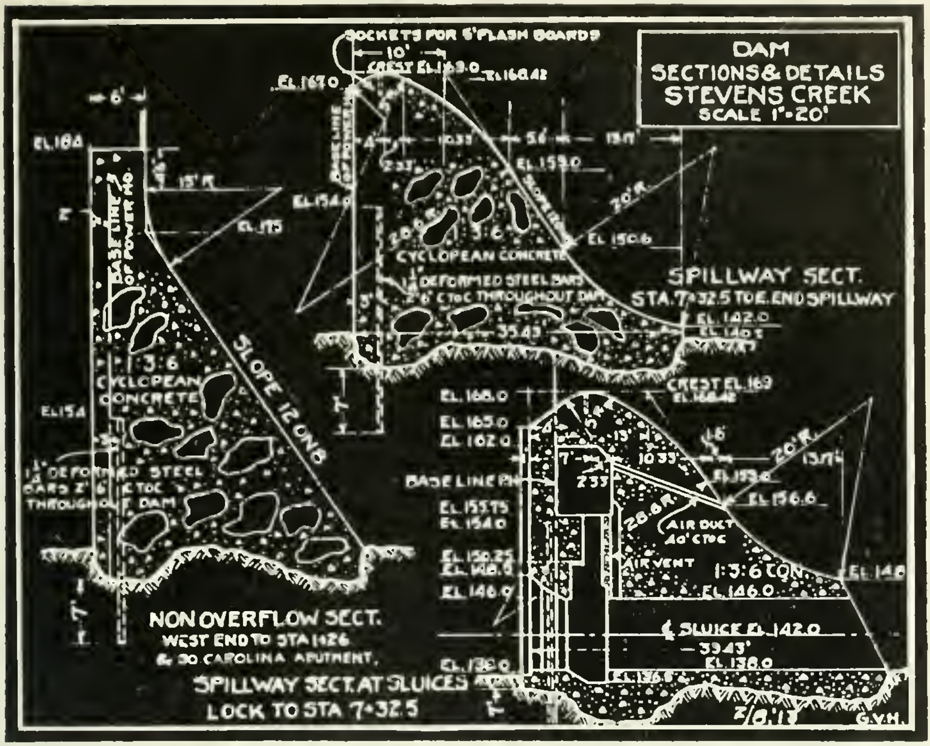
Power Available—The average horsepower available for the development has been computed for a period of twenty-seven years, and on a basis of a load factor of 33 1/3 per cent. is found to be very rarely less than 20,000 delivered horsepower.

Location—The location chosen for this development is just below the confluence of Stevens creek with the Savannah, and practically at the foot of a long series of rips in the main river. This location was determined to be the most economical and safest, after detailed surveys and numerous borings and soundings had been made.

General Description—In brief, the development consists of a dam having a total length, including power house, of 2,700 feet, a power house designed for an ultimate equipment of 31,000-h.p., with a present installation of 15,600-h.p., and the lock 30 feet wide and 150 feet long in the clear. A pond created by the dam extends about 14 miles up the Savannah river and about 13 miles up Stevens creek, and will have a surface area of about 4,200 acres.

Dam—The dam is constructed of cyclopean concrete. The spillway section is 2,000 feet long, of the ogee type, with an average height of about 30 feet and a maximum height of 47 feet. At the average height the sectional area is 619.5 square feet, and the base width 35.43 feet. The non-overflow sections have a combined length of 233 feet, with crest elevation 15 feet higher than the spillway.

The dam was designed to pass safely a freshet of 450,000 c. f. s., which is almost 50 per cent. larger than the greatest freshet on record—that of August 27, 1908, estimated to be 318,000 c. f. s. It is estimated that the 1908 freshet would



THESE CROSS-SECTIONS *of the Stevens Creek Dam show the method of construction. The accompanying photograph shows the spillway with sections in all the various stages of construction.*

cause a depth over the crest of 11.3 feet.

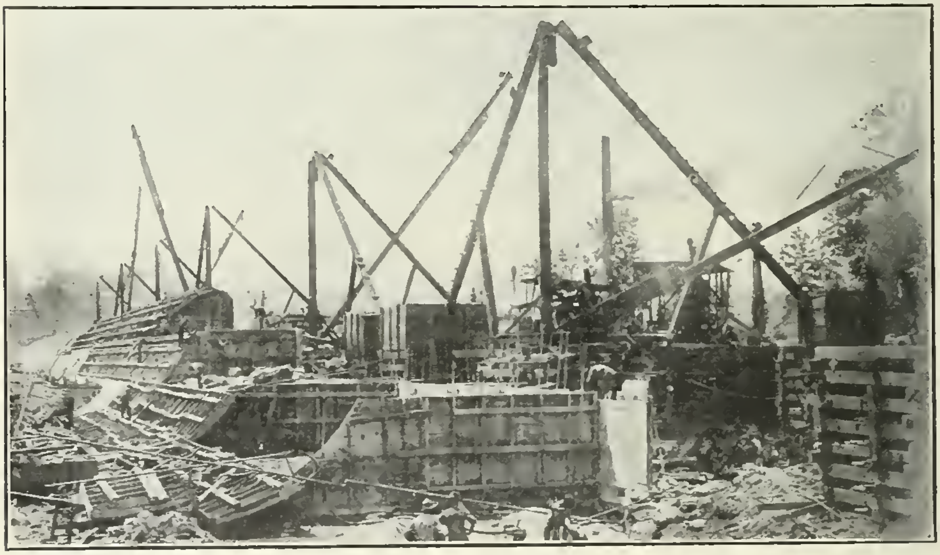
In order to assist in operating flashboards on the dam, as well as to aid in taking care of water during construction, and to provide a means for complying with the government requirement that no water shall be stored when the flow is below a certain specified limit, five sluice gates, 8 by 8 feet each, with Venturi setting, are provided thru the spillway section adjacent to the lock, and are operated at present by hand from a tunnel in the dam, provision being made, however, for a future motor operation.

Provision is made for the future use of flashboards, and sockets are also provided for guard pins, to safeguard the men when operating flashboards. At the request of the U. S. War Department engineers, deformed uplift bars having an equivalent sectional area of 0.625 square inch per lineal foot of dam, are placed vertically 3 feet from the upstream face of dam, extending 7 feet into the ledge and 15 feet or more into the dam, thruout the length of the dam and lock walls.

Great care has been used to secure a good foundation thruout. The ledge is principally an excellent quality of granite and schist, but at three points, one in each of the principal channels, it was necessary to remove from 10 to 20 feet of disintegrated rock before securing a good foundation.

As a preliminary to foundation work, test holes are drilled to determine character of ledge and to locate any possible seams. If necessary to determine extent of seams, Magenta dye has been forced in under pressure. This method has been very satisfactory, in that the character of the ledge being known in advance has prevented unnecessary drilling and excavation, and has also disclosed the presence of several dangerous, smooth, horizontal seams, to which it was necessary to excavate the ledge in order to prevent possible uplift and sliding. These test holes, as well as other holes, where necessary, were grouted under 100 pounds air pressure. Whenever necessary to prevent possible sliding, trenches have been cut in the ledge. It is believed that by these methods a very secure foundation has been secured at a minimum cost.

Lock—To meet the requirements of navigation, a concrete masonry lock has been constructed adjacent to the power house. The lock is 30 feet by 150 feet in the clear, and has a lift of 27 feet. There will be at least 6 feet of water over the lower miter sill, and the upper miter sill is 12.5 feet below the masonry crest of the spillway. It will be filled and emptied by means of a 6 by 6 culvert and ports, leading into the side of the lock, and controlled by gates set in gate wells near the lock gates. Heavy wooden lock gates have been provided, to be operated by hand winches.



STEVENS CREEK DAM *under construction, as it appeared August 29, 1913. A completed portion of the spillway of the dam is seen in the background and the various sections in which the concrete was placed are shown by the work going on in the foreground.*

Power House—The power house is designed for an ultimate installation of ten 3,125-h.p. vertical main units and two 450-h.p. exciters. The substructure is built complete for a superstructure 51 by 388 feet in plan, and consists in its lower part of cyclopean concrete and its upper part of reinforced concrete. The superstructure at present is built for five units and two exciters only, and consists of a steel frame with brick walls, and is provided with a 50-ton electric traveling crane.

Hydraulic Equipment—The turbines are being furnished by the I. P. Morris Company, and are of the vertical, single runner, 75-r.p.m., single-discharge type, 104 inches in diameter, set in a concrete spiral casing, and provided with concrete draft tubes. The efficiency is expected to be better than 86 per cent. Each unit is provided with a double floating lever oil operating governor, which can be controlled from the switchboard or by hand. A central oil pumping pressure system is provided, working normally under an oil pressure of 200 pounds. All operating parts of the turbine are accessible for quick repair, if necessary, making it unnecessary to unwater wheel casing with the one exception of accident to runner. The exciter turbines are 450-h.p., 40-inch diameter, 200 r.p.m., of a type similar to main turbine.

Electrical Equipment—The electrical equipment of the first installation consists of five Westinghouse, vertical type, revolving field, 3-phase, 60-cycle, 2,300-volt, 2,700-k.v.a. (at 75 per cent. power factor) generators, two 300-k.w., 250-volt vertical-type exciters, three 5,400-k.v.a. transformers, stepping up from 2,300 volts to 44,000 volts. All wiring, where possible, is installed in conduits, buried in the concrete floor.

Transmission Line—The transmission line to Augusta is approximately seven miles long, with Milliken type, galvanized steel towers, designed for two circuits, with three wires on each side. The height to the lowest cross-arm is 50 feet. The tower spacing is approximately ten per mile. At the Lake Olmstead crossing special towers are provided, 80 feet high, for the span of 960 feet. In the city, along the canal, latticed steel poles, spaced 200 feet apart, are used. The wire for the power circuits is No. 1/0 17-strand medium hard drawn copper, and the ground wire is 5/16-inch, 7-strand, copper-clad cable, having 30 per cent. conductivity. A telephone circuit is run on the towers 10 feet below the lowest power wires, and is transposed at every tower, and all instruments are protected by transformers. The power circuits have one complete transposition between the power house and the substation, and are hung on Thomas No. 1118 suspension type insulators.

Substation—The Augusta substation is located adjacent to the steam plant of the Augusta-Aiken Railway and Electric Corporation. On account of the limited ground space, the building was designed with two galleries. There will ultimately be installed three banks of three each, 2,000-k.v.a. single-phase transformers, stepping down from 44,000 volts, 3-phase, to 13,000 volts, 3-phase. Only one bank of three transformers is at present installed. Provision is also made to step down from 13,000 volts to the existing circuits in Augusta of 2,300 volts, 2-phase. All of the switches in the substation are remote control, and will be controlled from the switchboard in the steam station. All apparatus in the substation is furnished by the General Electric Company.

A Permanent Lighting Exhibit

A miniature exhibition of lighting and illumination effects shown by the Illuminating Engineering Society at the International Exposition of Safety and Sanitation in the Grand Central Palace, New York, December 11 to 20, 1913, was awarded a grand prize. In many respects this exhibit was remarkable and unique. Side by side were models and pictures of good and bad lighting. Comparative conditions were clearly exposed. Uses and misuses of light, with their attending good or bad results, were indicated in ways which were at once striking and impressive. So apparent were the advantages and superiority of good lighting that one might have wondered why so many examples of bad illumination could be found. The latter fact is all the more curious when it is learned that good lighting may be had in many cases at a cost not much, if any, greater than that paid for the bad illumination—in not a few instances it could be obtained for even less. It seemed evident that lighting may be good, bad, or otherwise, depending largely upon the care and skill with which it is planned and how it is used. The exhibit consisted of a series of booths and a large collection of pictures.

The entire exhibit, which was installed under the direction of a special committee of the society, is to be placed in the American Museum of Safety, 29 West Thirty-ninth street, New York, where it may be seen free by the public.

This is a demonstration of what a business administration of a municipal electric light plant can accomplish under the management of a competent engineer, J. R. Thomas, the superintendent. The weak spot is found in the necessity of asking the question, "What will the new city administration do to the present organization?"

A BUSINESS-LIKE CITY LIGHTING PLANT

THE success in the operation of the Crawfordsville municipal lighting plant, the history and construction of which was outlined in an article in MUNICIPAL ENGINEERING for February, 1913, vol. xliv, p. 81, has been continued under the same efficient management, the results of whose efforts were given in connection with that article.

The development in the use of electric power from the plant has been phenomenal, especially during the year 1913. This development is shown graphically in the accompanying chart, which shows the proportionate consumption of electricity by customers for power purposes for each month in 1912 and 1913. This diagram shows an almost constant increase, which was especially notable during the last five months of 1913. At the beginning of 1912 the power load on the plant was less than 150 h. p., whereas at present nearly 1,200 h. p. of motors are connected, showing an increase in the two years of at least 1,000 horse power, or more than 650 per cent. There has been a material increase in the lighting load, but it has nothing so remarkable about it as this increase in power load.

Three factors are important in producing this growth.

The first is the ability to produce the power, which was so fully supplied by the efficient management by the construction of the new plant which is described in the article referred to.

The second factor in the growth is the rates for power. These were fixed in September, 1911, at the following low schedule:

First 100 k.w.	4 cents
Next 400 k.w.	3½ cents
Next 500 k.w.	3 cents
Next 1,000 k.w.	2½ cents
Next 5,000 k.w.	2 cents
Next 5,000 k.w.	1¾ cents
Next 10,000 k.w.	1½ cents
Next 10,000 k.w.	1 cent

Up to the beginning of 1912 these rates did not have any very pronounced effect upon the increase in consumption and the large increase did not begin for a year after the schedule of rates was adopted.

The third factor in the increase in business has been an aggressive campaign for new business, especially in the power line. Solicitation and advertising have both had their effect, and the excellence of the service has retained the old customers and attracted new ones.

¶ NEWSPAPER ADVERTISING *proclaims the benefits of the use of electric current.*

Three-column advertisements have been run in the daily papers at intervals which are striking in their showings and in the arguments in favor of the use of electricity for power.

One advertisement compares the 1,000 horsepower of the electric motors in use with the 800 horsepower or less of all other forms of power in use in the city, and rests its argument on the question as to what is the reason for the phenomenal increase in the use of electric power and the answer "Ask any of our power customers."

Another advertisement on the same line shows that 18 of their 56 power customers have exchanged the use of 603 horsepower of other sorts for electricity from the municipal plant, 14 of whom were satisfied with their old plants until the management of the electric plant demonstrated that it could furnish cheapeer and better power.

The latest advertisement occupies four columns, shows the diagram reproduced herewith on a large scale, and contains the following reading matter:

Crawfordsville Electric Light and Power Co.

December was the biggest month in the history of The Crawfordsville Electric Light and Power Co.

Every month shows a material growth in the amount of electric power sold to Crawfordsville factories.

We are not only replacing other kinds of power with electric drive but are furnishing electric power to operate the additional machinery and equipment which the various factories are installing.

Every power user is a booster. Why?

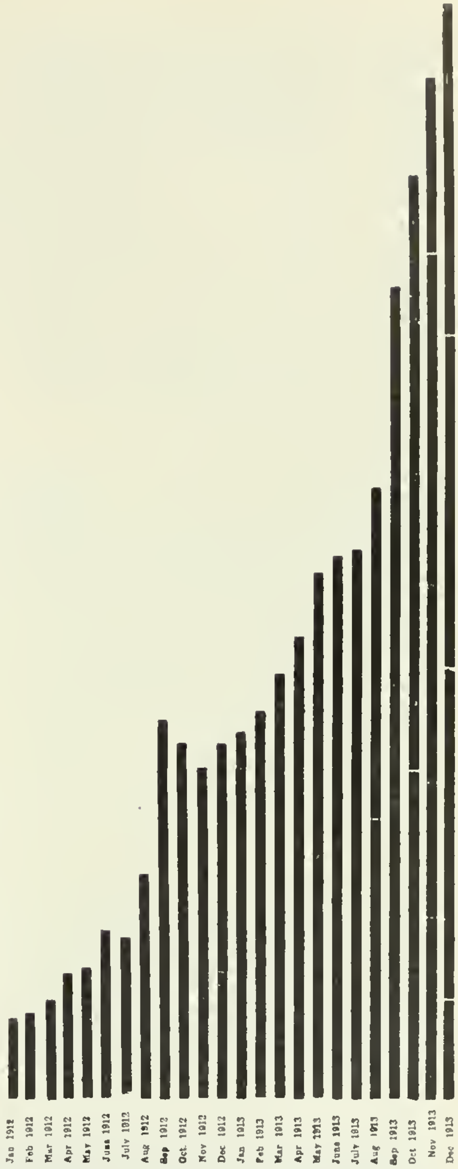


DIAGRAM *showing proportionate increase in electricity supplied for power to customers of the Crawfordsville municipal electric light plant. Less than* 150-*h.p. connected in January,* 1912; *nearly* 1,200-*h.p. in December,* 1913.

Because electrical power is cheaper. Because electrical power is more reliable. [Our power has been off only 3 minutes in over 2 years.] Because electrical power is more convenient. Because electrical power is more adaptable to any machinery. Because electrical power is available 24 hours in the day. Because electrical power requires no engineer. Because electrical power requires no fireman. Because electrical power requires no boiler insurance. Because electrical power requires no fuel. Because the other savings are too numerous to mention here.

Who purchases the supplies for your power plant, the fuel, boiler compound, packing, belt dressing, oil, waste, gage, glasses, oil cans, belt lacing, odds and ends—You?

Who receives the salesmen and listens to their voluminous arguments—You?

Who listens to complaints about this oil and that boiler compound—You?

Who listens to excuses for lack of power and shutdowns—You?

What is your time worth? Add that to all your power plant bills and contrast the total with the cost of your central station power—power that requires none of your time—that comes to you ready to use—that is always ready—always sufficient.

Those who have made the change are well pleased. Let us convince you.

The test of the permanency of efficiency in municipal operation is about to be made. A change in the political administration of the city took place on January 5 and the question has arisen as to whether the present efficient board and superintendent will be retained, and if they are not, whether an equally efficient management will be selected.

At this point it is pertinent to inquire why a change in the management of a business branch of the city administration should be made simply because a set of city officials has been elected who happen to vote for a different candidate for President of the United States.

The trustees of the Crawfordsville Electric Light and Power Company, owned by the city, who have been responsible for this enviable record, are M. W. Bruner, an attorney; G. B. Luckett, manager of a local brick manufacturing company, and G. F. Huggans, a retired engineering contractor. The executive officer of the board, who is responsible for all the technical matters and the details of operation, is J. R. Thomas, a young man, graduate of Purdue University, who has been in charge of the plant since 1903.

Motorcycles in Contracting Work

"The motorcycle enables a contractor to readily and comfortably supervise different gangs working in different sections at a small expense," states J. Ed Neolp, contractor, Columbus, Ohio. "I purchased my first motorcycle for this purpose in 1911 and so used it for two years at an up-keep expense of but $5.00."

A STREET RAILWAY TRAFFIC SURVEY

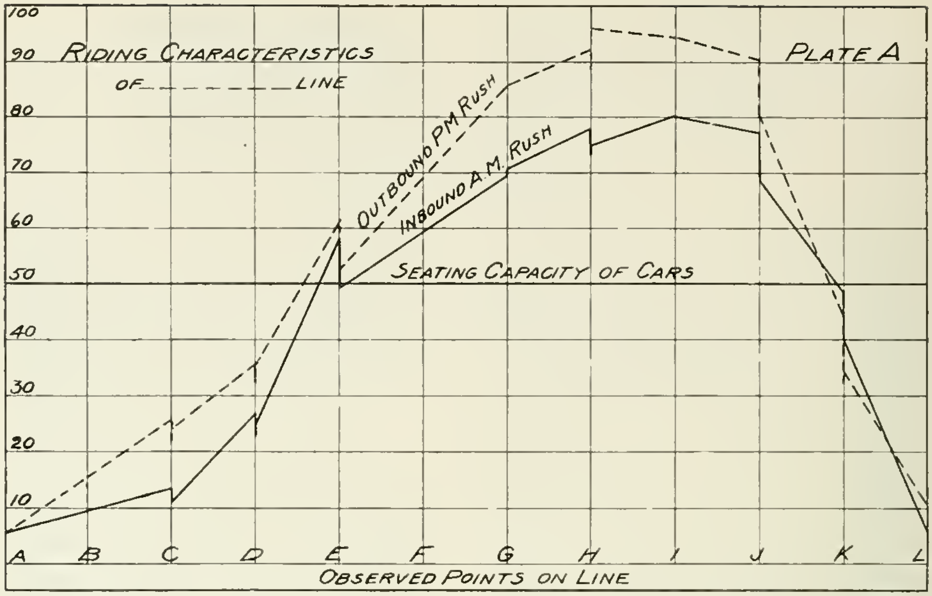
By C. M. Larson, Chief Engineer of the Railroad Commisson of Wisconsin, Madison, Wis.

One of the constant sources of complaints to municipal authorities is the lack of adequate street car accommodations. The author shows in this extract from a paper before the Wisconsin Electrical Association the method of making a traffic survey to show existing conditions, and the method of using the results in making a schedule for running cars.

THE modern street railway manager has at his disposal the means of obtaining exact data relating to traffic conditions and service requirements for every part of each line under his control. If he so desires, these may be plotted into charts that will show at a glance to any intelligent person just how one particular community fares compared with any other. These charts show him just where the operating department is wasting the company's money and why certain lines are operated at a loss when people are constantly demanding better service. By reference to them he discovers that his patrons are not so unreasonable as he had supposed. True he finds from his operating report that he has operated 2,000 car miles per day over this line, that considering the revenue and expense of operation there is no profit in operating this line, but upon a closer inspection of the chart he finds that a very large percentage of the cars have been running at a time of the day when nobody needs them or cares particularly whether they are operating or not. Simultaneously he discovers that during a correspondingly long period of the day, a great many more persons were desiring to ride than he has been providing for. He observes that a uniform schedule has been operated all day with additional cars during the rush periods, while as a matter of fact more than twice as many people ride in the afternoon as in the forenoon. He also discovers that a very small proportion of his patrons live within a mile or two of the end of the line while his cars have all invariably gone entirely to the end to make the turn, with a consequent large number of car miles operated to little useful purpose. His charts also show him that often there are relatively long periods when no service whatever is supplied, when interruptions have occurred. He may have been informed of this by the operating department but its real significance is only shown when plotted in this form.

If the system is of considerable size a traffic study department should be established either under the direction of the manager or the operating officer. If the system is small this officer may himself have direct charge of the details of the work provided he is thoroly familiar with the nature and scope of the investigation to be made. This department should not be a spasmodic affair, dependent for its existence upon a shortage of work in some other department. It should be permanent and should be prepared to supply to the manager or operating department reliable information of traffic conditions for any season, day, or hour, and upon any point of every line.

There is of course more than one way in which data of this kind may be collected, and the method best adapted will readily suggest itself to each company, but in whatever way this is done its collection should be under the direction of



CURVE *showing the variations in traffis at twelve different points on a street car line during the periods of heaviest travel in the morning and in the evening, indicating the points of maximum load and those where part of the service can be terminated. Note where the seating capacity is insufficient.*

the head of the traffic study department in order that results may be consistent and trustworthy. Checks of accuracy should often be made and the men taking the data should receive thoro instructions in methods best calculated to insure accurate results. It is usually desirable to record all data in bound pocket field books, tho printed cards may be substituted if desired.

It is common knowledge that ordinarily there is a certain point on each line near tbe beginning of the dischargal area where the number of passengers on the cars is usually a maximum. This point is approximately the same for travel in both directions and should be determined quite accurately as this is the point at which future observations will be made which will determine the number of cars necessary for operation of the line both during the rush and the non-rush periods.

Other critical and important points along the line are those where the number of passengers is so small as to justify the termination of part of the service at these points. In collecting these data a count of all passengers on all or a large proportion of the cars on the line should be made at predetermined points at intervals of a few blocks. A count at every block would be preferable in some respects, but this would require the presence of a man in addition to the conductor, while if the count is made only at intervals of several blocks, the conductor can usually do this in addition to his other duties except perhaps on heavy lines or during the busiest periods of the day. The count should cover a long enough period to obtain normal results with 24 hours as the minimum.

The figures thus obtained can be tabulated or plotted as shown on plate "A" attached. This plate shows the typical curve for the heaviest period in the morning and the same for the evening. On this plate is drawn a horizontal line showing the average seating capacity of the cars, and it will be noted that with a complete set of such charts, it is a simple matter to determine the point of maximum load and the points at which part of the service might be terminated. This latter determination cannot of course be made upon a study of the chart alone. A general knowledge of the rid-

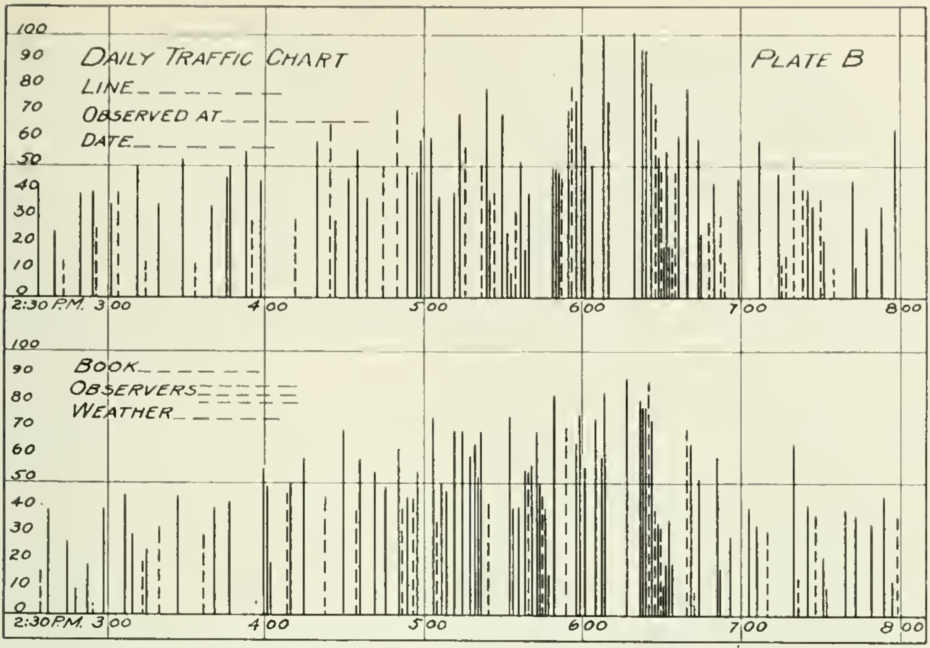


PLATE *showing traffic at different moments during each of two afternoons. Each vertical line shows the number of passengers in the car passing the point of observation at the time shown at the bottom of the line.*

ing habits of the residents in the neighborhood together with a careful study of transfer points must be coupled with the predetermined standards of service before such a point is finally established.

By use of the data thus collected, it is also possible to obtain a fairly accurate estimate of the average distance passengers are hauled for a single fare.

Having determined the point on the line where traffic is heaviest, accurate counts should be made covering a period of several days to insure normal results. For this purpose it is desirable to station checkers at the point in question with instructions to collect the following information for each car in both directions; the data for each direction being kept separately, preferably on opposite pages of a note book:

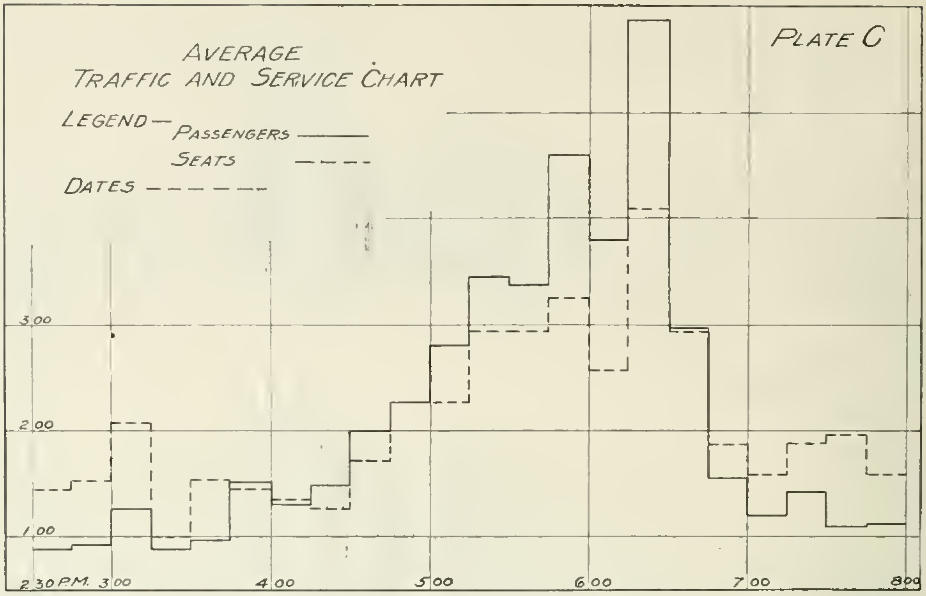
a. Route on which the car is operating.
b. Destination.
c. Origin when possible.
d. Run number when possible.
e. Car number.
f. Arriving or leaving time.
g. Total number of passengers.
h. Such other information as is desirable.

The field book should be ruled in columns with proper headings and in cases the cars come too often to permit of collecting all the data, only such as are positively necessary should be required. But in no case should a car be permitted to pass without a note to that effect even tho no data are taken.

It has been found that if the checker is familiar with the seating capacity of all types of cars, he readily becomes efficient in estimating the total number of passengers, basing his estimate on the relation between the vacant seats and those occupied, or upon the total number standing added to the seating capacity, after satisfying himself that all seats are occupied. Usually two checkers can cover one point for the entire day, but in cases of very heavy traffic, assistance is needed during the rush periods.

The data thus collected should be turned in for tabulating or plotting at the end of each day if possible, and any irregularities in schedule should be followed up and causes noted.

Weather conditions are important and should always be noted for all parts of



PLAT *showing average traffic and service. This gives the average for a number of days of such observations as those shown on Plate B, the averages being taken of all cars passing within fifteen minute periods. The average number of seats in the same cars is shown by the dotted lines and the comparison of the two sets of lines shows the conformity of the service to the traffic.*

the day, and note should always be made of any abnormal occasion such as ball games, park music, etc., which might affect the normal riding characteristics.

Having obtained the data from the checkers, this information may either be tabulated or plotted in the form of a curve or chart with all necessary notation to insure a true record of all pertinent facts. While to the engineer the latter method is usually desirable, others may prefer that the results be put in tabular form. These results may either be plotted by single days or the average of the total number of days observed may be included. In plotting each day's results it is desirable to represent the number of passengers on each car by a vertical line drawn from a base and to space these lines to represent the time interval between cars. Cars bound for different destinations, or originating at different places, may be represented by different types of lines as desired. Such a chart is shown on Plate "B," and represents part of the actual observations for two days on one of the lines in Milwaukee.

In plotting the average results obtained over a number of days, it is necessary to average the number of passengers by short periods, preferably of 15 minutes, and to represent the average number of passengers per period by a horizontal line extending across the space allowed for each period. Such a chart is shown on Plate "C," which is the average for several days on the same line as is shown on Plate "B." Upon this same chart can then be plotted the average number of seats furnished by the operating company during the corresponding period, and, if desired, the number of seats required according to any predetermined standard can also be plotted on this same chart..

Here then will be a complete record of the traffic, the service rendered, the service required and such other miscellaneous data as bear on the cast. Obviously this record is applicable to conditions for a certain season only. Such a record is necessary for week days, for Saturdays and for Sundays, as well as for other seasons of the year when the traffic is not of the same magnitude. There are, of course, variations in the traffic due to general weather conditions. These can usually be determined by general observations and the necessary steps taken for the required variations in the service.

Similar observations should be made at such points along the line as may be determined by circumstances. The principal purpose of these latter observations would be to furnish a basis for turning of cars which it is not necessary to operate the entire length of the line. The plotting of the data will be made in the same way as described for the point of maximum riding.

Standing by preference may refer to two different sets of riders. Certain persons may prefer to stand in a car whose seats are all taken rather than wait for a possible seat in a car following. There are also certain persons who prefer to stand even tho seats are available, provided they are permitted to ride in either the front or the rear vestibule. The proportion of last described passengers is quite large on certain types of equipment, especially if smoking is permitted in the vestibules and prohibited in the body of the car. As this preference may have a bearing on the amount of equipment necessary for satisfactory service, it is essential that checks be made. This can be done by careful count of persons standing when part of the seats are vacant, observing at the same time the total number of passengers riding, for the purpose of obtaining a percentage. The number of seats in the car must also be recorded, as the ratio of persons standing is affected to some extent by the number of seats vacant. Recent observations have shown that for cars with cross seats the ratio increases quite suddenly when about 50 per cent. of the seats have been taken, that is when there is an average of one person on a seat which normally is large enough for two. It is highly important that a complete description of equipment, company rules, etc., which in any way may affect this habit of standing must accompany any data of this sort, for it is obviously useless for instance to expect to find persons standing by preference in a closed car on which smoking is prohibited, and where passengers are never permitted on the front platform and only on the rear platform when the body of the car is so full that no more can enter.

It is not necessary here to go again into detail as to uses to which these data may be put. Too many schedules have been made in the past on anything but scientific bases. As stated above, the results demanded of the present day manager will no longer permit him to operate his railway by rule of thumb. The public is an interested party on one side and the manager representing the interests of his stock and bond owners is the interested party on the other side. Both must be recognized, and in order that full justice may be done to all, and that modern conceptions of the necessity of using all known means for the avoidance of waste and loss may receive due consideration, modern and scientific methods should be used to determine what is fair as between the parties directly interested, and what most nearly conforms to modern ideas of true economy. With the data collected and tabulated or plotted in serviceable form the manager or operating officer will at all times know whether or not he is doing justice to the position he holds.

As a sample of a schedule made up to give service as required and still avoid dead car mileage, the following table shows the variations in headway on the Court Street line in the city of Brooklyn, taken from testimony of Geo. L. Fowler, before the Railroad Commission of Wisconsin, May 6, 1912:

Time—	*Headway—*
5:00 to 5:36 a. m.	7.2 minutes
5:36 to 5:48 a. m.	6 minutes
5:48 to 6:00 a. m.	4 minutes
6:00 to 6:18 a. m.	3 minutes
6:18 to 6:52 a. m.	2 minutes
6:52 to 9:00 a. m.	1.6 minutes
9:00 to 9:12 a. m.	3 minutes
9:12 to 3:26 p. m.	4 minutes
3:26 to 4:00 p. m.	3 minutes
4:00 to 4:30 p. m.	2 minutes
4:30 to 6:12 p. m.	1.6 minutes
6:12 to 6:26 p. m.	2 minutes
6:26 to 7:00 p. m.	3 minutes
7:00 to 8:00 p. m.	3.2 minutes
8:00 to 11:00 p. m.	6 minutes
11:00 to 12:50 a. m.	15 minutes
12:50 to 1:08 a. m.	16 minutes
1:08 to 4:28 a. m.	20 minutes
4:28 to 5:00 a. m.	16 minutes

STEEL SHEET PILES IN EXCAVATION WORK

By Jules R. Breuchaud, President of The Underpinning and Foundation Company, New York City.

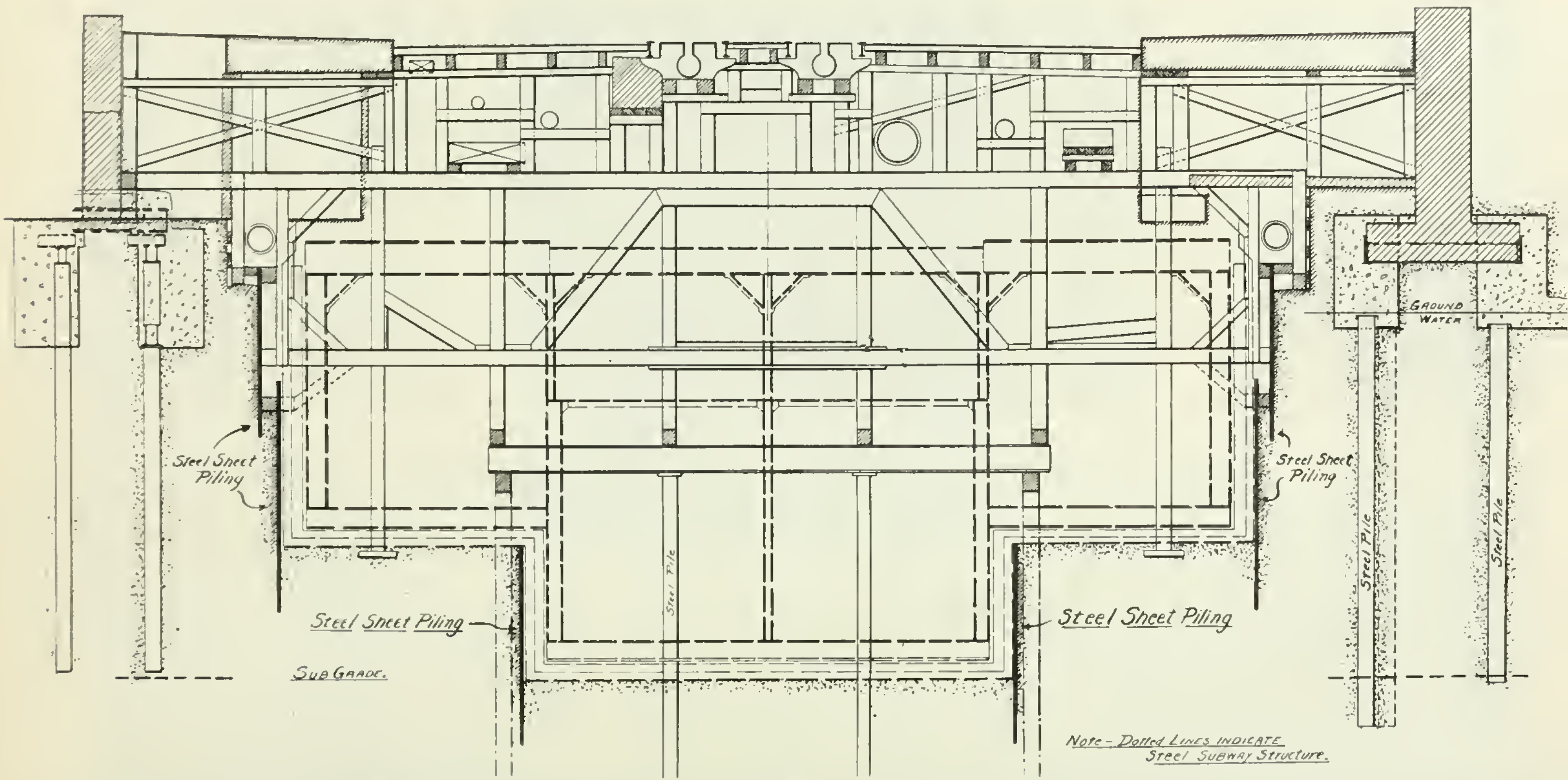
This description of the successful use of sheet steel piles in retaining the earth on the outside of subway and warehouse excavations demonstrates that the Chicago accident reported in our January number was unnecessary, since proper design and carefulness in installation will render the sheet steel retaining walls of such excavations absolutely safe.

IN important foundation work the difficulties of excavating in quicksand and soft wet soil in Greater New York necessitate the use of various forms of sheeting to retain the sides and to exclude water. Many years of experience of the Underpinning and Foundation Co. have included the application of several types of sheeting, and those that proved most efficient and satisfactory for the very delicate work on which the writer has recently been engaged, the conditions prevailing, the methods employed, and the results obtained, are here described. The steel sheet piles were a vital element of success in the difficult work here referred to that aggregates $2,500,000, and the care in selecting and installing them adds to the value of the unusually good results obtained.

Section 3 of the Broadway-Lexington avenue subway extends about one-half mile along Broadway from Houston street almost to Bleecker street. The material encountered is a brown sand varying from very fine texture, sometimes with a small percentage of clay, to a coarse variety, and in places running to a clean gravel mixed with sand and small boulders. Rock in the locality is from 45 to 70 feet below the surface and therefore is not encountered in this section of the subway structure, as subgrade varies from 26 feet to 40 feet below street surface. Ground water was not encountered at the north end of the work, but at the south end it stood at about 18 feet below street level.

The reason for the greater depth of the subway at the southerly end of the work is due to the fact that the two center or express tracks start to grade down about 900 feet from the south end, and at this end are 14 feet below the outside tracks. This depression is required for a future physical connection with a proposed cross line of subway at Canal street.

Under the present method of constructing subways, the street surface decking, trolley tracks, and sidewalks are maintained on timber posts and beams while the excavation is being carried on beneath. Not only are the street surface structures thus supported, but all the sub-surface structures, of which there are many, such as water pipes and sewers, telegraph, telephone and electric ducts, as well as heavy walls under the street and sidewalks, are similarly carried. It is, therefore, evident that when working in sand, and especially water-bearing sand, great care must be used in supporting the surface and sub-surface structures to prevent settlement. For this reason and to prevent absolutely the movement of the soil from beneath heavy buildings adjoining the work, sheeting at the sides of the excavation is necessary.



TYPICAL PLAN OF TIMBERING *for subway excavation at Grand street, New York City, showing the use of steel piling for retaining the earth. Note the proximity of the buildings to the excavation and the necessity of holding the earth absolutely to prevent settlement. The broken lines indicate the steel subway structure, above which earth and concrete will be filled in, all other structures and materials shown in the excavated space to be removed up to the surface of the street.*

The outside lines of the subway are about 7 feet from the building line, and the excavation and timbering are first carried approximately to the level of the foundations of the buildings along the work. These buildings are then underpinned to subgrade of subway, sheeting driven at the extreme neat or side lines of the subway structure, and excavation then carried down to sub-grade for the placing of concrete on which the steel structure is to rest. The open cut between parallel lines of sheeting is about 60 feet.

¶ WHERE EARTH *was solid wooden sheeting or concrete in pits was used to confine it.*

Along the north and central portion of the work, either 3-inch wooden sheeting was driven or a continuous series of neat line pits were sunk to 1 foot below subgrade and concreted in conjunction with the underpinning of the buildings. A continuous wall was thus formed, which, when excavation was carried to sub-grade for the subway structure, served the triple purpose of doing away with the sheeting, maintaining the material in front of and beneath the buildings adjoining, and forming a wall on which the permanent cast-iron pipe sewer was to be built. At the southerly end of the work, where water-bearing sand was penetrated, and greater depths were reached, the question of maintaining the ground at the sides of the excavation was a more difficult and serious problem. Several types of steel sheeting were considered and but two types were adopted.

¶ WITH WATER BEARING SAND *steel sheet piles were used.*

The Wemlinger corrugated sheeting used was ⅛ inch thick and 12 inches wide, and the spring lock sheeting was ¼ inch thick. After excavating down to ground level and completing the underpiping, a trench about 4 feet deep was dug at the extreme neat lines of the subway, 5-inch by 10-inch wale pieces placed, and the steel sheeting set up to line and plumbed ready to drive.

The Wemlinger sheeting was driven in 10-foot lengths by means of a McKiernan 600-pound compressed-air hammer, and as friction developed from increased depth of penetration, a 1,500-pound McKiernan hammer was used. A steel shoe was used to receive the blow from the hammer.

Owing to the thoro and careful bracing, very little trouble was experienced in regard to alignment. Of course, it is understood that an inch or so for play was allowed. The driving was slow, due to the cramped condition of working space, and if a heavier hammer could have been easily and economically handled it would have taken the place of the lighter type and expedited the work.

In this line of work, interlocking steel piling had an added advantage in that it can be driven to a neat line. The only area that is lost is the distance that the flat rivet heads keep the face of the piling from the waling piece, which is set on a neat line. On a large job, such as this work, where concrete is to be placed against the piling, this reduced area effects a saving in concrete.

Another important feature of the type of interlocking steel piles as used on this work is their ability to engage the interlock of adjacent units by side entrance, thus effecting a saving of the full length of the pile in necessary vertical clearance. This property proved to be of great value on this work, in a covered trench where 20-foot lengths may be assembled and driven in 25-foot headroom.

The Wemlinger corrugated pile has a very small section which greatly reduces the weight per square foot of wall surface, and if the conditions will allows it to be pulled, it can be used several times, if the driving is not too hard or severe. On account of the subway construction and interference of timbering, vault walls and other sub-surface structures, it will be impossible to remove any of the piling, which means that about 18,000 square feet of it will necessarily be left in place.

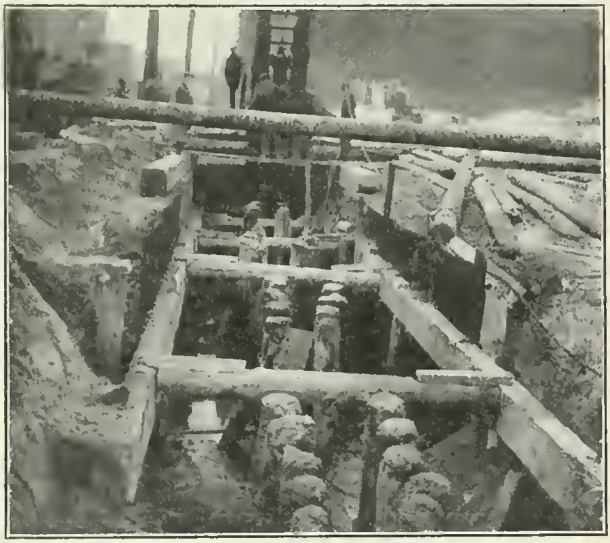
The pumping stations of Section 3 and of Section2-A, the adjoining contract, are close, and the combined pumping capacity amounts to 2,000 gallons per minute, using electrically driven centrifugal pumps. Pumping has been going on continually for about a year, and the water level has been lowered about half the required depth. It may be necessary to resort to the pneumatic process for the lower cuts, as the pumps so far do not seem to be effective for the lower depths. Driving the steel sheeting 4 feet below sub-grade has proved effectual in holding back the sides of the excavation and preventing movement of material below the bottom of the sheeting. Of course, the bottom of the subway excavation cannot be made tight by sheeting and bracing of the sides of the cut.

After driving sheeting at the side of the excavation, a sump was excavated and the water was carefully drawn down by steady pumping, in order to lessen the risk of rapid ground flowing, or of carrying fine material thru the pumps. Such loss of material might have caused dangerous settlement of buildings.

In order to lessen this hazard, and to assist free drainage, a double line of steel sheeting was driven to form a drainage trench connecting with the sump. The bottom of this was lowered a few inches each week by excavation. When there was any indication of "boiling" or of bubbling up of material, then lowering of the bottom of the trench was immediately discontinued and the water allowed to rise, and it was maintained at a level at which further "boiling" did not occur.

The steel sheeting was driven in two stages at the neat lines of the excavation, and after the ground water had been lowered by pumping to the level of the subgrade of the outside or local tracks, excavation was removed down to this level in the two outside tracks. Steel sheeting was then set up as before and driven on the outside lines of the central or express tracks to a depth of about 4 feet below sub-grade in order to maintain the outer tracks. This required sheeting varying in lengths up to 20 feet.

After this sheeting has been driven and if the water level can be lowered without resorting to the pneumatic process, the excavation will be completed, and the concrete for the subway floor placed, which will tend largely to seal the bottom, as the steel sheeting has stopped the flow of water from the sides of the excavation. This work is now going on without incident, and with entire satisfaction. If the water cannot be lowered without loss of material from the open cut, a roof will be placed on the steel sheeting at the sides of the excavation, cross steel sheeting driven at the ends, air locks installed, and the work completed under air pressure. The present vertical sheeting would thus form the sides of the caisson, the joints between the sheet steel piles being easily sealed with a coating of tar. After the permanent concrete bottom had been placed and sealed, the roof would then be removed to allow the subway steel to be erected.



TRENCH *for east line of piers on Franklin building, showing driving of foundation piles and use of sheet piling in excavating trench for concrete piers and walls.*

METHOD OF DRIVING *sheet steel piling with water jet and the lever, chain and pawl shown.*

Wemlinger steel sheet piling was used to great advantage in connection with the underpinning of many of the buildings along this section. At the southerly end of the work in the water-bearing ground, the Breuchaud method of sectional pipe pile underpinning, which requires no sheeting, was used very satisfactorily with no perceptible settlement of buildings, but at the north end in the dry sand, pits sunk alongside the foundation of the buildings were sheeted with Wemlinger piling in lengths from 4 feet to 10 feet, driven with hand mauls. It was imperative that no ground whatever be lost, as the column loads were often 300 to 600 tons each, and these pits were driven directly adjoining or below the spread footing. After concreting and transferring the column load to this new extended foundation, the steel piling was left in place.

The work of constructing Section 3 has not yet been completed, but it will be of interest to remark at this time, as an evidence of the safety and success of this work at present, that it was recently given the severest test possible in two of the heaviest rainfalls that have occurred in New York City in years, on September 4 and October 1. The permanent Broadway sewers, taxed to their capacity, could not begin to handle the run-off, consequently a dangerous and violent flooding of the excavation occurred, and it is proof of the great care used in the underpinning of the buildings and the maintaining of the ground by the steel sheeting, that no settlement of the buildings occurred, tho the flood waters filled the excavation to depths of 20 feet and 12 feet respectively on these two occasions.

A considerable amount of steel sheet piling was driven in connection with the construction of the piers and wall foundation for the Franklin and Nye Buildings, two 470 x 80 feet, 6-story concrete steel construction storage warehouses, built for the New York Dock Company at Atlantic Basin, Brooklyn, in 1911-1912. The foundations of the buildings rest on over 500 wood piles 25 to 30 feet long. There are 112 central columns and piers and a continuous outside wall footing for each building. The material on which the buildings rest is a firm, compact sand, and the warehouses are about 200 feet back from the wharf. Street level is about 4 feet above mean high tide.

As soon as excavation was commenced and wood sheeting started in some of the piers it was found impossible to lower the water level by pumping, as the water rose and fell with the tide, and the sheeting was not close enough to exclude the water. At the commencement of the work the piers were started by driving 3-inch tongue-and-groove spruce planks to depths of about 10 feet, the bottom level of piers. It was soon found that owing to compactness of the material, it was so difficult to get the sheeting down, either with mauls or light steam hammers, that the further use of wood was abandoned as impractical,, expensive and too slow.

Wemlinger steel sheet-piles, 1/8 inch thick, 12 inches wide, weighing 7½ pounds per foot were then used, driving being done in 10-foot lengths. Hand mauls and steam hammers were again tried, but the process was too slow and a water-jet and a lever to force the pile down were tried and found to work successfully.

Usually a pier was started by setting all the sheet-piles in place betwen the ranger and guide plank. They were then forced down by means of a wooden lever about 15 feet long placed upon the pile about to be driven so that the latter formed the fulcrum against which the lever acted. The short end was mortised for a 12-inch iron sheave about 2 feet from the sheet pile, and over it passed a chain with a hook which could be fastened to the ranger, the other end of the chain, terminated with a large iron ring, remaining loose, and would be pulled up as the lever was lifted. Fastened to the top side of the lever was an iron pawl which was hinged so as to engage in the chain, locking it in position, thus acting as a ratchet as the sheeting was forced down.

After setting the sheeting in position, the lever was placed on the pile and the hook fastened to the ranger, and three men would apply weight to the long arm of the lever as the water-jet loosened the material at the foot of the pile. Five men handled the work of jetting and driving sheeting, and an average of 70 pieces of piling were driven per day. Over 70,000 square feet of sheeting were driven by this method, and the same sheets were used several times.

A number of the piers and a considerable part of wall trench were first sheeted and excavated in advance, and the wood piles, which varied in number from 10 to 24 per pier, were then driven and cut off at proper grade. The column bases or wall footings were then concreted and the sheeting pulled and re-driven in another part of the lot. Some of the foundations extended to a greater depth for the location of boiler room and basement.

PULLING STEEL SHEET PILING *is simple with a gin pole and a small engine.*

The advantage in using steel sheeting is evident both in the actual excavation work, which was greatly delayed by the use of wood sheeting, and in the great saving in cost, for, while wood sheeting could be used but once because of the severe driving, the steel sheeting was used not only on this work, but has since been used elsewhere on later contracts.

The cost of driving the sheeting was about 2½ cents per foot. The sheeting was pulled by a 5-part tackle, operated by means of a gin-pole and small swinging engine, requiring four men and a foreman. In this way an average of 90 piles were pulled per day at a cost of 1½ cents per square foot of pile.

THE WATER WORKS OF OSHKOSH, WIS.

A critical study of a water works plant under private ownership, made by competent engineers, shows the needs of the system and enables the inference to be drawn as to the reasons for the present condition. It will be of value in the negotiations pending for purchase of the plant by the municipality and as an example of the study that should be made under similar circumstances elsewhere.

THE city of Oshkosh, Wis., has a population of about 34,500, estimating the increase since 1910 at about 1,500, and is a prominent center for manufacture of articles made of wood, its output of sash, doors and blinds, for example, being greater than that of any other city in the country.

The city adopted the commission form of government and its three commissioners have terms of six years, one being chosen at each biennial election.

The city is located on Lake Winnebago and on both sides of the Fox river, and is built upon about three-fourths of the area of 7.9 square miles included within the city limits. It has 5.9 miles of asphalt paving, 2.9 miles of brick, 1.8 miles of cedar block and 1.1 miles of other kinds of paving, and other streets are improved with tar macadam to the extent of 5.3 miles, water-bound macadam 16.0 miles, and gravel 19.0 miles, making 52 miles of improved streets. There are 50 miles of unimproved streets and 17 miles more which are platted but are not in use.

The waterworks plant is owned and operated by the Oshkosh Water Company and was first built in 1883. Since the commission form of government was adopted the city has voted to buy the plant, but the final action has not been taken. The Wisconsin Railway Commission, which is the public utilities commission of the state, has made a valuation of the plant which can be used as the basis of the negotiations for the purchase.

At the present time the works are in the charge of the president of the company, W. G. Maxey, who has been with the company for almost its whole active existence. Complete and accurate records are kept of the distribution system and of the performance of the pumping station and other details, so that quite full information was on hand on which to base the physical valuation of the plant and the judgment of the proper cost of maintenance and operation.

As the plant now stands it may be described as follows: Lake Winnebago is the source, having a watershed draining over 6,000 square miles and varying little from its average level, thus furnishing an inexhaustible supply. The intake is a 24-inch riveted boiler-iron pipe, terminating in three perforated copper conical points turned up in a depth of 16 feet of water 800 feet from shore, connecting thru 131 feet of cast-iron pipe to the pumping station. A 16-inch cast-iron emergency intake extends from the station 131 feet to a 6-foot circular cistern in 5 feet of water. Anchor ice has given some trouble, but has never seriously interrupted the supply.

The intake discharges into a 400,000-gallon sedimentation basin, 10 feet deep, and the water is raised thence to the filters thru a 12-inch pipe by a 3,000,000-gallon Lawrence single-stage, low-lift, centrifugal pump directly driven by 15-h.p. Westinghouse engines. There is a duplicate pump, and water can be drawn directly from the intake pipes when the sedimentation basin is out of commission.

There are 12 Warren filters of 8.75 feet diameter and 2 Jewell, 15.25-foot, wooden tank, gravity filters, the total capacity being 3,000,000 gallons a day, the same as one pump. The discharge from the filters is thru a 16-inch pipe to a clear-water basin 15 feet deep of 1,250,000 gallons capacity or to a circular brick concrete-lined pump well, 24 feet deep, of 18,000 gallons capacity. Large emergency pipes connect basins and pump well and the layout of gate valves and piping is complete and adequate for any emergency.

The pumping station, adjacent, is at the foot of Washington street, a mile from the business center, and supplies the entire city under direct pressure. The operating floors are well above high water in the lake.

¶ THE EFFECT *of the introduction of a comparatively small proportion of meters has been quite marked.*

The pumping equipment, installed when the works were built, includes 2 Gaskill, horizontal, crank and fly wheel, compound, duplex, double-acting, 4,000,000-gallon pumps, which are used alternately, each running one month at a time and kept warm during its idle time, ready for operation. There is also a 1,500,000-gallon Worthington, horizontal, compound, duplex, double-acting pump in reserve, which was erected in 1888. There are 4 Battis Bros. 80-h. p. boilers, of later dates, 2 of marine type erected in 1899 and 2 tubular type erected in 1901. Three steam pipes supply the 2 Gaskill pumps, the centrifugals, and the Worthington respectively, and the Worthington is also connected with one of the Gaskills.

The effect of the introduction of meters upon the consumption of water is shown by the following table:

This table shows a very pronounced diminution in the consumption per capita, some 25 per cent, and almost a doubling of the number of meters in the same period, but there has been in the same time an increase in the number of services which is almost the same in number as the increase in number of meters. It might be deduced that a small increase in proportion of metered services produces a large decrease in consumption per capita, and this will occur if the new meters on old services are judiciously located. If instead of number of services, number of consumers had been reported, the comparison would be more satisfactory, for the services not in use would not then act to reduce the percentage of increase in possible sources of reduction in waste. If actual waste is to be studied the number of services should be considered, but if reduction in waste is the consideration the number of sources of possible reduction is the basis, that is, the number of services thru which water is supplied to consumers.

The maximum consumption of water recorded was 5,325,480 gallons in 24 hours on Jan. 14, 1913, during a fire lasting 20 hours. This was much beyond the filter capacity and somewhat more than the capacity of one pump. The maximum consumption at normal pressure was 3,618,000 gallons in 24 hours on July 8, 1911, again beyond the filter capacity but within the capacity of either of the two larger pumps. During tests of capacity of the system for fire protection it developed that the consumption increased from 3,360,000 gallons a day at the normal pressure of 41 pounds, to 5,530,000 gallons at the fire pressure of 100 pounds.

It has been recommended that 2 5,000,000-gallon pumping engines, usable on either high or low-pressure work, be

CONSUMPTION OF WATER IN OSHKOSH, WIS.

Year Ending June 30.	Daily Consumption, Gallons.	Estimated Population Supplied.	Gallons per Capita.	—Number of— Services.	Meters.
1909	3,004,000	32,300	93	2,921	628
1910	2,561,000	32,800	78	3,086	738
1911	2,525,000	33,300	76	3,243	880
1912	2,607,000	33,800	77	3,344	1,033
1913	2,367,000	34,300	69	3,393	1,166

installed for safety in case of breakdowns and repairs.

The pipe distribution is shown in the accompanying table:

DISTRIBUTION OF PIPE IN OSHKOSH WATER SYSTEM.

Diameter. Inches.	Length. Miles.	Percentage of total.
4	7.40	13.5
6	34.56	62.9
8	6.78	12.4
10	2.65	4.8
12	2.48	4.5
16	1.05	1.9
Total	54.92	100.0

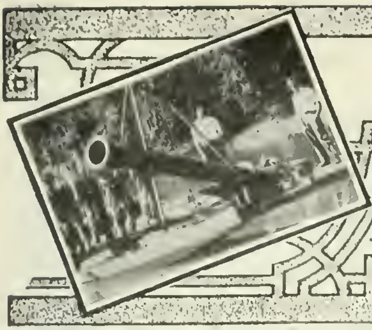
The map of the pipe system shows that the main from the pumping station, 16-inch diameter, is too small and the branches to the lumber and manufacturing districts are insufficient. In the small distribution main system the connections between intersecting pipes are too far apart, making the system weak in time of fire protection demands. The Fire Underwriters' engineers recommend an additional 12-inch supply main from the pumping station and 8 to 12-inch feeders in different directions so as to insure fire supply amounting to 4,000 gallons a minute at 75 pounds pressure anywhere within the principal mercantile district, 2,500 to 5,000 gallons in the different lumber and manufacturing districts as they may require and 1,500 to 2,500 gallons at 60 pounds in any block in the residential districts, in addition to sufficient capacity for the ordinary consumption. They make also their standard recommendations that the minimum size of mains where fire protection is needed be 6 inches where there are frequent connections at intersections and 8 inches where dead ends and lack of cross lines are likely to be the conditions for some time, and especially in blocks 600 feet or more in length; that in mercantile, lumber and manufacturing districts the minimum sizes be 8 inches, with numerous cross connections, and 12-inch where they are lacking; and that 4-inch pipes and dead ends be eliminated as rapidly as possible.

Other standard recommendations of improvements are made, including addition of gate valves so that a break will not require shutting off more than 500 feet of pipe in important districts and 800 feet in others, the present lengths running from 1,400 to 2,300 feet in important districts and 1,440 to 4,500 feet in residence districts.

¶ HYDRANTS *are the important feature of fire protection and should be numerous and have proper outlets.*

Hydrants should have 6-inch barrels, 6-inch gated connection to main, 5-inch foot valve and one 4½-inch and two 2½-inch outlets. It is also recommended that in mercantile, lumber and manufacturing districts there be 2 hydrants at each street intersection and intermediates where blocks are over 350 feet long; and in residence districts one hydrant at each street intersection and additional hydrants enough to bring the distance between hydrants down to or below 350 feet. Threads should conform to the National standard. The system now has 484 hydrants, averaging 330 feet apart in the mercantile district and 535 feet in the residence district, each hydrant serving 2½ acres in the former and 4 acres in the latter districts.

The water company has noted no trouble from electrolysis, street railway rails being well bonded and recently renewed, tests of bonding made annually and the last one showing no electrolytic activity.



EDITORIAL

PROMOTION OR BONUS STOCK IN PUBLIC UTILITIES.

The address of President Winslow before the Wisconsin Electrical Association, an extract from which is on another page, touches upon a subject which is under frequent discussion by promoters of public service companies and presents the common view taken by them. There is neither time nor space here to enter into a discussion of the question, but one suggestion may be made with the hope that it will arouse thought and discussion.

It is now conceded by practically every one that the judicious control of the public service utilities which is exercised by the Wisconsin Railroad Commission and by other bodies with like responsibilities and ability to sustain them, has resulted in a stability in the securities of such companies which more than compensates for any disadvantages arising from such control. In other words, the methods of doing the business of public service corporations have been changed and established upon such a uniformly sound basis that their stocks and bonds have been taken out of the speculative class and are now safe and stable investments.

Mr. Winslow would have us believe that there must still be a speculative feature in the starting of a public service industry, but it is fair to ask why this speculative feature is any more necessary in the starting of such an industry than in its subsequent operation, and at what stage in its proceedings the speculative feature must be dropped and the water squeezed out, for, that all the promotion expenses beyond certain legitimate organization expenses and commissions must be eliminated, has been definitely demonstrated by the public service commissions in their investigations on which to base schedules of rates. Mr. Winslow's address does not give any fundamental reason for changing this decision.

Must not the change in methods of doing corporation business be made in their organizations as well as in their subsequent operation? Is not the ordinary promoter wisely barred from operation under a public service commission? He often promotes for his own benefit without reference to the possible loss of those whom he interests in his schemes, certain loss sometimes, because there is really no speculation about it, no matter what the prospective investors may think.

Is it not better, in the beginning, to wait until there is a real demand for the service proposed, even until the local business men and investors are ready to take up the matter in earnest and invest in the company, until the speculative feature is reduced to a minimum by the development of the demand and the procurement of as many advance contracts for the service as possible? Once in a while the development of a town will be delayed by this course of action, but not often.

There is no lack of local interest in the starting of a public service corporation on a reasonable showing of profit not too far in the future, even if it is to be in competition with other similar industries, provided the possibility of manipulation of stocks for the benefit of a few is eliminated, as is demonstrated by the prompt success in the establishment of such corporations as the Consumers' Gas Trust Company in the natural gas field in Indianapolis more than twenty-five years ago, and its recent successor in the artificial gas field, the Citizens' Gas Company.

If the possibility of speculation in the stock is removed, the speculative remainder in the doubts regarding the amount of business available will be almost negligible for any one with business ability enough to be trusted with the organization of such a company. It would seem that the proper field for legislation is in the line of proper protection of the stock of public service corporations from speculative manipulation rather than in letting down the bars to speculation and manipulation. There seems to be no reason why the plan so successful in the voluntary associations named should not be enacted into permissive legislation, if not compulsory upon persons wishing to form public service corporations.

THE AMERICAN CITIZEN IS NOT DEMOCRATIC.

The reply of Mr. Mayson, to be found on another page of this number, to Mr. Bradford's article on the commission form of government, which appeared in the December number, suggests the reiteration of the statement that the average dweller in the American city does not care to be bothered with the city government, and much prefers to be governed, provided he himself is not interfered with. And the larger the city the more pronounced is the expression of this state of mind.

Municipal Engineering has often expressed its opinion that the form of government is not so important as the demonstration of interest in the government by the people. A scientific form of government is always to be desired, because it is easier to administer such a form, but at the same time it is easier to maladminister such a form.

We take more interest in our national government than in our local city government, more in our state government. The interest manifested seems to be in inverse proportion to the nearness of the government to our own affairs, with the possible exception of the county government, which is even more neglected by the average citizen than that of the city.

Possibly this is because the ballot is shorter. Mr. Mayson seems to overlook the observed fact that the average voter is not able to consider intelligently more than, say, three or four names on a ballot. If there are more, he is likely to vote the ticket in block rather than individually, if there is any chance to group the names. Really this seems to be the only advantage of the commission form of government, and, like the others named, this is not the exclusive property of that form. We do get better men, on the whole, when we vote for only one, two or three at a time, than when we vote for more.

What we really need is more interest by the voters in their city government. And the thing which will do more than any other external influence to aid in the extension of this interest will be such change in the machinery of nominations and elections as will give the voter some hope that his opinion has a chance to be recorded in selecting the candidate. But this will be of no value unless the change in the state of mind of the voter is made and he really takes an interest in every step of the process. Atlanta has good results because its citizens do take an interest in its welfare and its city government.

QUESTION DEPARTMENT

Manufacturers of Wood Block for Street Paving

Would you mind sending us a list of manufacturers of wood block for street pavements? Thanking you in advance for the favor, we are, B., Evansville, Ind.

Manufacturers of wood blocks and creocoters of blocks for pavements are quite numerous. Among them are the Yellow Manufacturers' Association, 711 Wright building, St. Louis, Mo.; U. S. Wood Preserving Company, 165 Broadway, New York City; Barber Asphalt Paving Company, 806 Jackson boulevard, Chicago, Ill.; Kettle River Company, Minneapolis, Minn., and St. Louis, Mo.; Jennison-Wright Company, Toledo, Ohio; Wyckoff Pipe and Creosoting Company, 50 Church street, New York City.

Ordinance Governing Trees in Parks and Streets

The Noon Civics Club of this city propose a campaign of education among the people of Fort Smith as to the care of trees and parkage in the city and hope to be able to prevail upon the city government to pass such ordinances as will have the effect of caring for and preserving the trees, beautifying the parks, etc.

I understand that you have from time to time published articles treating on these subjects, also that you have published ordinances passed in different cities covering these matters, and I am writing you with a view of securing copies of these publications.

H. T. Smith, ——, Ark.

Articles in MUNICIPAL ENGINEERING upon these subjects have appeared at intervals during the past four years in particular. They include the following:

In vol. xlv, p. 367, on maintenance of fire department grounds; p. 445, on how to lay out a small city park.

In vol. xliv, p. 482, on protecting trees from insect pests; p. 134, on irrigated trees; p. 143, on effect of parks and playgrounds on real estate values; p. 425, on ordinances requiring weed cutting and refuse removal; p. 37, on ordinances governing poles and wires; p. 232, on ordinances requiring ornamental trolley poles.

In vol. xliii, p. 262, on tree surgery; p. 233, on the tussock moth; p. 126, on a power machine for spraying trees; p. 326, on designing a street for a small city; p. 297, on Chicago's recreation centers; p. 254, on ordinances requiring weed cutting and refuse removal; p. 81, on ordinances regulating bill boards.

In vol. xlii, p. 249, on ordinances for removal of obstructions from the street.

There are numerous articles on tree planting in streets, care of street trees, effects of pavements and sidewalks on trees, municipal control of shade trees by law and by ordinance and the results thereof, in earlier numbers.

A good book on the subject is Solotaroff's "Shade Trees in Towns and Cities" ($3). Another book that may be of use in one branch of the work is Mero's "American Playgrounds" ($1.70).

A recent ordinance providing for cooperation between city and property-owners in planting trees and for municipal control of planting and maintenance reads as follows:

An Ordinance Creating the Park, Tree and Flower Commission of the City of San Leandro, Prescribing the Duties of Said Commission, and Fixing the Penalties for Violation of the Ordinance.

The Board of Trustees of the city of San Leandro do ordain as follows:

Section 1. A commission of subordinate officers is hereby created to be known as the Park, Tree and Flower Commission of the city of San Leandro. It shall be comprised of five members, including the president of the board of trustees and four others appointed by said board, at least two of whom shall be women.

They shall hold office for two years, commencing May 1, 1910, and until their successors have been duly appointed; provided, however, those first appointed under this ordinance shall so classify themselves by lot that two of them will go out of office at the end of the first year, towit: May 1, 1911.

The members of the Park, Tree and Flower Commission shall not receive any compensation for their services.

Sec. 2. The Park, Tree and Flower Commission shall hold regular meetings at least once every month; special meetings may be called by the chair or upon request of two members.

At the first meeting in May of each year they shall elect a secretary and a treasurer. The secretary shall keep a complete record of all the proceedings and attend to all correspondence. The treasurer shall have charge and custody of all funds, and shall keep an account of all receipts and disbursements. The president of the board of city trustees shall be ex-officio chairman of the commission and shall preside at all meetings. In case of his absence a chairman pro tem. shall be elected by the other members of the commission.

Sec. 3. The Park, Tree and Flower Commission shall have full and complete charge of the planting, trimming and care of all trees, palms and flowers on the streets, sidewalks and parks of the city. They shall encourage the planting of ornamental trees, palms and flowers, not only on the public streets and parks, but also on the private grounds of our residents; and for the latter purpose, in order to stimulate friendly rivalry, they may award cash prizes for the most successful, either to children or adults, or both.

Sec. 4. Whenever in the judgment of the commission, it is deemed desirable to plants trees, palms or flowers upon any street or portion thereof, or whenever a petition or request therefor has been made by a number of the owners of real property fronting thereon, the commission shall secure from the city book a list of all the owners of real property fronting on such street or portion thereof, and send them a written or printed notice through the United States mail, requesting them to attend a meeting at a certain time and place specified in such notice.

The chairman of the commission shall preside at such meeting and call upon the property owners in attendance to express themselves and determine by majority vote of those present whether trees, palms or flowers, if any, shall be planted on their street.

If a majority of the property owners present at such meeting decide in favor of a certain kind of tree, palm or flower, the planting of which is not prohibited by ordinance, the chairman shall call upon each and every one of them to sign an agreement in writing to pay a specified sum, amounting to their proportion of the cost thereof, based upon the amount of frontage owned by each of them respectively, which sum shall be payable within thirty days after such trees, palms or flowers have been planted.

Thereupon, and before adjourning the meeting, the chairman shall appoint a committee of three property owners from among those present to wait upon the remaining property owners on such street who failed to attend the meeting and secure their signatures to the aforesaid agreement.

After said agreement has been returned to the chairman with all the signatures obtainable the commission will prepare a written report to the board of city trustees, informing them of the trees, palms or flowers required. Such report shall contain the name of the street, the total frontage to be planted on both sides thereof, and the number and kind of tree, palm or flower required.

The trustees will thereupon cause the city clerk to secure bids from not less than three well-known nurseries, upon receipt of which the contract will be awarded and the trees, palms or flowers purchased; and upon arrival they shall be planted under the direction of the superintendent of streets.

Sec. 5. All trees or palms under the provisions of this ordinance should be set back from the street corners so as to give the least amount of obstruction to street lights. They should be planted a certain distance apart, according to the size they usually attain at full growth. All trees, the branches of which usually spread to the extent of twenty feet from the trunk at full growth, such as the locust, should be set back twenty-five feet from the corners (measured from the property line) and placed at least fifty feet apart.

All trees, the branches of which usually spread to the extent of twelve feet from the trunk at full growth, such as the mountain ash, should be set back fourteen feet from the corners (measured from the property line) and placed at least thirty-five feet apart.

Palms should be planted not closer than twenty feet apart.

It is expressly understood, however, that the provisions of this section shall not apply where young trees or palms are planted between old or decadent trees.

Sec. 6. It shall be unlawful for any person to plant, trim or remove any tree, palm or flower growing on the streets, parks or public grounds of the city of San Leandro, or wilfully injure or destroy the same.

Sec. 7. In order to assist in carrying out the objects of this ordinance the city trustees may levy and collect a tax not exceeding two cents on the one hundred dollars valuation of all real and personal property in the city, to be known as the park, tree and flower fund, payable to said commission on request.

Sec. 8. Whenever a street is planted with trees or palms under the provisions of this ordinance, and the expense thereof paid for by the property owners as therein provided, their trimming, nurture and future care shall be paid for thereafter out of the public funds of the city.

Sec. 9. Every person violating any of the provisions of this ordinance shall be punishable by a fine not exceeding one hundred dollars, or by imprisonment in the city jail or the county jail of Alameda county not exceeding three months, or by both such fine and imprisonment.

Sec. 10. All ordinances or parts of ordinances in conflict herewith are hereby repealed.

Sec. 11. This ordinance shall take effect from and after May 1, 1910.

Cost of Cincinnati Pavements

A year or so ago you published some figures on the comparative costs of several different kinds of pavements in Cincinnati.

Will you kindly tell me where I can find these articles? B., ———, Ind.

On page 458, vol. xlii, of MUNICIPAL ENGINEERING, June, 1912, is a report by James E. Barlow, the engineer of the Bureau of Municipal Research in Cincinnati, later assistant city engineer, which gives details of cost of pavements and cost of maintenance and repair of pavements and outlines a method of keeping cost records and historical data concerning the pavements.

The annual report of the Department of Public Works of Cincinnati for 1912 contains some data on the cost of recent Cincinnati pavements and on the cost of repair and resurfacing of old pavements which are of much interest.

Fire Alarm for Small City

We are compelled to put in operation in our town some kind of a fire alarm. Does anybody make an electric fire whistle?

Do many towns of 2,000 use electric gongs? In your opinion what is the best for us to install? J., Mayor, ———, Ill.

The writer suggests the steam or the electric siren as distinctive in quality of sound and capable of making noise enough and of being used to give signals with.

If our readers have anything they think would be of interest we will publish brief articles describing the apparatus installed and stating the satisfaction given, if sent to us for the purpose.

How to Lay Concrete Walks

Have you back numbers giving instruction on concrete walks and on reinforced concrete, if so, what numbers? D., ———, Neb.

The article on concrete pavement construction in vol. xlv, p. 8, will apply except perhaps as to surface finish to the construction of sidewalk. That on cracks in concrete on p. 54 will also be of direct interest, and that on the use of steel curb and gutter forms on p. 86 may have its application. The description of the Nelson street viaduct at Atlanta, Ga., on p. 145, and of the concrete pipe test on p. 146 are of interest regarding reinforced concrete. Other articles in vol. xlv are on methods which have developed successful concrete pavements, p. 152; steel vs. wooden sidewalk forms, p. 179; chimney withstood severe wind strain, p. 181; laying cement sidewalks, p. 196; concrete pavements in various cities, p. 186; concrete pavement costs, p. 243; the Capitol avenue bridge at Indianapolis, p. 268; concrete walls, p. 408.

There are many articles in earlier numbers, a list of some of which will be found in vol. xliv, p. 328.

The standard specifications of the American Concrete Institute for concrete sidewalks, latest edition, are as follows:

SIDEWALKS.

Materials.

1. Cement—The cement shall meet the requirements of the standard specifications for Portland cement of the American Society for Testing Materials and adopted by this association. (Standard No. 1.)

2. Fine Aggregate—Fine aggregate shall consist of sand, crushed stone or gravel screenings, graded from fine to coarse and passing when dry a screen having ¼-inch diameter holes; shall be preferably of silicious material, clean, coarse, free from dust, soft particles, loam, vegetable or other deleterious matter, and not more than 3 per cent. shall pass a sieve having 100 meshes per linear inch. Fine aggregate shall be of such quality that mortar composed of one part Portland cement and three parts fine aggregate by weight, when made into briquettes will show a tensile strength at least equal to the strength of 1:3 mortar of the same consistency made with the same cement and standard Ottawa sand. In no case shall fine aggregate containing frost or lumps of frozen material be used.

3. Coarse Aggregate—Coarse aggregate shall consist of inert materials such as crushed stone or gravel, graded in size, retained on a screen having ¼-inch diameter holes; shall be clean, hard and durable; free from dust, vegetable or other deleterious matter, and shall contain no soft, flat or elongated particles. In no case shall coarse aggregate containing frost or lumps of frozen material be used. The maximum size of coarse

aggregate shall be such as to pass a 1¼-inch ring.

4. Natural Mixed Aggregates—Natural mixed aggregates shall not be used as they come from the deposit, but shall be screened and remixed to agree with the proportions specified.

5. Sub-Base—Only clean, hard suitable material, not exceeding 4 inches in the largest dimensions, shall be used.

6. Water—Water shall be clean, free from oil, acid, alkali or vegetable matter.

7. Coloring—If artificial coloring material is required only mineral colors shall be used.

8. Reinforcing Metal—The reinforcing metal shall meet the requirements of the standard specifications for steel reinforcement adopted March 16, 1910, by the American Railway Engineering Association.

Sub-Grade.

9. Slope—The sub-grade shall have a slope toward the curb of not less than ½-inch per foot.

10. Depth*—(a) The sub-grade shall not be less than 11 inches below the finished surface of the walk.

(b) The sub-grade shall not be less than 5 inches below the finished surface of the walk.

11. Preparation—All soft and spongy places shall be removed and all depressions filled with suitable material which shall be thoroly compacted in layers not exceeding 6 inches in thickness.

12. Deep Fills—When a fill exceeding 1 foot in thickness is required to bring the work to grade it shall be made in a manner satisfactory to the engineer. The tops of all fills shall extend beyond the walk on each side at least 1 foot, and the sides shall have a slope not greater than 1 to 1½.

13. Drainage—When required, a suitable drainage system shall be installed and connected with sewers or other drains indicated by the engineer.

*Sub-Base.**

14—Width—Thickness—On the sub-grade shall be spread a suitable material as hereinbefore stated which shall be thoroly rolled or tamped to a surface at least 5 inches below the finished grade of the walk. On the fills the sub-base shall extend the full width of the fill and the sides shall have the same slope as the sides of the fill.

15. Wetting—While compacting the sub-base, the material shall be kept thoroly wet and shall be in that condition when the concrete is deposited.

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*Note.—When a sub-base is required, eliminate paragraph 10 (b). When a sub-base is not required, eliminate paragraphs 5 and 10 (a). Unless paragraph 10 (a) is eliminated 10 (b) will be void.

Forms.

16. Materials—Forms shall be free from warp and of sufficient strength to resist springing out of shape.

17. Setting—The forms shall be well staked or otherwise held to the established lines and grades and their upper edges shall conform to the established grade of the walk.

18. Treatment—All wood forms shall be thoroly wetted and metal forms oiled before depositing any material against them. All mortar and dirt shall be removed from forms that have been previously used.

Construction.

19. Size of Slabs—The slabs or independently divided blocks when not reinforced shall have an area of not more than 36 square feet and shall not have any dimension greater than 6 feet. Larger slabs shall be reinforced as hereinafter specified.

20. Thickness of Walk—The thickness of the walk should not be less than 5 inches for residence districts, and not less than 6 inches for business districts.

21. Width and Location of Joints—A ½-inch expansion joint shall be provided at least once in every 50 feet.

22. Joint Filling—The expansion joint filler shall be a suitable elastic waterproof compound that will not become soft and run out in hot weather, nor hard and brittle and chip out in cold weather.

23. Protection of Edges—Unless protected by metal, the upper edges of the concrete shall be rounded to a radius of ½-inch.

Measuring and Mixing.

24. Measuring—The method of measuring the materials for the concrete, including water, shall be one which will insure separate uniform proportions at all times. A sack of Portland cement (94 pounds net) shall be considered 1 cubic foot.

25. Machine Mixing—When the conditions will permit, a machine mixer of the type that insures the uniform proportioning of the materials thruout the mass shall be used. The ingredients of the concrete or mortar shall be mixed to the desired consistency and the mixing shall continue until the cement is uniformly distributed and the mass is uniform in color and homogeneous.

27. Retempering, that is, remixing mortar or concrete that has partially hardened with additional water, will not be permitted.

TWO-COURSE WALKS.

Base.

28. Proportions—The concrete shall be mixed in the proportion by volume of 1 sack Portland cement, 2½ cubic feet fine

aggregate and 5 cubic feet coarse aggregate.

29. Consistency—The materials shall be mixed wet enough to produce a concrete of a consistency that will flush readily under slight tamping, but which can be handled without causing a separation of the coarse aggregate from the mortar.

30. Placing—After mixing, the concrete shall be handled rapidly and the successive batches deposited in a continuous operation completing individual sections. Under no circumstances shall concrete be used that has partially hardened. The forms shall be filled and the concrete struck off and tamped to a surface the thickness of the wearing course below the established grade of the walk. After the concrete has been thoroly tamped against the cross forms they shall be removed and the material for the adjoining slab deposited so as to preserve the joint. Workmen shall not be permitted to walk on the freshly laid concrete, and if sand or dust collects on the base it shall be carefully removed before the wearing course is applied.

31. Reinforcing—Slabs having an area of more than 36 square feet, or having any dimension greater than 6 feet, shall be reinforced with wire fabric or with plain or deformed bars. The cross sectional area of metal shall amount to at least 0.041 square inches per lineal foot. The reinforcing metal shall not cross joints and shall be lapped sufficiently to develop the strength of the metal.

Wearing Course.

32. Proportions—The mortar shall be mixed in the manner hereinbefore specified in the proportion of 1 sack Portland cement and not more than 2 cubic feet of fine aggregate.

33. Consistency—The mortar shall be of a consistency that will not require tamping, but which can be easily spread into position.

34. Thickness—The wearing course of walk in residence districts shall have a minimum thickness of ¾ of an inch, and in business districts a minimum thickness of 1 inch.

35. Placing—The wearing course shall be placed immediately after mixing and in no case shall more than 50 minutes elapse between the time the concrete for the base is mixed and the time the wearing course is placed.

36. Finishing—After the wearing course has been brought to the established grade it shall be worked with a wood float in a manner to thoroly compact it. When required the surface shall be troweled smooth, but excessive working with a steel trowel should be avoided. The slab markings shall be made in the wearing course directly over the joints in the base with a tool which will completely separate the wearing course of adjacent slabs. If excessive moisture occurs on the surface, it must be taken up with a rag or mop, and in no case shall dry cement or a mixture of dry cement and sand be used to absorb this moisture or to hasten the hardening. Unless protected by metal, the surface edges of all slabs shall be rounded to a radius of about ½-inch.

37. Coloring—If artificial coloring is used, it must be incorporated with the entire wearing course, and shall be mixed dry with the cement and aggregate until the mixture is of uniform color. In no case shall the amount of coloring used exceed 5 per cent. of the weight of the cement.

ONE-COURSE WALK.

The general requirements of the specifications covering two-course work will apply to one-course work with the following exceptions:

38. Proportions—The concrete shall be mixed in the proportion of 1 sack Portland cement to not more than 2 cubic feet of fine aggregate and 3 cubic feet of coarse aggregate passing a one-inch ring.

39. Placing and Finishing—The form shall be filled, the concrete struck off and the coarse particles forced back from the surface, and the work finished in the usual way.

40. Reinforcing—When a single course walk is to be reinforced, the metal shall be placed at the middle of the section. The minimum amount of metal shall be as specified in paragraph 31.

Protection.

41. Treatment—As soon as the concrete has hardened sufficiently to prevent being pitted, the surface of the walk shall be sprinkled with clean water and kept wet for at least 4 days. The walk shall not be opened to traffic until the engineer so directs.

42. Temperature Below 35 Degrees F. —If at any time during the progress of the work the temperature is, or in the opinion of the engineer will within 24 hours drop to 35 degrees Fahrenheit, the water and aggregate shall be heated and precautions taken to protect the work from freezing for at least 5 days. In no case shall concrete be deposited upon a frozen sub-grade or sub-base.

WORKERS IN THE FIELD

Commissioner Ward Proposes Chlorine Process to Purify Buffalo's Water

The Editor of MUNICIPAL ENGINEERING:

Sir—Buffalo pumps as high as 187,000,000 gallons in a day for 450,000 inhabitants, or over 400 gallons per capita, while many cities use only from 70 to 100 gallons per capita. With Buffalo's new pumping station completed, there will be a total capacity of 900 gallons per capita. How about Commissioner Ward's statements in reference to purifying this vast amount of water that the "chlorine necessary, annual cost is almost negligible," with fully 50,000,000 gallons wasted per day? It is also stated by Commissioner Ward that "The apparatus for mixing the chlorine at the intake is simple and will cost $10,000 or $15,000 only and the cost of the chlorine necessary to be used during the year is almost negligible."

On repaving Elk street 26 service pipes were found destroyed by electrolysis and only 2 services having houses, others vacant property. If same condition exists thruout city, should not a water waste survey reduce Buffalo's water consumption from 400 gallons by one-half or to less than 200 gallons per capita?

Why attempt to purify such a vast amount of waste water without cutting down consumption to a minimum by stopping leaks in mains, service pipes and taps?

FRANK C. PERKINS, Buffalo, N. Y.

Low Suction Lift More Economical for Turbine Pump.

The Editor of MUNICIPAL ENGINEERINGS

Sir—In your reply to the superintendent of water works who asked in the December number, p. 537, for the economical suction lift for a pump, it is stated that within the limits of 16 feet or 2 feet that the cost will be the same.

While this would apply for steam-driven pumps it would not apply to the turbine pump, as it has been the experience of several hydraulic engineers, and also my own, that when suction lift was greater than 12 feet the wear on the impellers of the turbine pumps became excessive, requiring in some cases the replacing of the impellers within a year from the installation of the same. The two cases I have in mind were pumps we installed at 15 feet above the water level and changed to 10 feet above water level. The impellers, which cost about $600.00 each, had not to be replaced each year as previously had been required with the heavier lift. In fact, these impellers mentioned are still in operation with very little deduction in efficiency at the end of two years.

ANDREW F. MCCALLUM,
City Engineer, Hamilton, Ont.

Patents on Vertical Circulation in Sewer Tanks

The Editor of MUNICIPAL ENGINEERING:

Sir—Answering the recent letter addressed by the Sterilization Company of Newark, N. J., to your paper, I regret that I am compelled to state that the positive statement made by them "that the so-called vertical circulation used by me at Springfield, Mo., is neither new nor original, but is an essential feature of the process set forth in the Travis and Ault patent, application for which was filed September 13, 1910," is at complete variance with the facts.

The patent referred to above is Patent No. 1,076,721, and was granted on the 28th of October, 1913. The process covered by the above patent can best be described by quoting directly from the specifications of the letters patent:

"The objects of this invention are to remove the impurities in suspension in sewage and other impure liquids; to secure the deposit and collection of such impurities rapidly and completely, in the order of their grossness and specific gravity; to provide for such deposit and collection a tank divided into compartments with sloping bottoms, and means for controlling the flow from one compartment to another along said bottoms; to provide means for attracting from the sewage those impurities which exist in the form of colloids or solids in pseudo-solution; to provide means for removing the scum or solid matter which floats on the top of the liquid; to collect all of the solid matter in a common sludge pit, from whence it may be led by a single pipe, while the liquid effluent escapes through another channel; to enable the sludge to be drawn off from any compartment at any time without stopping the operation of the tank; to thus keep the tank in constant action in a uniform undisturbed condition; to utilize the pressure of liquid contained in the tank to force out the sludge from the bottoms of the compartments; and to obtain other advantages and results as may be brought out in the following description." * * *

"Briefly, the operation of our improved tank results in: (a) The separation of the grosser solid particles in the sewage in the well-known manner by means of a screen or the like, either fixed or movable, which is interposed in the flow of the sewage in such a way that the grosser solid particles are retained on or against the upstream surfaces of the screen whence they are from time to time removed by manual labor or mechanical means. (b) The separation of heavy solids chiefly of an inorganic nature, such as road detritus, by passing the sewage thru the first section of the tank. (c) The separation of the lighter solids of the fine particulate matter and of the solids in the colloid state in a succeeding section or sections of the tank. (d) The collection and removal of the several dissociated solids from the various sections or compartments of the tank."

The basic claim of this patent is as follows:

"1. The herein described process of purifying sewage or other liquid, consisting in supplying the liquid to a reservoir, allowing a portion of the liquid to escape directly from the upper part of the reservoir, conducting another portion of the liquid from the upper part of the reservoir downward nearly to the bottom of the reservoir and then upward thru the reservoir and out at its upper part, conducting the liquid escaping from the first said reservoir to a second reservoir, and repeating in said second reservoir divisional flow of the liquid in the same manner as thru the first reservoir, but in different proportions."

After a careful perusal of all of the specifications and claims of the letters patent the writer has failed to find any mention whatever of the vertical circulation which is claimed by the sterilization company as an essential feature of their patent.

To show further how completely at variance with the facts is the statement that the "so-called vertical circulation is neither new nor original with Mr. Potter as it is an essential feature of the Travis and Ault (Hampton tank) patent," which is No. 1,076,721, the writer begs to refer to Patent No. 1,081,329, covering the process of operating settling tanks and allowed the writer on the 1st of August, 1913, and issued by the department on the 16th of December.

This patent completely covers the vertical circulation referred to by the sterilization company, as can be seen from the basic claim which, quoting from the letters patent, is as follows:

"1. The process of settling sewage comprising admitting sewage to one side of a tank and drawing off water from the opposite side thereof, permitting the heavier matter to settle into a lower chamber thru an opening in the bottom of said tank, and causing an artificial circulation from said tank to said lower chamber."

How can the Sterilization Company explain the fact that a patent has been allowed the writer for artificial vertical circulation at the time when the Travis and Ault application for patent was before the Commissioner of Patents if it were true, as they claim, that such circulation forms an essential feature of the process claimed in the Travis and Ault patent?

Furthermore, the writer first saw a representative of this company a month after the designs for Springfield were completed. These designs were completed before the middle of February, 1912. The plans were then taken to Springfield by the writer in person for submission to the city authorities. The completion of the drafting of the finished plans took two weeks longer and they were forwarded to the writer (then in the Southwest) on March 1, 1912. These plans were finally approved by the municipal authorities at Springfield on March 15, and the work ordered advertised for April 4.

On March 1 the writer received a letter under date of February 23 from the Sterilization Company, admitting that they were informed by his office that the plans were based upon other designs than theirs, and requesting consideration of their method.

The writer returned to New York on March 19 after an absence of a month, and the following day a representative of the Sterilization Company called. For the first time the writer conferred with this company in reference to their system and its application at Springfield. They were advised that the Springfield designs would not be altered, but in response to their request were informed that if they desired to submit an alternate bid based upon their own plans at the public letting on April 4 such bid would be given consideration if accompanied by guarantees of efficiency.

On the 26th of March a sketch plan was submitted by the Sterilization Company, showing what they proposed to offer, and on the 29th of March a letter was received from them giving a bill of material required for their plan. They found that it was impossible for them to submit a proposition on the sewage disposal plant as a whole, but requested the submission of their tank plans to general contractors.

Alexander Potter, New York.

Ideal Blue Print Equipment

The Editor of Municipal Engineering:

Sir—We are pleased to give you a description of our blue-print department and trust same will be of suggestive value to municipal engineers contemplating similar installations.

The drawing rooms, mailing room and blue-print room are connected by a dumbwaiter, upon which all plans and mail are sent from floor to floor. A system of buzzers and speaking tubes enables the clerk on one floor to signal the clerk on any floor for which mail or blue prints are intended. It is not necessary at any time to carry any packages from one floor to another. The blue-print department was located in the basement because it was deemed advisable to have this room isolated from the other offices, as the blue-print department supplies blue prints for the master mechanic, operating department and mill order department, as well as for the drawing rooms.

It is not necessary to have the blue-print department in the same room or on the same floor with the drawing rooms, provided it is easily accessible to them. One objection to having a blue-print room in the drawing room is the tendency on the part of the draftsmen to wish to change drawings for revisions while they are being printed in the blue-print room.

In managing a blue-print room it is advisable to insist that all orders for prints be received from one source. By receiving the orders from one office it is always possible to dictate which prints are required first, and affords a better means of checking up the drawings which are sent to and returned from the blue-print room.

The blue-print department occupies two rooms, one 16 feet 3 inches by 19 feet, and the larger room 15 feet by 32 feet, the rooms being connected by a large door so that the two rooms are practically one as far as utility is concerned.

In the smaller room there is one continuous blue-print machine, a feeding table and a cabinet.

In the larger room are a blue-print machine, one feeding table, a supply cabinet, two trimming tables and a small table which serves as a desk for the chief operator.

The two feeding tables are about 2 feet wide by about 5 feet long and are placed directly in front of the machine. The operator stands between the feeding tables and the machine, and uses the tables for sorting out the tracings which are to be printed.

The two cutting tables are each about 4 feet wide by 6 feet long, and are used altogether for trimming and sorting blue prints. At the left end of the cutting tables are circular knives running in guides to cut the paper.

The two cabinets are used for storing blue-print paper, potash, extra globes, etc.

The receptacle for holding the blue-print paper is on a shelf which has perforated holes, and the door is provided with a screen opening. The object of the perforated holes and screen opening is to provide ventilation to keep the paper dry.

Another means for keeping the paper dry, which is sometimes used, is to place unslaked lime below the shelf which holds the blue-print paper.

The blue-print machines are of the Pease Peerless type, provided with electric heaters. The machines being continuous, paper is printed in rolls, and not in sheets.

When the machine is not in use it is necessary to keep a "dummy" in the machine, so that the paper to be printed can be attached to the "dummy" and started thru the rolls without the necessity of spending time in starting the paper thru the various rolls. The "dummy" is simply spoilt paper about 20 feet long. When it is desired to stop printing, the "dummy" is attached to the good blue-print paper and is run thru the machine until the "dummy" runs from the beginning of the machine where the tracings are fed to the winding-up rolls.

When printing the tracings are fed into the machine and by means of a roll and canvas band the tracing is moved in contact with a glass hump and while in motion the tracings are printed. The motion of the tracing is upwards, and while the tracings are moved frontwards toward the operator the paper itself which is printed travels over to the washing and drying apparatus.

The washing apparatus consists of a tube which is perforated with numerous small holes to squirt the water evenly over the surface of the paper. As the paper travels upwards it is treated to a solution of potash, which is squirted on the paper likewise by means of a perforated tube. The paper is then washed again by water from another tube and then passes over the electric dryers.

As the paper comes down over the dryers it is received on a set of endless belts, which roll the paper up automatically. The paper can then be cut at the operator's convenience for trimming.

The width of the paper which can be handled in these machines varies from any size up to 42 inches wide.

While one machine might be sufficient to take care of the volume of work handled, it is advisable to have the two machines rather than one as a matter of convenience in printing rush orders without stopping the current work, and also to avoid delays in printing when one machine is being temporarily adjusted or repaired.

Often it is necessary to make prints on linen cloth; it is then a big convenience to have one machine print on linen and to permit the other machine to continue the printing on paper.

In some establishments an attachment is put on to the continuous machines for making direct blue line prints, but such prints are not required at this plant.

In making blue line prints a direct process is used, whereby the blue line prints are made directly from the tracing. This is a distinct improvement over the old method of making vandyke prints from the tracings and then reprinting the vandykes for blue line prints.

The machines are capable of printing 72 lineal inches of rapid printing paper per minute, but it is found advisable to use a speed of about 50 lineal inches per minute, as the operator cannot feed the tracings at a much more rapid speed.

As the different grades of paper print with different speeds and a clean tracing will print faster than an old tracing, the speed of the machine can easily be regulated by means of a rheostat, which is within reach of the operator.

On the basis of square feet each machine is capable of printing about 4,800 square feet of paper per working day of 8 hours. This is equivalent to 800 standard size prints, which are 24 by 36 inches outside dimensions.

Two operators are employed to handle the quantity of work, but if the volume of work is large enough to warrant keeping the two machines constantly busy at printing it would be necessary to have two trimmers in addition to the two operators. As it is with the amount of printing quoted in this paper, two operators are sufficient to take care of the work.

During the year 1912 832,825 square feet of paper was used, of which 811,614 square feet was actually printed, leaving a waste of 21,211 square feet, the percentage of waste being about 2½.

The largest amount of printing was made in May, when 85,365 square feet was printed, which is an average of 3,162 square feet per day. This average is less than the capacity of one machine, but the advantages in having two machines were explained before.

The largest output for one day was made on April 3, 1913, when 7,974 square feet of paper was printed.

When figuring the cost of maintenance it was announced that the life of a machine was 15 years. This would make the depreciation per year $70.00 for each machine. The cost of electricity for lighting, power and heating was assumed to be $300.00 per year for each machine. The total cost of supplies, maintenance and operation for the two machines for the year 1912 is as follows:

Cost of blue-print paper........	$2,212.27
Salaries, two operators	1,486.65
Supplies, such as globes, fuses, coils, potash	130.96
Depreciation for two machines..	140.00
Lighting, power and heat.......	600.00

The writer is entirely satisfied with the machines used, as they have been giving excellent results with a low cost of operation and maintenance.

For emergency cases it is possible to send a tracing down to the blue-print room and to receive a blue print of that tracing within ten minutes.

We are buying our prepared blue-print paper in Chicago, but because of the inconvenience of getting the paper and keeping fresh paper on hand, it would be advisable to install a blue-print paper-coating machine.

A very good machine on the market is one manufactured by the C. F. Pease Company, Chicago, and called "The Pease Simplex." This machine occupies a floor space of 3 feet by 5 feet by 10 feet high, and has a capacity of turning out over 350 100-yard rolls per month.

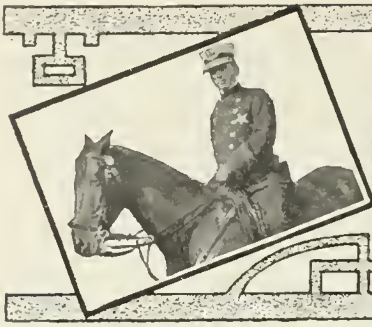
The paper stock runs into a chemical bath, where it is coated and then passes up into a dryer and ironing rolls, and is then rolled up automatically, ready for the blue-print machine.

The paper is measured automatically and a small bell can be set to ring when fifty or one hundred yards are coated.

After being set once, the machine requires very little attention and can be operated by the same operator who is printing at the blue-printing machine.

To further simplify the operation of this machine chemicals are prepared, mixed ready for use. These chemicals are prepared either in the dry form or in solution. F. W. Dencer, Engineer,

American Bridge Company, Gary, Ind.



LEGAL DECISIONS

Decisions of the Higher Courts of Interests to Municipalities

Water pumping station must safeguard dangerous machinery.—The pumping station of a water company was an "establishment" within Factory Act, May 2, 1905 (P. L. 352), which provides for the guarding of dangerous machinery in establishments, though it was not what is commonly called an industrial establishment.—McNabb v. Clear Springs Water Co., (Pa.) 87 Atl. 55.

Municipal electric plant—power service—charge for extra expense.—A city, which undertakes to furnish electric light aud power to the public, is subject to the same duties and obligations, and possesses the same rights and privileges as private persons or corporations doing the same class of service. Such a city is obliged to furnish power to all applicants who pay its proper and reasonable charges therefor. It cannot dictate to consumers what selection of appliances they shall make, as between those in common practical use. In this case relator found it necessary or advantageous in his business to use three-phase motors. Such motors are in common practical use. The city could not furnish current for three-phase motors without the use of transformers costing about $80. With such transformers it could do so. It refused to furnish power at all, unless relator would discard his three-phase motors and install one-phase motors, to which the city system was adapted. Held, the court should require it to do so. It does not follow that the city must bear the burden of the expense of such transformers. If a particular consumer desires service, which the city can supply only by the installation of transformers at an expense which is substantial, and which is not entailed in furnishing power to others, then the consumer who occasions such special expense should bear the burden thereof. The one essential is that, whatever the charge, it must apply to all persons similarly situated, to the end that there shall be no discrimination. As to the method of adjustment of such expense, whether by an installation charge, a rental, or an increased rate, the city has a large discretion. Its regulation, if fair and reasonable and free from discrimination, is binding on the applicant for service.—State ex rel W. J. Armstrong Co. v. City of Waseca et al., (Minn.) 142 N. W. 319.

Items to be considered by public utility commission in fixing purchase price of water works.—In a proceeding before the railway commission, brought by a municipal corporation under section 1797m—82, St. 1911, for the purpose of fixing the compensation to be paid for a water works plant operated by a public utility corporation under an indeterminate permit, the commission must award "just compensation," which means fair and reasonable value at the time possession of the property is actually taken. Tho, under the provisions of the law, payment may be deferred in the discretion of the commission for a reasonable time after possession is taken, legal interest must in that case be provided for in the order from that time until the payment is made, in order to constitute "just compensation." The order in such a case cannot rightly require the municipality to pay, in addition to such just compensation, the costs of an action which may be thereafter brought by the utility corporation against the commission to alter or amend the order, whether such action be successful or not. No allowance can be rightly made in such order for the value of the indeterminate permit, for the reason that such permit has ceased to exist. If the commission, in reaching its conclusion as to "just compensation," takes into consideration, in connection with other data bearing thereon, an estimate of the present cost of reproduction of the plant, such estimate can not rightly include the cost of work which may be legally assessed. and in the exercise of good business judgment ought to be assessed, against the consumer: e. g., in the present case the cost of trenching, and of breaking up aud relaying permanent pavements for the laying of new service pipes from the main to the corporation cock in the curb. "Going value" is that element of value which comes from the fact that the business is a going concern. It is not franchise value, nor the value of good will. It is difficult to separate or measure in dollars, because the value of the plant and business is inherently indivisible, and this latter value is obtained by taking a comprehensive view of each and all of the elements of property, tangible and intangible, including property rights, and considering them as inseparable parts of a harmonious entity, and exercising the judgment as to the value of that entity. In this way the "going value" goes into the final result.—Appleton Water Works Co. v. Railroad Commission of Wisconsin, 142 N. W. 476.

Relations of municipal light plant with competing private plant—right to furnish power and water.—A city or village has the power, under the provisions of section 8704 et seq., Ann St. 1911, to construct and operate a municipal electric light system for the purpose of furnishing lights to the city and the inhabitants thereof. Under our statutes, the city may use the engines and power of an electric light plant to pump water for the use of the city and its inhabitants. In constructing such a system, due regard must be given to the rights of the owners of the present system. The municipal system should be so constructed as not to unnecessarily interfere with the property rights of the owners of the present plant, and in case of necessary interference the city will be liable for the injury sustained. The city having denied that it will construct its light plant in such a manner as to interfere with the property rights of the owners of the present system, and introduced proof to sustain that allegation, held that plaintiffs are not entitled to enjoin the construction of the municipal plant before there is actual or threatened interference.—Bell et al. v. David City et al., (Neb.) 142 N. W., 523.

Village not liable for defective water trench outside of improved roadway.—An unpaved street in a country village had a roadway thirty or more feet wide outside of which a water main had been recently laid. The earth had been returned to the trench by hand, it not appearing whether or not it had been tamped. Plaintiff, who saw the situation, attempted to cross the trench, not at a street intersection, in going from a coal yard adjoining the street to the street, and was injured when the wheel of his wagon dropped into the soft earth throwing him out. Held, that the village was not liable for his injuries.—Patow v. Village of Oakwood, (Mich.) 142 N. W. 575.

Water service cannot be refused pending judgment as to justice of increased rate.—Where a water company, after the expiration of a contract with the city whereby it furnished water to the citizens at certain rates, notified the consumers that it would sever its water connections in the future unless they signed an agreement to pay an increase of one-third in the rates, a temporary injunction can be issued to restrain the severance of the connections pending the determination as to the justice of the increase. Under Code Civ. Proc., section 448, providing that where the question is one of general interest or the persons who might be made parties are very numerous, one or more may sue for the benefit of all, a water consumer may sue as plaintiff on behalf of all others similarly situated to restrain a water company from severing its connections with the consumers in a city after the termination of its contract with the city, unless they would agree to an increase in the rates.—Whitmore v. New York Interurban Water Co., 142 N. Y. Supp. 1098.

Sidewalk Assessments per Front Foot Average.—The statute provides, "That the owners of real estate so abutting shall pay the entire cost of such work, on the basis of the respective frontage of the property on the sidewalk or curbing to be paved or improved." Held, that the entire cost of construction on each street should have been apportioned on the basis of frontage, and that the assessment against the defendant of the entire cost of the work done in front of his particular lots was illegal; but that the failure to properly apportion the cost of the work does not preclude the plaintiff from hereafter making a proper assessment. Town of Minden (La.) v. Glass, 61 So. 874.

Value of Water Power

In the case of Kraft v. Hanover & McSherrystown Water Co., in the Supreme Court of Pennsylvania, reported in 88 Atl. Rep., p. 909, the plaintiff sues for damages because the water company, by pumping water from the stream, reduced the amount of power available at his mill, some distance below the water works intake, and had done so for about six years. The evidence showed that the water company pumped not more than 400 gallons a minute from the stream, that this would amount to 0.8 of a horse power if delivered at the mill, and that the cost of a horse power per year was estimated at \$90. It was also shown that the stream was so low at times prior to its use by the water company that the mill owner was obliged to install steam power for part of the time.

Nevertheless, the jury gave the mill owner a verdict for \$2,550, and it was reduced by the court to \$1,922.49, the verdict of the jury being deemed excessive by him.

ROADS AND PAVEMENTS

The Relative Economy of Constructing Bituminous Pavements by Penetration Methods

By George C. Warren, President of Warren Brothers Company, before the American Association for the Advancement of Science.

IN his treatment of this subject which has been selected by the Society, it is but fair for the writer to state that he is commercially interested in bitulithic pavement and Warrenite highway construction, and has carefully avoided all participation in the development of any inferior form of construction. Notwithstanding this affiliation he has endeavored to submit an unprejudiced discussion of the subject. He proposes to consider the matter of "economy" in its broadest sense, i. e. general efficiency rather than initial cost of construction, which cost of construction is in reality only one factor, and the writer believes one of the least important, although quite generally regarded as the all important factor of economy.

Taking this broad view of economy, the writer proposes to adhere strictly to the subject and not becloud the issue by referring to the makeshift forms of construction, which are so frequently miscalled "bituminous concrete (mixed method)" but which are not concrete at all; either because:

(a) On the one hand they consist of mineral aggregate of nearly uniform size, merely coated with bitumen, containing about forty per cent. of voids, thru many of which a good sized worm could crawl, and thru which water can pass as freely as thru a grape basket after the "seal coat" of original thickness, less than one-fourth (¼) inch, has been broken or worn off by traffic; or

(b- On the other hand they consist of mortar (mixture of sand and bitumen), with the addition of a little fine crushed stone (just "enough to swear by"), like currants in a fruit cake.

Nor does he propose to discuss the makeshift construction, which consists of spreading oil or other bituminous material over concrete or old macadam road surfaces, because this is not really a penetration method, as the bitumen does not in practice penetrate the roadway, but merely produces a thin temporary surface coating consisting of the bitumen and the sand or screenings spread over same.

Keeping constantly in mind this broad view of the term economy he proposes to discuss only:

(a) True bituminous concrete and

(b) bituminous macadam as defined by the American Society of Municipal Improvements at its 1911 Convention at Grand Rapids, as follows:

BITUMINOUS PAVEMENT DEFINITION.

"*Bituminous Concrete* is a pavement consisting of a combination of broken stone and sand, or fine mineral matter, cemented together with a bituminous cement, and which has all its ingredients mechanically mixed before being laid. To be termed a bituminous concrete it must partake of the well-known characteristics of concrete, that is, there must be stone enough in its composition to form an important part thereof and add to its strength and durability; also there must be enough of the mortar constituent, that is, the sand and bituminous cement, to properly support and bond together the largest particles. It is normally a one-layer pavement, all parts of it having equal stability, due both to the structure of stone and the bond of the bituminous cement, and depending on the base for vertical support only. It may or may not be finished with a skim coat and top dressing of sand or stone chips. It is adapted to be laid on either a concrete or macadam base which may or may not have a light coat of bitumen to increase the adhesion."

"In the paving mixture, gravel may wholly or in part be substituted for

PORTION *of Huntington Avenue, Boston, laid with broken stone treated with asphaltic materials applied by the penetration method, after four years of wear.*

crushed stone, and fine crushed stone for sand. Mineral dust also may be added to increase the density and stability of the mixture."

"*Bituminous Macadam* is a pavement consisting principally of crushed stone, retains its integrity of structure mainly by the mutual support of the various particles of stone, aided by the slight bonding value of the fine mineral matter in its composition, and protected from surface disturbances by an upper bonding of bituminous material. It is a one-layer pavement and there is no definite distinction to be made between the wearing surface and the base, as in their nature they must be knit together in one structure. Practically all the horizontal stability as well as vertical support is from the macadam base. * * * "

As it is manifestly impossible to express a true comparison of the economy of these two types of construction in dollars and cents, the writer will endeavor to show the relative satisfaction which has been given the public by several instances where both types have been in use on the same street for several years.

In a paper prepared by the writer for the International Road Congress held in Brussels in July, 1910, on the subject of "Bituminous Roads—Mixed and Poured," he referred to a then recently constructed "bituminous macadam penetration method" road then one year old and constructed with most careful consideration of the details and most approved methods of construction on Huntington Ave., Boston, one section using bituminous cement prepared from coal tar and the other from asphalt.

A series of eighteen photographs accompanied that paper, showing, that notwithstanding the unusual care practiced in the construction, the unequal distribution of the bitumen was such that the surface of the road was badly marked, rutted, and shoved, in many places having a surplus of bituminous material, and in many other places pitted and ravelling where insufficient bitumen was distributed, or where it had penetrated insufficiently into the voids between the particles of stone.

Now, after four years' use and very considerable repairs each year, the bituminous cement prepared from coal tar has practically all disappeared, and the macadam, which is also badly worn, is carrying the traffic. In small portions of the surface, where a surplus of bituminous material was used, it is still in evidence and its condition fairly represented by the photographs taken in March, 1913.

The section in which asphalt cement was used, is, after four years' use, in better condition than the coal tar cement section referred to above, because, in the asphalt section the asphalt for the most part is still in evidence, but the road surface is in a most deplorably unsatisfactory condition, as shown by the accompanying photograph.

On the same side of Huntington Ave.,

but two miles nearer the center of the city, and consequently carrying more than double the volume of traffic of the "penetration method" construction above referred to, is a "bituminous concrete mixed method" pavement laid in 1905, which has stood the traffic of eight years and is illustrated by the second photograph shown herewith.

The relative economy of these two stretches of pavement is about as follows:

First—Length of time street was closed to traffic during initial construction, about equal for the two types.

Second—General appearance of street surface at time construction was completed, about equal.

Third—General appearance during the first warm weather in the spring following construction: Bituminous concrete presented uniform, hard, gritty surface, affording easy traction, and good footing for horses. Penetration method, where insufficient amount of bitumen had been used, was already ravelling in spots, but where excess of bitumen had been used, surface was badly shoved in spots, and bleeding to such an extent that the area which had been laid with asphalt cement was given a coat of crushed screenings, which soon ground up and made the street exceedingly dusty for some weeks, and also made traction so heavy during warm weather, that horses approaching this stretch at a trot would break into a walk before traversing one-half its length.

Fourth—Interruption to traffic while making repairs: Bituminous concrete, has stood for eight years without any such interruption. Penetration method, has during the four years of its life, been repaired in spots many times, with traffic naturally impeded, even tho not entirely blocked by the repair gang.

HUNTINGTON AVENUE, *Boston. A section much nearer the city than that shown in the preceding photograph, laid with bituminous concrete. Note the excellent condition after eight years of use.*

MASSACHUSETTS AVENUE, *Cambridge, Mass., at Arlington street, looking toward Harvard Square, laid with bituminous concrete in* 1909 *and in excellent condition December* 3, 1913, *the date of this photograph.*

Fifth—Initial cost of the stretch laid by the penetration method is not known by the writer, but was probably about two-thirds that of the bituminous concrete.

Summarizing the above shows that these two types of construction have given the city service as follows:

Bituminous Concrete: A wearing surface perfectly satisfactory for all classes of traffic for eight years. The volume of traffic being moderately heavy at time of construction, and steadily increasing since that time.

Penetration Method: Gave satisfactory wearing surface during the few winter months immediately succeeding its construction, but has never been satisfactory since that time.

This construction was cheap in first cost, but its present condition well illustrates the fact which should be axiomatic, but is not generally so regarded, that first cost is but one and that a small factor in the question of economy. Altho the street referred to does not carry more than moderate or medium traffic, it is a most inportant street. Opposite the above section referred to, laid with "bituminous pavement by penetration method," there are millions of dollars in public and private property, including Boston's pride, the new Museum of Fine Arts, the Boston Opera House and the Harvard Medical School buildings and grounds. The unsightly and uncleanly condition of the roadway is the one blot on the landscape and a form of pavement construction, which would have avoided that blot, would have been an economy even if the first cost had been five times as great and could not have been secured at lower cost.

As an example of "bituminous concrete" roadway surface measuring up to the standard of the A. S. M. I. definition above quoted, Dartmouth St., Boston, opposite the Vendome Hotel, extending from Newbury St. to Beacon St. and crossing the world-famous Commonwealth Ave., is cited. This pavement was constructed in 1903.

After the Dartmouth St. pavement had been in use for eight years, a strip thru the center one-third the width of street was removed in connection with the building of a sewer, which removal developed that the wear in eight years had been inappreciable.

Boylston St., Boston, from Dartmouth St. to Hereford St., laid with bituminous concrete in 1904, sustained the heavy traffic of that business thorofare for eight years until in 1912 it was removed, its removal being necessitated by the construction of a new railroad subway, and this street was relaid with the same material in 1913.

Another example of comparative results of "bituminous concrete—mixed method," and "bituminous macadam—penetration method" on the same street, is afforded by Massachusetts Ave., Cambridge, Mass., where, like Huntington Ave., Boston, the "bituminous concrete" is nearer the center of the City, and therefore subjected to the greater traffic. The portion of Massachusetts Ave. from a point near the B. & M. R. R. Bridge, North Cambridge, to the entrance to the subway opposite Harvard College, was laid with bituminous concrete in several sections from 1909 to 1912, and is illustrated by the accompanying photograph of the oldest portion.

The east side of Massachusetts Ave., Cambridge, from Blake St. about 500 feet north of the B. & M. R. R. Bridge to Alewife Brook at the city line, a distance of about one mile, was laid with "bituminous macadam—penetration method" in 1908. This has been entirely resurfaced three times during the intervening 5 years and is now in bad condition, as shown by the fourth of the accompanying photographs.

In substantiation of the assertion of the writer at the outset of this paper that the spreading of oil or bituminous material on a concrete road is but a makeshift construction, he incidentally calls attention to the west side of Massachusetts Ave., Cambridge, from the B. & M. R. R. bridge in North Cambridge to the city line at Alewife Brook, which was laid with portland cement concrete pavement in September, 1907, has required heavy repairs every year since, and in 1912, after repairing the holes in the concrete, was coated with liquid bituminous material and sand, of which it received a second application in 1913

As confirmation of the truth of the corresponding statement made at the outset of this paper, that so-called and miscalled "asphaltic concrete mixture method" (open mixture) is not worthy of discussion under the title of this paper, the following illustration is given of a section of Commonwealth Ave., Boston, near the Brookline line and about five miles from the State House, in which photograph are shown contiguous sections of "open mixture" and "bituminous concrete," both laid in September, 1912.

True economy in road or pavement construction cannot be measured by dollars and cents of cost, however frequently the effort may be made to so measure it. Consequently in considering the subject the writer is not making any effort to discuss economy from that point of view. The real measures of economy are, general suitability for the purpose intended; durability; utility; wear and tear on vehicles; sanitation; cleanliness; sightliness; and last and least of all, first cost. These are matters which must or should receive careful consideration in each particular case.

MASSACHUSETTS AVENUE, *Cambridge, Mass. Section laid in* 1908 *with bituminous macadam by penetration method. Resurfaced three times and now in bad condition, as shown by photograph.*

COMMONWEALTH AVENUE, *Boston, Mass., showing contiguous sections of bituminous concrete and bituminous macadam laid in* 1912 *and their condition after about a year of use.*

Doubtless there are some places where the traffic is so exceedingly light that the penetration method will produce a surface which will answer all practical purposes, and in such cases the less cost of this type would naturally make it the more economical in the broad sense in which the writer has endeavored to view the subject. However, it is the writer's firm belief that such cases are exceedingly rare, and that in judging any one particular case, it is exceedingly dangerous policy to assume that this type of construction will give any better satisfaction to the general public than the cases cited in this paper; and when forming such a judgment, it must be remembered that the traffic on all streets and roads is increasing by leaps and bounds, and at far greater rate than it increased in former years, therefore the tendency is always to underestimate the amount of traffic a street or road will be called upon to resist.

In conclusion, we must not be unmindful of the fact that in the construction of any type of roadway surface, full consideration must be given to careful, scientific, accurate details of construction and to the further fact that "the best is none too good" applies with special force to road construction.

From the examples selected for illustration which have come to the writer's immediate notice, he has attempted to select examples which have had the benefit of most careful construction and supervision, subjected to similar traffic conditions, and he believes that the examples illustrated are typical of the several types of roadway surface referred to, and subjected to moderate normal traffic conditions.

Report on Concrete Roads in Wayne County, Michigan

Road commissioners and engineers who are struggling with the problem of building roads that will stand up under a large volume of automobile and motor truck traffic, mixed with teaming, will find much information of interest and value in the seventh annual report of the Board of County Road Commissioners of Wayne county, Michigan, recently issued.

This report covers the year ended September 30 last, and is fully illustrated with engravings from excellent photographs showing the method followed in making the concrete roads for which Wayne county is becoming famous, as well as the appearance of the main county roads leading out of Detroit before and after improvement. It embraces a tabulated record of all kinds of traffic passing over the roads and of all cracks and holes that have appeared in the concrete surfaces. Itemized costs of construction of different roads are given, and there are reports of tests of strength of different samples of concrete to show the effect of the amount of mixing; also a report on an experiment in the elimination of expansion joints.

The report points out that the only serious objection that so far has been advanced against concrete roads is the development of cracks, and the commissioners do not consider this is a material objection, as the cracks can be repaired readily with a little hot tar, and the formation of cracks can be minimized by careful workmanship. A careful count was made of all cracks that had occurred in more than forty-five miles of roads put down before January, 1913, and it was found that there were 500 transverse cracks and 1,156 longitudinal cracks in 9,121 25-foot sections of concrete laid during 1909, 1910, 1911 and 1912. Thus, there was one crack for every five and one-half sections, or in an area of about 1,650 square feet.

The traffic census taken on the roads leading out of Detroit covers seven days in August and seven days in September, twenty-four hours a day, and shows an average passing any one point in the twenty-four hours was as follows:

Single-horse, 195; team, 207; automobile runabout, 137; touring car, 512; motor truck, 42; motorcycle, 59.

The showing made by motor trucks introduces a complication in road building and maintenance. This is certain to increase at a rapid rate for both city and country, and necessitates a better foundation and wearing surface than is being constructed in many localities.

The Construction of Creosoted Wood Block Pavements

By R. S. Manley,
President Creosoted Wood Block Paving Co., New Orleans, La.

A CREOSOTED wood block pavement should show no evidences of wear for many years if the proper materials are used, and if they are assembled in the proper way.

The correct depth of base, or foundation, varies with the soil conditions, but the materials forming this concrete foundation and the methods of mixing are in such common use as to be standard and easily secured.

We are interested principally in the construction placed on top of the concrete. The principal causes of defects of more or less serious nature are (1) irregular or uneven surface due (a) to careless laying, (b) to shifting of sand cushion, (c) breaking or settling of concrete. (2) Expansion difficulties due to the entrance of water into the blocks either by way of the joints or from below.

The first (irregular or uneven surface) is death to any paving material because a depression in the surface holds water and repeated churnings of wagon wheels in the depression are bound to cause an enlargement and deepening of the depression.

To avoid (a) the concrete should be mixed quite wet and finished smoothly with a flat wooden spreader, which gives a surface practically as even and uniform as could be obtained by templet. On this should be spread from one-half to one inch of clean sand, making the sand cushion conform to the contour of the finished street. On this place the blocks quite closely together, roll thoroughly until a perfect surface with no inequalities has been obtained and until the blocks are firmly in place. It will require a great deal of rolling to accomplish this, but the end justifies the means. After this fill all joints two-thirds full of hot bituminous filler of such melting point as is suited to climatic conditions, and spread a thin coating of sand thereon. The use of bituminous filler is, in my estimation, the most important of all. It converts the street into an effective watershed which, without absorbing any of the water, directs it into storm sewers or other drainage paths. Should any water remain on the surface the wind and the sun, both good evaporating agencies, will rapidly dissipate it.

Now, you have an absolutely even surface, water-proofed and converted into a watershed. This surface cannot be worn by traffic, because the pressure of wheels is even and regular and there is no dropping or jolting of wheels entering and leaving low spots. The blocks are laid tightly together, so that there is no wearing at the joints. There can be no change in the sand cushion as long as the surface remains intact, a solid sheet, in fact, of wood block cemented together by the filler, and consequently the difficulty of shifting cushion is avoided. It is assumed that the concrete is sufficiently strong so that it will not break or settle. In planning the depth, any error should be on the side of too great, rather than too little depth.

Expansion difficulties are eliminated by the use of bituminous filler, for there can be no expansion without absorption of water, and no absorption of water when all rainfall is conducted quickly to drainage sewers. In addition to this it must be remembered that with the bituminous filler each block is surrounded by an individual expansion joint.

The other way of constructing wood block surface which is sometimes recommended is to provide a mixed sand and cement cushion and sand-filled joints or interstices. The sand and cement cushion does not give the opportunity for absolutely smooth surface that the sand cushion gives and is considerably more costly. The sand filler in the joints allows moisture to be absorbed in the pavement, and ultimately this moisture gets into the blocks and trouble ensues. It is only on extremely heavy traffic streets that sand can be used as a filler without expecting some expansion difficulties sooner or later. The proof of the pudding is in the eating and the proof of theories of wood block construction lies in the actual occurrences on the street.

It can be stated without fear of successful contradiction that every sand-filled pavement in the South has at one time or other given trouble from uncompensated expansion, and with equal confidence it can be stated that not one bituminous-filled pavement has given trouble from this cause.

Now there have been objections put forward to the bituminous filler because of the belief that it would produce a sticky surface, disagreeable in warm weather; but if the proper filler is secured and it is correctly applied, there can be no such objection. The suitable filler has a consistency of rubber and can be taken in the fingers, bent and twisted without soiling the fingers. In applying this filler a spreader with squeegee attachment places the filler in the joints where it is needed and not on the surface of the blocks where it is not needed.

It is proper also to use less creosote oil per cubic foot of timber when bituminous filler is used, for the primary function of the creosote oil in this case is to preserve against decay instead of trying to make the creosote oil fill the double role of preservative and absolute waterproofer. No one familiar with preservative methods and history will question the efficacy of sixteen pounds of creosote oil per cubic foot in preserving against decay for an indefinite period. We, therefore, see that bituminous filler can be used carefully and without inconvenience because of stickiness.

To sum up, therefore, provide adequate smooth concrete foundation, use enough sand to cover any inequalities in the concrete or depth of blocks (except in railway areas and on grades when use sand and cement mixed), lay blocks tightly, roll until smooth, fill joints with bituminous filler, spread coating of sand, and turn on traffic.

Economical Plant for Handling Gravel for Road Building.

The good roads movement has been well established in the State of Indiana. In order to facilitate this movement Mr. J. Harris Reed, township trustee at Waterloo, Ind., succeeded in having a law passed which gives the township trustees authority to purchase machinery for excavating material for road building.

After this law had been signed by the Governor a number of the township trustees at once availed themselves of the opportunity and advertised for bids on excavators for excavating gravel from dry and wet pits.

Mr. Reed was practically one of the first trustees in Indiana to install such an excavator. He purchased a Shearer & Mayer drag line cableway excavator. This excavator was put in operation the latter part of July and has been excavating sand and gravel from several different pits and under various conditions.

In his investigation of machinery Mr. Reed based his selection on equipment having the greatest efficiency under various conditions. The excavator as installed consists of a ¾-cubic yard capacity excavator bucket suspended from a carriage which travels up and down an inclined track cable attached to a tension

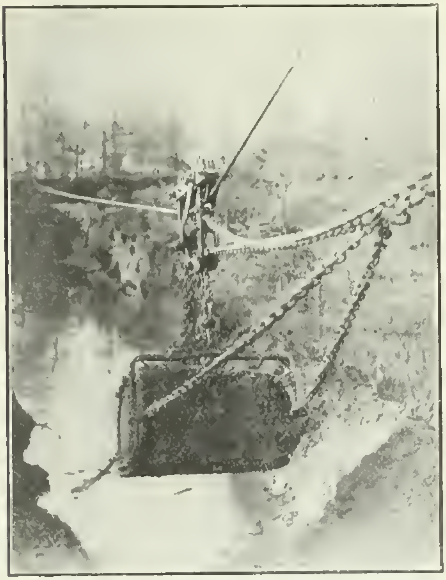


FIG. 1. *Drag-line bucket excavator filled and emerging from wet gravel pit.*

mechanism at the top of a mast at one end and to a ground anchorage at the other end. In operating the excavator the track cable is raised and lowered by means of a line from the hoist to the tension mechanism.

To bring the bucket to a digging position the operator allows the bucket to travel down the incline and by lowering the track cable brings the bucket in contact with the material. The bucket is then filled by dragging it thru the material by means of a load line attached to the front and running thru a guide block at the top of the mast and down to the hoist. When the bucket is filled the track cable is pulled taut, which raises the load above the material, as shown in Fig. 1.

The load is then conveyed up the incline at full speed until a traveler block riding ahead of the carriage strikes an adjustable stop button on the track cable, which automatically reduces the speed of the carriage and at the same time causes the bucket to dump its load. All shock of the impact between the traveler block and stop button is absorbed in the chain mountings of bucket and carriage. This dumping arrangement allows the operator to become highly efficient, as no time is lost at the dumping point. To return the bucket to the digging point the operator releases the friction of the hoist and the carriage travels down the incline by gravity.

Since its installation this machine has done the work of stripping loam and clay overburden and excavating sand and gravel from the underlying beds in wet and dry pits. The nature of the material has varied from sticky clay and loose sand to hard-packed gravel and boulders.

Fig. 1 shows the loaded bucket emerging from a wet gravel pit. Fig. 2 shows the bucket in transit from pit to dump.

The plant was furnished by and installed under the supervision of Sauerman Bros., Monadnock block, Chicago, engineers and dealers in cableway machinery.

Greater Winnipeg Water District

Tenders are being called for February 11 for the following preliminary work on the Greater Winnipeg water supply project: Railway track grading and track laying, including right-of-way clearing; 60-lb. rails and track sundries; five residences and office buildings; 85-mile telephone line; certain core drilling in the rock near the proposed Red river crossing of the water supply.

The work to date has engaged the services of about 100 men, including engineers and their assistant labor. They have cross-sectioned and explored the country between Winnipeg and Indian bay, Manitoba, and trial lines are being run for the aqueduct. Considerable success is being attained in efforts to discover a uniform continuous down grade from Shoal Lake to Winnipeg, so that a gravity supply at minimum cost may be available in Winnipeg. The remainder of the winter will be required for completing studies of this problem.

A large staff has also been engaged in the office in the collating of field notes, in making the preliminary designs. Good progress can be reported in drafting of specifications for the preliminary stages.

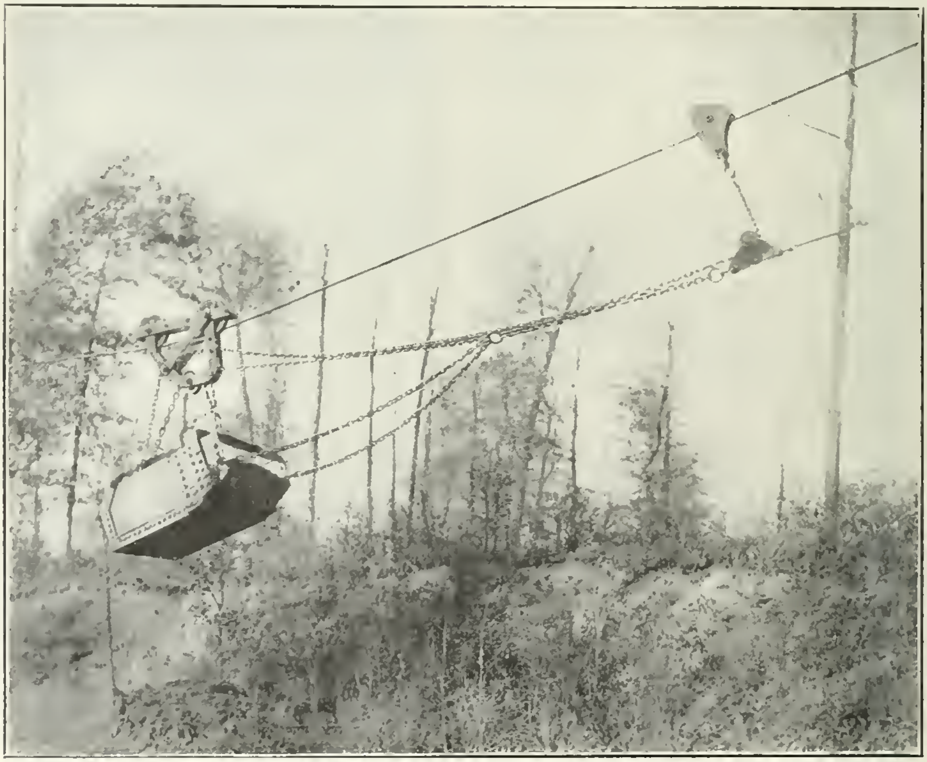


FIG. 2. *Drag-line excavator bucket on its way from gravel pit to dump, side view.*

FIRE AND WATER

Cost of Los Angeles Water Supply

That the Los Angeles aqueduct is completed none too soon is shown by the last annual report of the department, which shows the rapid increase in territory served by the city plant and the difficulties which the municipalities taken in have had in supplying themselves.

The report gives a detailed statement of the cost of the great aqueduct, showing all the items of the cost as follows:

The first issue of Aqueduct bonds, expended in preliminary surveys, purchase of lands in and above Owens valley, water rights, rights of way, etc.	$1,500,000.00
The second issue, $23,000,000, expended in construction of aqueduct, minus $61,000 on hand and $700,000 of salvage	22,239,000.00
Aqueduct liabilities unpaid as hereinbefore set forth.	490,000.00
	$24,229,000.00
Paid out of Water Revenue Fund as follows:	
One-half of Mr. Mulholland's salary during period of construction of aqueduct..	$ 52,500.00
Purchase price of San Fernanda Reservoir site.....	126,000.00
Cost of San Fernando dam to date	319,785.73
Interest on Aqueduct bonds paid by tax moneys, up to May 12, 1913	3,110,057.93
Making total cost of the aqueduct	$27,837,343.66

The original estimates, represented by the $24,500,000, have been exceeded some 3 1-3 million dollars, including the payments of interest. Work not included in those original estimates includes about a million dollars spent in additional cover over the aqueduct, and the San Fernando reservoir work in the table, in all some $1,500,000.

It will be noted that the funds expended have come from three sources: the two issues of bonds, which will a little more than pay the bills, including the extras, on the aqueduct proper; the water revenue fund, which will pay the San Fernando reservoir bills, and the taxes levied to pay the interest on the aqueduct bonds.

There has been considerable complaint of the charge made in recent years for extending new mains of 80 cents per front foot, but it is fully justified by the financial principles which should govern. It is found to be too low to meet the cost of the extensions. A new plan is proposed whereby the water rates will be lowered to those who pay the front foot assessments in a lump sum, or they will be kept at the present rate for those who cannot or prefer not to pay the assessment at once, thus enabling them to extend the payment over a series of months or years.

The board recommends that the rates for those entitled to the reduction be made 50 cents a month minimum, allowing 500 cubic feet to use, and 7 cents a hundred with a minimum of 75 cents if the consumption is more than 500 cubic feet a month—rather a peculiar combination.

Sinking of a Steel Well at Galesburg, Ill.

The question of an adequate water supply for the city of Galesburg, Ill., up to a short time ago, has been a vexatious one. Tho a city of 25,000 inhabitants, it has been dependent for its supply upon about five small wells 8 inches in diameter and 80 feet deep. The strata thru which these wells are sunk consist of about 14 feet of clay on top, followed by 55 feet of a very fine sand, then 10 feet of a coarse torpedo sand, with some gravel, 1 foot of blue rock and slate, with solid blue clay at 80 feet. The bottom 20 feet of the casing is perforated, allowing the water to pass thru, it being lifted by a small impeller operated by a motor at the ground surface. The water-bearing stratum is struck at 60 feet below the surface, and the sand at this point is so fine that it is but a short time after the construction of a well until it becomes choked up with sand passing thru the perforations of the casing, and a new well is necessary.

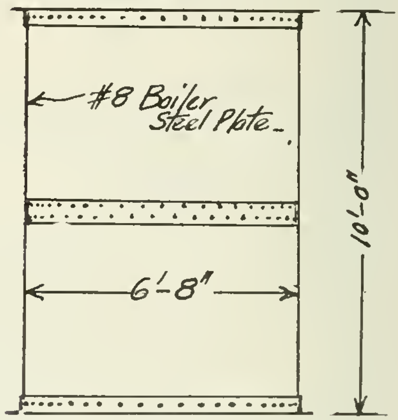
The city finally determined on the sinking of a large steel well as the best solution of their problem. This well is 9 feet in outside diameter and about 6 feet 8 inches inside diameter, made up, first, of a so-called strainer section 20 feet long, whose final position is in the water-bearing strata, and five ten-foot sections of so-called air shaft. The strainer section consists of two cylinders attached and braced together, one inside the other, both perforated with about 40 per cent. perforation. At the bottom of the section the inside cylinder flares out to the diameter of the outside cylinder, as shown in sketch, forming a cutting edge for the sinking of the well. This strainer was hoisted up and set down vertically in a square shaft 12 by 12 feet, excavated to a depth of 20 feet and provided with guides for keeping the steel casing in plumb. The annular space between the perforated cylinders was then filled with gravel, forming a filter for the water to pass thru.

The work of excavating was carried on with a nine-foot orange-peel bucket operating inside of the steel cylinder, allowing the casing to settle as the sand was removed from the bottom. As this work progressed the ten-foot sections of air shaft and outside forms made up of 1/16-inch boiler steel were added and the space between filled with concrete, producing a weight of about 2 tons to the running foot. The work was continued until the entire casing was in place, the cutting edge of the strainer section being 80 feet below the surface of the ground and the top of the air shaft at a point 10 feet below the surface, this distance being brought up with a square concrete shaft 8 by 8 feet inside measurement, after the work of excavation was completed. The inside diameter of the strainer section is 6 inches less than that of the air shaft, leaving a small offset, on which a heavy steel bulkhead plate was placed. This bulkhead is provided with a 24-inch opening in the center, around which is bolted a 24-inch cast-iron blind-flanged cylinder 30 inches high to serve as manhole, and three other openings for suction pipes and sounding valve. Two feet of rich concrete was placed on the bulkhead and on this were built the foundations for a direct-connected horizontal centrifugal pump and motor, designed to deliver up to 500 gallons of water per minute against a total head of 95 feet.

The work of sinking this well had been so carefully planned that there was scarcely a hitch in the job from beginning to end. However, there were some difficulties which arose which might be interesting to discuss for the benefit of engineers and contractors contemplating similar work.

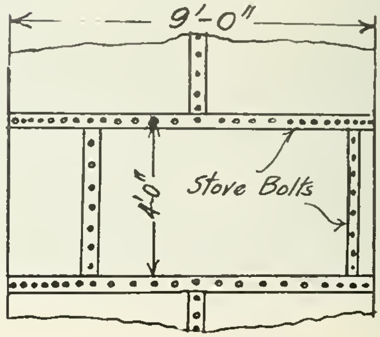
At the outset the work of sinking the casing was a very simple matter, there being such an abundance of weight in the casing and the amount of friction small. Every bucketful of sand removed was a telling one, causing the casing to drop from one to six inches. However, when a depth of 40 feet was reached it became very noticeable that friction was playing its full part and more weight was needed to keep the casing traveling at a rate corresponding to the amount of material removed. It might be well to

Section of 10' Air Shaft serves as inside form for Concrete Wall.



Sections bolted together.

Outside Forms.

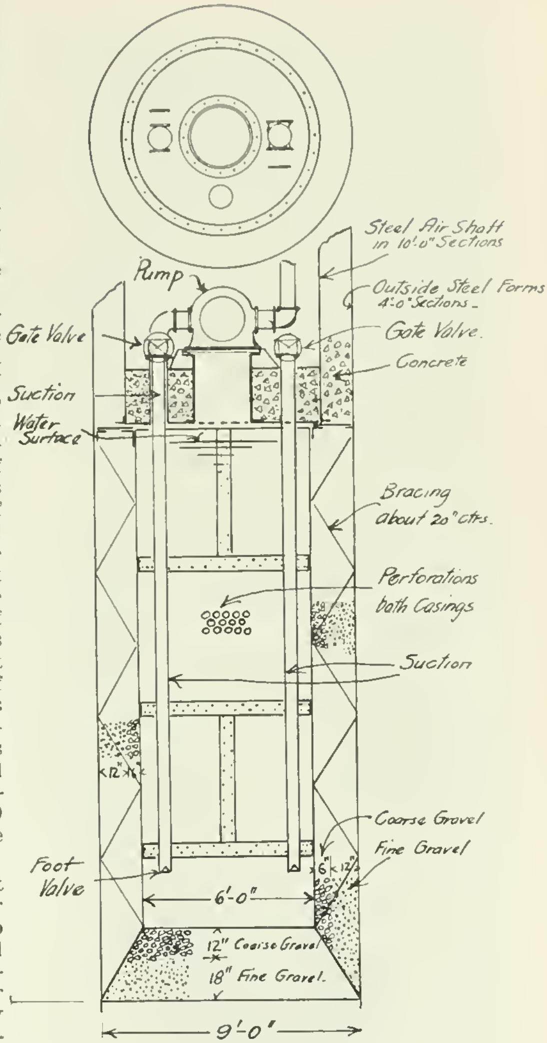


point out here the effect of insufficient load on the casing. In this event the excavation may be carried on until a great deal of material has been removed from outside of the casing, this material sliding in as each bucketful is withdrawn. Finally a point is reached when enough sand is removed from the outside to equalize the retarding force due to skin friction with the load of the casing, at which time the casing drops. The result of this excess excavation is to disturb the ground surface in the vicinity of the well, displacing the sheeting with which the preparatory square shaft is timbered, and destroying the purpose of the guides. Great care should be used in work of this kind to prepare adequately for load necessary to cause the casing to sink without the removal of any excess materials. It was found that, upon reaching the water-bearing strata, the rate of increase of resistance due to friction was greatly reduced, and with the addition of more load rapid progress was made until at a point about 70 feet below the surface the materials were so compacted that it was almost impossible to operate the orange-peel bucket with any degree of success, the bucket removing sometimes half a cubic foot, sometimes nothing at all. On account of the close proximity of two other wells the use of dynamite was forbidden, so a heavy chisel bar weighing about 1,000 pounds was made, this being hoisted up to the top of the well and then dropped. By continuous operation of this bar and bucket the full 80 feet was finally accomplished and the balance of the work completed.

Comparing the two types of wells at Galesburg it is readily seen how superior the large well is to the small wells. Tho the initial cost is greater, it will be noted that the difference in the cost of operation in favor of the large well pays for the difference in initial cost within a very short time. Assuming the cost of production of electric current at 2c per k.w. per hour, and noting that each small well requires a 27-h.p. motor, whereas the large well produces twice the amount of water delivered by one small well with a 20-h.p. motor, there is an approximate saving of $10.00 per day in the operation of this well over the others for an equal amount of water delivered. Again, in maintaining this well it is noted that it is practically impossible for sand to pass thru the 18-inch wall of gravel placed in the strainer. However, in the course of time as this does occur, it is a simple matter to remove the blind flange of the 24-inch cylinder and clean out the sand with a small orange-peel bucket or other device.

As to the method of construction, that is, sinking the well, it is very much more satisfactory than attempting to excavate and curb up, since the lateral pressures exerted by the strata to be penetrated are a source of great trouble and difficulty, and serious cave-ins are likely to occur as a result of imperfect timbers and faulty work in sheeting up. It is suggested, however, that in cases where the top soil and clay extend down a considerable distance, the excavation can be carried thru such strata and sheeted up, and the deeper such excavation can be carried the greater the reduction of friction on the casing after the sinking progresses, and the greater the effective load of the casing.

This type of well admits of a variety



Sketch showing Strainer Section in final position.

of pumping methods, all of which may be installed and operated with great economy over the types of pumping machinery used in the small bore wells. With the installation of the pump on top of the bulkhead, as at Galesburg, it is still often possible to have it set underneath the level of the water strata, so that the necessity of priming is done away with, all parts of the pump, however, being in the dry air shaft.

The total cost of the large well at Galesburg amounted to about $7,000.00, including pump and motor, and while this figure might form a basis for computing the cost of similar wells, yet various conditions are apt to alter the case quite materially.

This work was done under the personal supervision of James F. Seiler, chief engineer of The Willis Shaw Machinery Company, New York Life Building, Chicago.

Importance of Meter Inspection

W. J. Spaulding, Commissioner of Public Property, Springfield, Ill., has the following to say regarding meter inspection and repair:

"In the average American city, I think the use of meters is almost indispensable. They are especially an advantage here because extravagance is characteristic of Americans. We are also impatient and intolerant toward what might be considered petty regulations. Rules regarding the use of water, which I understand are strictly enforced in some European cities, would be looked upon here as pestiferous. The meter will automatically and effectually do the work of many rules and inspectors. It seemed to us that to expend large sums to develop our plant and increase the supply while a large portion of the daily pumpage was getting away without doing anybody any good, would be like adding waste to waste. Our first step, therefore, was to install meters. This at first was left optional with consumers, but was encouraged in two ways; first, by the city furnishing the meter at its own expense and maintaining it so far as ordinary wear and tear is concerned; and second, because the consumers usually enjoyed a saving over the old fixture rate.

"It is necessary only to make the patrons understand that conservation means in the end lower rates and better service for them. The proposition is simple. For example, if 10,000,000 gallons are pumped thru the mains, and only 5,000,000 gallons devoted to legitimate use, the 5,000,000 gallons of waste must be added to the bills of the consumers the same as if it had been used. If the 5,000,000 gallons which were wasted had been sold, it is obvious that the rates could have been reduced 50 per cent. and the water department still would have received the same gross income, less the cost of additional mains.

"One matter that should not be overlooked with reference to the meter problem is that a meter is a machine and will get out of order. A water system might better not be metered at all, at least from a revenue standpoint, if the meters are to be installed and then allowed to take care of themselves. I think it is a serious mistake for the consumer to own the meter. The water department should own, install and take care of meters, and so keep its records that it can show the history of every meter from the time it was installed down to date.

"One point which should be urged upon the managers of municipal plants is that meters are of little value in conserving the water supply or as a means of equitably spreading the charge for the use of water unless there is adopted a system of testing meters at regular intervals and keeping them approximately accurate. In our opinion a test should be made at least once every two years. Meters which have been in service from eight to ten years are apt to under-register anywhere from ten to ninety per cent. When meters are found out of order they should be promptly replaced with accurate ones. The custom which prevails in some places of estimating bills one period after another because the meter is out of order, is, to say the least, very discreditable from the standpoint of efficient management.

"In the summer of 1911 we started a test of all meters which had been in service more than two years, the test made at the premises. These tests showed that about four meters out of five were from 5 per cent. to 90 per cent. slow. It should be explained, however, that these meters had been in for from two to twelve years. Most of them had been in service eight or ten years. To illustrate, we removed a meter which had been yielding 75 cents per month in revenue, and replaced it with an accurate one. The revenue at this place rose to $13.00. Reference to the ledger showed the registration had been gradually falling off for several years. Of course, the consumer felt greatly aggrieved and assumed that he was being robbed, but was finally convinced that he was wasting a great deal of water and by a change in management cut his bill down to about $4.00 per month, which in his case might be considered normal. This is only one of the many similar cases. I think it is safe to say that on all meters that had been in more than eight years we were losing 40 per cent. in income on the average.

"Following is the total cost of meter repairs for the year ending March, 1912:

Total No.	Name of Meter	6 Inch	4 Inch	3 Inch	2 Inch	1½ Inch	1 Inch	¾ Inch	⅝ Inch	Total Amount	Total No. repaired	Av. cost per meter repaired
653	Crown	.....	.....	$ 3.62	$16.76	$ 9.36	$44.03	$ 72.26	$549.01	$ 699.82	452	$1.55
1,775	Buffalo	.....	.....	.....	.....	2.02	6.13	6.72	130.33	145.20	174	.83½
2,101	Lambert	.....	.....	.....	.....	.....	2.16	.....	106.54	108.70	121	.90
96	Trident	.....	.....	.....	.....	.....	1.68	9.62	17.29	28.59	39	.73
46	Keystone	.....	.....	.....	11.27	.....	.....	.....	5.43	16.70	13	1.28½
45	Nash	.....	.....	.....	.....	.....	17.82	8.43	15.21	41.46	21	1.97½
20	Empire	.....	.....	.....	.....	.....	.68	.....	7.53	8.21	7	1.17½
54	Hersey	.....	.....	14.22	7.06	.....	2.63	.73	4.40	43.02	18	2.39
39	Badger	.....	.....	.....	.....	.....	.....	.....	22.44	22.44	13	1.72½
53	Standard	.....	.....	.....	.....	.....	.....	.....	.94	.94	2	.47
26	Worth	.....	.....	.....	.....	.....	.....	.....	3.81	3.81	9	.42
2	Gamon	.....	.....	.....	.....	.....	.....	.17	.....	.17	1	.17
5	Gem	.....	.....	.....	1.22	.....	.....	.....	.....	1.22	1	1.22
7	Rotary	.....	.....	.....	.....	.....	.....	.72	.68	1.40	2	.70
2	Thompson	.....	.....	.....	.....	.....	.....	26.73	.....	26.73	2	13.36½
4,924	Totals	$1.08	$17.08	$17.84	$36.91	$11.38	$75.13	$125.38	$863.61	$1,148.41	875	$1.31¼

"The plant also has single King, Westing and Hersey Disc meters, which were not repaired.

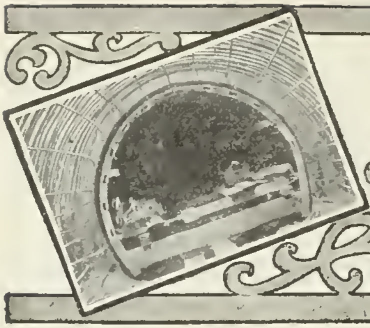
"The average cost of installing meters is about $1.50 (not including stop and waste). The average cost of installing meters in a pit, outside the building, is $7.50."

Outside installations are accessible at all times and those municipalities having outside installations can cut down their cost of meter inspection fully 50 per cent. Springfield has about 400 outside meter boxes, furnished by the H. W. Clark Company of Mattoon, Ill., 300 of which are of vitrified earthenware and the other 100 of concrete. The bottom of the box itself extends 6 inches below the frost line. The partial burying of the cover combined with dead air space within the box and the radiating surface of warm air at the bottom of the box insure protection from frost.

Glass Signs Adorn New Boulevard Lamps in Memphis, Tenn.

Boulevard gas lamps, like the one illustrated herewith, have been installed by the City of Memphis, Tenn., on Peabody and McLemore avenues, a part of McLean boulevard and Snowden Circle. It is probable that they will be installed at an early date on Central avenue. The lights are turned on and off automatically by a clockwork device, the effect of which is to greatly reduce the cost of maintenance.

The attractive glass signs, which have been combined with the boulevard lamps on Peabody avenue, are coming in for much favorable comment from citizens living in that section of the city. The advantage of these signs lies in the fact that they are as plainly visible at night as in the day time.



SANITATION

The Hill Motor Vacuum Street Cleaner

By Francis M. Weldon, Paris, France.

ALTHO the new Italian motor vacuum road cleansing machine is of recent date, it appears to be the appliance needed to clean city streets effectively. The machine was first put into practical use at Rome and Milan, where several of them are now at work. A Sheffield concern, the Hill Ordnance Works, has taken up its manufacture for the rest of Europe. The new cleaner works on the vacuum suction principle, drawing all mud and street refuse into the machine.

The automobile truck carries a 30-h.p. gasoline engine, upon which is fitted the vacuum device and a large storage body for holding the refuse. Driven by chain from the engine is a large cylindrical brush five feet in length, which rotates within a sheet iron shell placed quite near the ground, the brush running at the high periphery speed of 5,000 feet per minute. It raises the sweepings part way round and then delivers them into the box body at the rear. Owing to the strong draught set up by the rapidly revolving brush, all dust, mud and refuse is drawn up by suction and the centrifugal force throws is into the collecting chamber and here compresses it tightly, so that quite a considerable load can be taken into the receptacle before emptying. Twenty different flat brushes of suitable fiber run along the length of the cylinder, and each brush works in a slide holder so arranged that all the brushes can be slid in or out at the same time by the simple movement of a lever so as to come in contact with the ground. Thus the brush pressure is well adjusted, and the brushes can be used down to very near their base. Another lever at the driver's seat serves to raise and lower the brush cylinder as a whole. As the movement of the brush is quite independent of the car drive, by using a separate chain drive for the cylinder the brush can be run forward or backward in case of need and can keep on running even when the car is stopped, or the car may be run on the road with the brush lifted and out of action.

A well-designed container serves to hold all the refuse, and for this purpose there are used two, three or even more separate sheet iron boxes, all mounted in line across the well-closed box body and just back of the brush, so as to receive the material as the brush delivers it. As much as 50 cu. ft., or a weight of 2 tons, can be held in the inside, and this is unloaded most conveniently and quickly by letting down the hinged back door onto the street so as to afford an inclined way, the several boxes having wheels for running them out to the ground level for emptying. In practice the loaded car can be quickly run to headquarters for emptying, or in other cases it can be followed by a cart or power wagon. The machine can also be designed so that the box body part serves as a trailer and can be separated from the front part for this purpose. The brush is well enclosed at the bottom by a suitable apron made of leather and metal so as to run over irregular parts of the street surface, and a separate driver's lever raises this screen when need be, especially for back driving of the car.

At the official trials held at Manchester, England, mud on the streets, due to wet weather, and other material put on expressly for the purpose, such as clinker, ashes and various kinds of refuse, were cleaned successfully. On Oxford road, Mosely street and others the automobile had to run among heavy traffic and was quite successful in this respect. The machine left a very clean surface of 5-foot width, taking up mud, sand, paper, clippings and even good-sized pieces of brick and wood paving blocks. Dry cleaning was tested within a large shed with ashes, straw and dust strewed on the ground. The cleaner absorbed all this refuse without raising any dust. For this reason and because decaying material is tightly enclosed and gives no smell, the work is done under healthy conditions for the public. The machine can also take up snow and water and can be used rapidly after heavy falls of rain or snow without inconvenience to passers-by.

In Southport the total street area swept was 2,933 square yards, and refuse collected, 2 tons, at speeds of 6 to 10 miles an hour, the time taken, including emptying of bins, being 18½ minutes, delivering three loads of refuse. Time taken to empty the boxes, 3 minutes. Gasoline consumed, 1/14 gallon (12 to 20 miles per gallon). Chauffeur, attendant and cost of gasoline (adding also depreciation, upkeep, etc., of cleaner) bring the total cost of cleaning as estimated for an area of 12,000 square yards to $1.08. Cost of cleaning by one horse sweeper and one cart, $2.93. By comparison of these two figures the great saving in cost will be easily seen.

THE HILL *motor vacuum road-cleansing machine, an Italian invention.*

In Milan, Italy, the actual work of sweeping is found to be for the automobile cleaner 100,000 square feet per hour of service, and for a horse sweeper and its cart the work is 33,593 square feet an hour, the machine being three times as fast as the old method.

The Refuse Incinerator at Moose Jaw, Canada

By F. Cartlidge, Sanitary Engineer.

The incinerator at Moose Jaw, Saskatchewan, Canada, was erected by Heenan & Froude, of Manchester, England, in 1912, at a cost for building, plant and chimney of $50,000.

The installation is a 3-cell plant of the high-temperature type, rated to destroy 40 tons of mixed refuse per 24 hours. Provision is made for an additional cell to be added when required, which will make it a 4-cell unit, increasing the capacity at least 33 per cent.

The grate area is 90 feet. The furnace bars are of cast iron, gutter shape, perforated to permit the free passage of air into the whole body of burning refuse.

Each cell front is fitted with a sliding cast-iron door, fire-brick lined, suspended and operated by means of a wire rope and balance weights for easy manipulation.

Along the center of the bottom of each furnace is a sliding drawbar; to the far end is attached a plate shaped to the section of the furnace, which, when withdrawn at the time of clinkering, is intended to clear out the contents of the cell into an iron wagon run on an iron rail track. This is operated by means of a light winch, which is moved opposite to the particular cell to be clinkered. So far this has not been of much use to us, as very little clinker is made with the class of refuse burned, and it is often more expeditious to clean out the ash with hand rakes into iron wheelbarrows.

The air blast is usually maintained at a pressure not exceeding 3 inches in the ash pit and a temperature of 150 to 200 degrees F. The air for this purpose is drawn from above the floor of the charging platform, thus removing any foul odors that may arise from the storage of refuse, is passed down a shaft 2 feet square, drawn thru a suction fan 3 feet in diameter, 590 revolutions per minute, driven thru a regenerator at the back of the boiler, where it is heated by the hot gases that have passed under the boiler and before reaching the chimney, and into the ash pit, from where it is driven thru the perforated furnace bars into the burning refuse. Arrangement is provided for regulating the amount of air passing into the fire, and while cleaning is in process it can be shut off altogether. The engine to drive the suction fan is a Heenan high-speed self-lubricating one of 12 h.p. at 268 r.p.m., under a steam pressure of 30 lbs.

The cells are arranged side by side in one continuous chamber, so that each grate is of mutual assistance to the others, being charged and clinkered alternately.

Adjoining and in communication with them is a combustion chamber of ample capacity for the thoro mixing and complete combustion of the gases.

The fires are charged from the charging platform above into sheet-steel hoppers, each 1 1/3 cubic yards capacity, from which the refuse is discharged onto a small drying hearth at the back of each cell by removing sliding doors, which are operated from the clinkering floor. This can be done without opening to the atmosphere, thus maintaining the heat in the furnace during charging operations.

Next to the combustion chamber is installed a Babcock & Wilcox water-tube boiler, with a heating surface of 1,700 sq. ft., over which the hot gases are passed and are available for the generation of 100 to 150 h.p. at 120 lbs. pressure per square inch.

The entire furnace combustion chamber and boiler settings are of pressed fire brick, with well-set arches and corners rounded off, built on a substantial concrete foundation to prevent the possibility of any settlement. The building housing the plant is of local brick, approached on one side by an inclined driveway, up which the wagons are taken for unloading onto the charging platform. On the latter is storage capacity for about 50 tons of refuse, or equal to a day's accumulation. A self-contained radial brick chimney, 4 feet 6 inches by 120 feet, is erected close to the building to carry off the waste gases from the furnace. This chimney was built by the Canadian Kellogg Company, of Montreal.

The plant was completed and put into commission in July, 1912, after a 24-hour test conducted by the builders, with the following results:

OFFICIAL TESTS, MOOSE JAW INCINERATOR, JULY, 1912.

Date of test, July	25-26
Duration of test, hours	24
Grate area, sq. ft.	90
Heating surface of boiler, sq. ft.	1,700
Ratio of heating surface of boiler to grate area	18.8 to 1
Av. temp. of feed water, deg. F.	45
Av. temp. of combustion chamber, deg. F.	1,750
Highest temp. of combustion chamber, deg. F.	2,000
Lowest temp. of combustion chamber, deg. F.	1,400
Av. steam pressure, lb. per sq. in.	125
Weight of refuse burned, tons	53.51
Weight of residual clinker, tons	11.625
Percentage of clinker	21.73
Refuse burned per hour, tons	2.23
Refuse burned per sq. ft. of grate area per hour, lb.	49.6
Total weight of water fed to boiler, lb.	59,700
Equivalent weight of water from and at 212 deg. F. fed to boiler, lb.	72,655
Water evaporated per hour, lb.	2.487
Equivalent water evaporated from and at 212 deg. F. per hour, lb.	3.027
Horse power developed (34½ lbs. water evaporated per hour into steam from and at 212 deg. F., 1 horse power)	96.6
Water evaporated per lb. of refuse, lb.	0.56
Water evaporated from and at 212 deg. F. per lb. of refuse, lb.	0.68
Cost per horse power per hour, cts.	1.154
Cost per ton of refuse destroyed, cents	51.8
Actual amount of steam available for power per lb. of refuse, lb.	.44

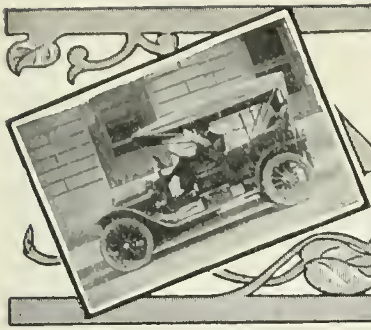
The low evaporation per pound of refuse burned is accounted for by the fact that the safety valves were unable to carry away all the steam generated. The door of the first compartment of the boiler being kept open the greater portion of the test, allowed cold air to rush in and cool down the gases. This was done to avoid any danger caused by an excess pressure being generated on the boiler. During this test the steam rose considerably above blowing-off pressure.

A second test, on July 31, 1912, of eight hours' duration, was made to ascertain the evaporation of water per pound of refuse burned. During this test 14,342 lbs. of refuse were burned, the evaporation working out at 1.125 lbs. of water per pound of refuse. In both instances when the tests were made the weather was fine and refuse burned was in a comparatively dry state.

More recent observations, made under ordinary working conditions, show an average evaporation of 0.86 lb. of water per pound of refuse. Working the full day of twenty-four hours with dry refuse, 50 tons are usually burned, leaving 25 per cent. of residue in the form of ash. No attempt is made to sort out the refuse except removal of the tins too large to pass thru the fires. Less than 50 per cent. is house refuse, the balance being chiefly stable manure and miscellaneous waste. Small carcasses, dogs and pigs are disposed of by burning in the combustion chamber. A special hopper filled from the charging floor is proposed that will obviate the necessity of opening the doors of the combustion chamber to destroy the large quantities of wet fruit that will not burn in the furnaces. No arrangement was made for the burning of large carcasses, such as horses and cows, but in more recent plants the makers have remedied this defect.

For some months no use was made of the steam generated by the waste heat, except to drive the fan engine, nor of the other residuals. Some of the steam is now utilized for pumping sewage, for washing closet pails and heating adjoining building. Very little clinker is made, and that of small size, but some has been used for the top layer of the bacteria beds at the sewage disposal works, and the fine ash is now used as a base for disinfecting powder.

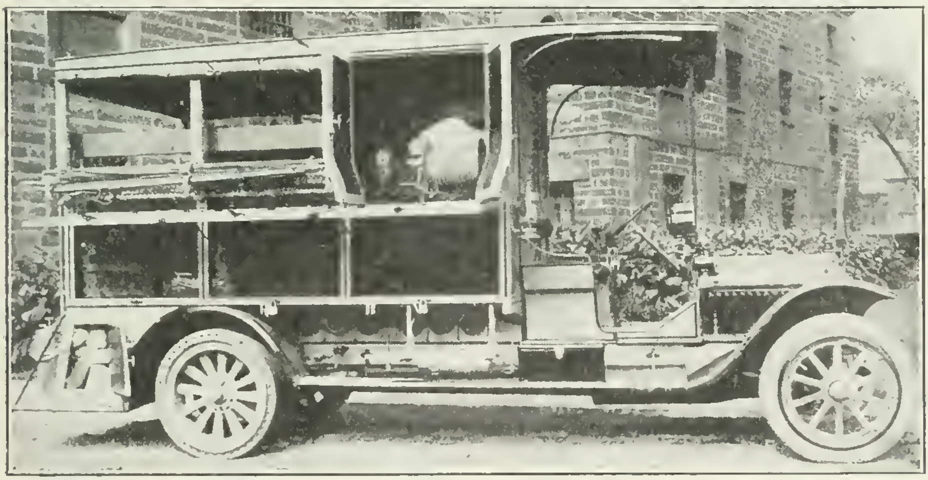
The income from these sources and the sale of bottles and other material will run about $2,500 per year.



Automobiles in Municipal Service

Motor Trucks to Rescue Entombed Coal Mine Victims

To rescue, revive and treat entombed and injured miners and thus reduce the loss of life and lessen the injuries resulting from the periodic disasters in the coal mines of the United States, the Bureau of Mines of the Department of Interior has evolved a new plan of relief work involving the extensive use of motor rescue trucks of a special design equipped with all the paraphernalia known in the science of relief work.



WHITE MOTOR TRUCK *equipped with everything necessary for a mine rescue corps.*

The first vehicle of the new type, built according to government specifications, was constructed by The White Company of Cleveland, Ohio, and delivered to the Bureau of Mines in Pittsburgh, Pa. It is a veritable hospital, carrying every piece of portable equipment that is useful in rescuing miners, quenching flames, resuscitating the unconscious and administering first aid.

Included in the equipment are two pulmotors, six oxygen tanks, fifty regenerators, an oxygen pump, two stretchers, a life line, box of explosives, lanterns, tents, fire extinguishers, complete telephone system and a full complement of hose, axes, saws, miners' tools and medical and surgical supplies. The equipment is complete even to the extent of providing for the bird and cage that are used in detecting poisonous gases in mine shafts.

A majority of the members of the American Mine Safety Association, who saw the first truck in operation during their recent convention in Pittsburgh, predicted a big reduction in casualties. A mine explosion, with all its effects except human injury, was staged during the convention. The truck with its full equipment was tested by government representatives while moving picture operators, also employed by the government, recorded every act and movement to show absent mine operators how lives can be saved and danger lessened.

The Bureau of Mines has proposed that mine owners in each district establish motor rescue stations at central points, from which each district may be served.

Inasmuch as instant access to everything is essential, the truck body has been built with a special place for everything it carries.

Under the driver's seat are carried ten Draeger reviving outfits. Six oxygen tanks are carried beneath the body on a specially built sub-frame and cradle, the tanks lying crosswise of the truck so that they may be pulled out quickly when necessary. On the left side of the chassis frame there is attached an oxygen pump, which is operated by the power of the motor. In back of the driver's seat there are hooks for a five-foot crowbar and tent poles.

Immediately in back of the driver's seat and extending the full height of the truck there is a series of compartments opening on the outside of the truck. These compartments carry a tent, 22 feet of hose, three miners' picks, three miners' shovels, one four-pound sledge and two hand axes. In back of these compartments are two seats, arranged lengthwise, with folding lazy-backs and protected by a brass railing. Beneath the seats there is a series of smaller compartments. Beneath the rear steps there is another compartment with doors at each side and in the end. There are also shallow drawers to take saws, hose couplings, reducers, spanners and 200 feet of half-inch rope.

The central compartments along the sides of the body contain one life line reel, a telephone system, part of which is carried into the mine, and an assortment of compasses, braces, bits, chisels, hacksaws, blades and snatch blocks. Suspended on the outside of the body on specially designed hooks and clamps are stretchers, fire extinguishers, axes, lanterns, etc. Two special boxes are built on the running boards to accommodate a large number of mine lanterns and small boxes are built on the rear wall of the forward compartment to carry two first-aid boxes and a pump. The truck is equipped with an eight-inch swivel headlight, mounted on the dash, and is fitted with non-skid tires. It is painted battleship gray with black striping.

An Automobile as a Locomotive

The accompanying photograph shows an automobile which has been fitted with flanged wheels and is used for hauling loads on a light railway. The turntable used is perhaps the most unique feature. The apparatus and its use is described as follows by J. A. Roberts, of Roberts Bros., railroad contractors, Chicago, Ill., the designers:

AUTOMOBILE *used as a locomotive, steel wheels, turntable always at hand.*

"The turntable which we use is a very simple device, consisting of practically six parts, namely, two inclined rails, two blocks and two bridle rods.

"To turn the machine we lay a short block in the center of the track, each end resting on a tie. On this we have a crosspiece or bolster at right angles with the track and drop a pin thru the two pieces, which holds the upper one in position. The rails are then placed on this crosspiece or bolster, and held to gage by use of the two bridle rods, above referred to, the tapered points of the rail resting on the track. The machine is then backed up on this turntable until it balances, when it is an easy matter to turn it either at right angles to run off the track entirely, or all the way around, if desired.

"The push cars attached behind the machine are not much heavier than hand cars, and can be very easily lifted off the track by six or eight men.

"The tires used are regular locomotive tires, of course not so heavy as used for that purpose, but having standard flanges. The wheels on the machine shown in photograph are the wood wheels which came with the automobile, on which we put a heavier felloe, but we have found that they are not strong enough for the purpose, and are now equipping them with solid cast steel wheels, on which we shrink the same tires.

"The principal use we make of the machine is hauling our men to and from work while engaged in surfacing or ballasting railroad tracks. Our camps are usually located on sidetracks, when it is necessary to make runs of from one to six miles, in order to get men to and from work. We find it safe to operate at a speed of twenty-five miles per hour, which is a great deal faster than can be obtained by use of hand cars, and the men are not tired out when they reach the work."

Cutting Down Hauling Costs

It has been shown by various investigations that the cost of distribution adds a large percentage to the retail prices of all products of the farm and factory, and that transportation is an important item in the cost of distribution.

During the seventy years that steam railroads have been operated in America the cost of haulage by rail has been cut from 7 1/3 cents per ton-mile to 7½ mills. The price today is slightly higher than thirteen years ago.

Transportation by water is considerably cheaper than by rail, varying from one-half mill per ton-mile on the Great Lakes and the ocean, to 3 mills on canals from 5 to 10 feet deep. Such transportation is essentially long haul and in bulk. There remains the cost of moving freight from the producers to the shipping point and from the railroad freight yard and steamship pier to the factory or warehouse, the wholesaler and retailer and finally to the ultimate consumer. It is these repeated movements, each over a relatively short distance, that multiply the transportation costs.

In 1906 the Department of Agriculture estimated the cost of hauling twenty-three different farm products to shipping points from nearly 1,900 replies, from correspondents. At a little more than 23 cents a ton hauled by horse and wagon, the average length of haul being almost ten miles, largely over earth roads, only 8 per cent. of the roads being improved.

The only known way of reducing the cost of haulage by team is to improve the roads, but whatever gains have been made in this way probably have been offset by the increased cost of horses, hay and grain, labor and other items. Consequently, no relief has come from this quarter.

Apparently the only remaining hope for actual and substantial reduction of transportation cost lies in the commercial motor vehicle. No official investigation has been made into cost of operating motor truck and delivery wagon, but large users of these vehicles have demonstrated to their satisfaction that they are much more economical than horses, saving one-third to one-half.

Detailed reports of the operation of motor trucks and delivery wagons in the service of thirty prominent companies, engaged in various lines of business, in fifteen different cities, have been analyzed and show the cost of haulage and delivery per day, per mile, per ton-mile and per package. Wherever possible, the cost of performing the same service with horses and wagons was set opposite the figures for motor haulage for comparison. These horse costs were given in each case by the companies owning the motor vehicles from their own experience with horses engaged in the same service.

The results indicate that the average cost of hauling in the city by motor is 11¼ cents per ton-mile, as compared with 17¾ cents by horse. This represents a saving of 36 per cent. The average cost of deliveries by department stores, furniture, clothing and grocery stores, meat markets and electric light companies is shown to be approximately 8 cents by motor and 16 cents by horse, representing a saving of more than 50 per cent. by the former method. The analysis shows that the average cost of operating motor trucks and delivery wagons, embracing all sizes of both gasoline and electric machines, is $10.97 a day. This covers all items of operation and maintenance, such as driver, garage, interest and depreciation. The average cost of doing equivalent work with horses is $16.75 a day, which represents the expense of from two to three wagons, with drivers. Here is a saving of more than 34 per cent.

What the general use of these vehicles will mean to a community is indicated by some figures submitted by the head of a Chicago cartage company to the Chicago Association of Commerce. This report states that more than 250,000 tons of freight are hauled thru the streets of Chicago daily by team and motor truck and that this represents an annual business of more than $60,000,000 or about $25 a year for every inhabitant. There are more than 50,000 horse-drawn wagons and trucks in use in Chicago and about 4,000 motor trucks and wagons. When the 50,000 are converted into 20,000 motor vehicles, the direct saving in haulage will amount to from $20,000,000 to $30,000,000 or $8.25 to $12 a year each inhabitant, or about $35 to $50 a year for each family.

Reduction of traffic congestion, resulting from the elimination of more than half of the vehicles, will so expedite haulage that it can be done still cheaper by motor wagons. Real estate now devoted to stabling horses and wagons and the storage of hay and grain can be devoted to better purposes. Street cleaning costs and sickness and mortality resulting from street filth and the fly pest will be much less.

Again, the last census showed 24,000,000 horses and mules in the United States. Twenty-five per cent. of the total value of all agricultural products goes to feed animals to furnish transportation and power. Motor vehicles and traction engines, which consume gasoline, kerosene, coal and other fuels derived from inedible materials or from alcohol distilled from waste vegetable matter, can do most of this work and release this tremendous acreage of productive land for the raising of human food. The effect that this should have on the cost of food stuffs is obvious, altho it has not been estimated.

The Triple Combination Fire Engine

The following data submitted by Oliver E. Smith, engineer fire department, East Cleveland, Ohio, are based on the operation of a Robinson triple combination fire engine, chemical and hose wagon from January 1, 1913, to October 11, 1913:

Cost of repairs	0
Cost of lubricating oil	$12.18
Cost of gasoline, 208 gallons, average 18c per gal	37.44
Total cost	$49.62

Calls answered, 50; distance traveled, 93 miles; cost per mile 53.35 cents.

"This piece of apparatus," writes Mr. Smith, "is practically a complete fire department in itself and consequently appeals to cities which must economize in the number of pieces of equipment. In the case of small fires you have the chemical, and in quantities almost as great as that carried by the chemical, or chemical and hose alone; and the chemical in our experience is used successfully in three-fourths of all fires and is all that is required. If the water hose is necessary, you have it in as great quantities as are carried by the hose wagon alone; and you have the additional advantage of a set of pumps always ready to use with hydrant, cistern or river and with as much power as the steamer, and superior to the steamer in maintaining a steady flow of water thru a long, continuous period of service. You have with you, in case their use is necessary, an amount of ladders equal to that carried on any combination wagon, and the time consumed in reaching a fire over that consumed by the smaller wagon is so small that the greater equipment more than counterbalances the loss of time."

The following report by Thomas Ballantyne, chief of fire department, Savannah, Ga., shows the saving effected the first year in cost of building stations as well as in the comparative cost of maintenance by the installation of motor apparatus:

Estimated cost of horse-drawn steam engine	$4,800.00
Estimated cost of combination chemical and hose wagon	2,000.00
Two teams of horses at $300 per head	1,200.00
Four sets of harness	200.00
Harness hangers and incidentals	400.00
Fire station	7,000.00
Total	$15,600.00
Triple auto engine	$7,500.00
Accessories	350.00
Fire station	5,000.00
Total	$11,850.00
Saving in initial cost	$3,750.00

Maintenance of horse-drawn apparatus—		
Engineer per month	$80.00	
Captain per month	80.00	
Five firemen at $70.00 per month	350.00	
Upkeep of two teams of horses at $38.88 per team	77.76	
Total maintenance per month	$587.76	
Total maintenance per year		$7,053.12
Maintenance of Robinson triple combination auto engine—		
Captain per month	$80.00	
Mechanical engineer	80.00	
One fireman, per month	70.00	
Oil, gasoline, tires and repairs	14.82	
Total maintenance auto per month	$244.82	
Total maintenance per year		$2,937.84
Saving in maintenance for one year		$4,115.28
Total saving for first year		$7,856.28

MISCELLANEOUS

Production of Portland Cement in 1913

Acording to returns received by the United States Geological Survey up to January 12, 1914, it is estimated by Ernest F. Burchard, that the quantity of Portland cement manufactured in the United States in 1913 was approximately 92,406,000 barrels, compared with 82,438,096 barrels in 1912, an increase of about 9,967,000 barrels or 12 per cent. The estimated shipments of Portland cement during 1913 were 88,853,000 barrels, compared with 85,012,556 barrels in 1912, an increase of about 3,840,000 barrels, or 4.5 per cent. On account of a large surplus of production over shipments stocks of cement at the mills apparently increased more than 45 per cent., or from 7,811,329 barrels in 1912 to 11,375,000 barrels at the close of 1913. In 1913 the relations between production and shipments were the reverse of those for 1912, when shipments exceeded production. It may be necessary to revise considerably the estimates of stocks, but it is believed that these figures for production and shipments are close to those that will be shown by complete returns from all producers.

Altho few definite statements as to selling prices are at hand it is evident that the average value per barrel was appreciably higher than in 1912. Increases of 10 to 25 cents a barrel are reported from several plants in the Central and Eastern States, but there were slight decreases reported from a few plants in the Rocky Mountain district.

Two new plants, both in Washington, were added to the list of producers during 1913.

Public Relations

By J. H. Pardee, President The J. G. White Management Corporation.

Some of us can remember the early days of street railway development when the difficulties and problems which confronted the promoters and operators of traction properties were nearly entirely of a technical nature. The general public stood on the side lines, always interested, yet assuming no particular risk excepting perhaps in granting the right to erect poles and overhead wires in public streets for the distribution of the deadly electric current. The public cannot be said to have considered itself as a partner in the development, but rather that it was by outsiders who were willing to risk their fortunes on it. The consent of the public was sometimes given in view of possible service and anticipated commercial development.

Today the situation is very different; the public is indeed considered a partner in the management of the affairs of public service properties. Promoters may be confident that electric railways can be successfully built as far as the purely technical features are concerned; they must now make sure that their schemes have the approval of public opinion. The officers of street railway companies are now bearing heavy responsibilities in this new phase of utility administration, the guidance of public relationship. Traction lines are public servants existing for the comfort of the people and bearing to them certain well-defined obligations in the way of safe and adequate service at equitable rates; the public owes them fair treatment and protection from the indirect confiscation of their property by legislation, making it impossible to earn proper returns on investments in such property. Due to the failure of municipal ownership the public has found, after many costly trials of this inefficient method, that the most expedient and practical solution of the problem lies in the development of traction systems by private capital, together with proper and fair regulation by commissions representing the public interest.

From this comparatively new system of utility regulation have come a great many abuses of the regulatory power. Prompted by an ill-advised public opinion, and, in some cases, ignorant of actual conditions, commissions have been known to impose upon electric railways very onerous conditions, limitations, etc., which have so seriously burdened such companies as to actually set back their development to a very considerable extent by inspiring the ever-cautious money lender with fear. Unreasonable regulation can, in the long run, harm no one but the public itself, for it automatically, by the very laws of economics, increases the date at which money can be drawn into this field of investment, and hence the rates which the public must pay for service. It is my confident belief that, in the abuse of regulatory powers, the pendulum has now commenced to swing back and that public service commissions are coming more and more to realize their obligations to security holders as well as to the sovereign partner, the public.

Having the greatest confidence in the general integrity of our American public, I believe most of the unfair burdens which have been saddled upon street railway companies with the consent of public opinion have been the result of gross misconception concerning the affairs and conditions of operation of such companies. The greater part of the general public knows very little about the electric railway business and are easily misled by those who picture them as monstrous monopolies, turning over tremendous and unwarranted monetary returns to their owners.

I believe, in general, that public opinion has come to realize that it, too, must endeavor to establish a harmonious spirit of co-operation between street railway companies and those whom they serve in order to arrive at the very best result for all concerned, and also believe we may expect to see a great improvement along these lines in the very near future.

Effect of State Regulation of Public Utilities

By William H. Winslow, President of the Wisconsin Electrical Association.

SUFFICIENT time has now elapsed since the passage of the original public utility and stock and bond laws to permit of forming a reasoned judgment on their results and tendencies.

As regards established utilities, their effect has, I believe, been, on the whole, beneficial—both from the standpoint of the public and that of the utilities. Certainly the belief that excessive profits were being received by public service companies must have been dissipated, as it is doubtful if in a single case returns have been disclosed more than equal to the minimum which a bank, factory or trading concern must earn in order to be called successful.

It has been said of these laws that they have taken the utilities of the state out of the field of speculation. As regards existing companies, this is perhaps both true and proper. Applied to new enterprises, however, it would be more nearly correct to say that they have made their financing difficult or impossible, and it is to this phase of the situation that it is desired to call particular attention. No laws can make hazardous enterprises (and all new ventures are more or less so) anything but speculative, and it is becoming apparent that the laws in question are stifling development and will continue to do so unless modified. This is a matter of fully as much importance to the people of the state at large as it is to the utilities; possibly even more so, for, while capital can find other outlets, the loss to the state resulting from arrested enterprise is positive and unescapable.

The plain facts of the matter are that in most cases money cannot be obtained for new ventures in the utility field, either by the sale of capital stock at par, or by the sale of bonds, or any combination of the two. That this is so is due to a number of conditions peculiar to quasi-public businesses,—among them the very large initial investment needed and small early returns received, and the fact that increases in investment are governed, not by the desires or convenience of their owners, but by the demands of the public. What is required is that speculatively inclined investors, who alone are attracted to such enterprises, be offered both a first lien on the property and a share in the profits over a mere interest return, when—and if—such profits are earned. This was formerly accomplished by the issuance of bonus stock, and very many people who were formerly violently opposed to such issues now realize that they were an economic necessity and entirely different from "watered stock" properly so-called. While bonus stock issues were economically sound and, within proper limits, in the public interest, rather than the reverse, they were open to the objection that they did not clearly show that their value was based on earning power only. For this reason, they cannot be—and possibly should not be—revived.

How, then, can the deadlock which appears to exist be broken? Apparently, only by legalizing the issuance of stock without par value, or profit-sharing certificates, as they are sometimes called, such as are now permitted by the laws of several of the states. Not only would such issues facilitate the financing of new enterprises, but they would make possible the consolidation of many small and necessarily inefficient plants, with great resulting advantage to the community served. The head of one of the large companies that has combined scores of plants in other states has stated that were issues of profit-sharing stock without par value permitted in Wisconsin, his concern would enter the state and, thru the well-known economies resulting from the substitution of a few large plants for many small ones, be enabled in many cases to largely reduce present rates.

While this is a matter that does not directly affect most existing utilities, we are all vitally interested in the progress and development of the state, and should, I believe, do what we can to further such an amendment of the stock and bond law as will relieve the present situation.

New York City Budget for 1914

The budget of New York City for 1914 is published in *The City Record* for December 2, 1913, and covers some 99 large pages. The total is $199,388,157.52, of which $192,995,551.62 is to be raised by direct taxation; $2,969,579.21 by sale of corporate stock (corresponding to municipal bonds); $1,168,176.11 from special and trust funds; $1,761,601.13 from water revenues; $438,433.95 from bridge revenues, and $54,815.50 from revenue bonds.

The Board of Aldermen and city clerk require $301,218.24.

The central administration of the city requires over $7,000,000; Manhattan central administration nearly $3,000,000; Bronx, $1,258,000; Brooklyn, $2,275,000; Queens, $2,000,000; Richmond, $722,000.

Schools require $39,500,000; census, $89,000; parks and public buildings, $3,300,000; police, $17,400,000; fire, $9,300,000; health board, $3,500,000; charities, $3,700,000; hospitals, $1,500,000; tenement house department, $767,000; water, gas and electricity, $7,500,000; street cleaning, $7,700,000; charitable institutions, $5,300,000; *The City Record*, $929,000; being a few of the principal items.

Technical Associations

The Indiana Engineering Society's program at its convention January 22 to 24, had the usual excess of papers which makes discussion all but impossible. Some of the papers were given in abstract or read by title as a consequence. One session had road building as its principal subject, another bridges and railways, another public utility regulation, and another the floods of March, 1913. Roads and public utilities had the most satisfactory treatment. The road question is the most behind in the state, while public service regulation, since the installation of the state commission last year, has had very reasonable success. Prof. Albert Smith, of Purdue University, was chosen president.

At the January 19 meeting of the New York Electrical Society, Dr. Elihu Thomson delivered a lecture on "The Wireless Transmission of Energy."

The program of the January 15, 16 convention of the Wisconsin Electrical Association was of unusual interest and two or three of the papers are given elsewhere in more or less completeness.

A paper on a universal datum plane for New York City was presented by Frederick W. Koop, at the meeting of the Brooklyn Engineers' Club, January 8.

The annual meeting of the American Society of Civil Engineers included the usual business meeting and trips of inspection of engineering works. On January 23 and 24 were held three sessions for the discussion of road construction and maintenance in accordance with the custom of the past three or four years.

The annual meeting of the New England Water Works Association, Jan. 14, was filled with valuable committee reports, a paper on construction of dams, by A. E. Walden, and the address of the retiring president, J. Waldo Smith.

The American Wood Preservers' Association held an interesting and important meeting at New Orleans, La., January 20 to 22. F. J. Angier, secretary, Mt. Royal Sta., B. & O. R. R., Baltimore, Md.

The program of the National Conference on Concrete Road Building under the chairmanship of Dr. W. F. M. Goss, begins Thursday afternoon, February 12, and closes Saturday, Feb. 14, at noon. It is full of papers and reports of committees by the foremost experts and covers all details of the subject from financing to joints and shoulders. Being held in connection with the Chicago cement show, it should be attended by most of those interested in the subject of good roads and good street pavements, in other words, by more than the Auditorium hotel convention hall can hold.

The National Brick Manufacturers' Association will meet in New Orleans, La., March 2-5.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

February 4: Assistant preparator in paleontology in the National Museum, Washington, D. C., at $60 a month.

February 18, 19: Laboratory assistant in petrography in Bureau of Standards, Department of Commerce, Washington, D. C., at $1,400 to $1,800 a year.

Technical Schools

The winter course in highway engineering at the Ohio State University, Columbus, O., will be held February 16 to 18 by the civil engineering department. The course includes about five lectures a day for eleven days, to be given by well known road experts of the state and of the United States.

The extension division of Indiana University will hold at Bloomington, Ind., on February 5 and 6, a conference on taxation in Indiana which will be addressed by various experts on the question from Indiana, Wisconsin and New York and Indiana and other universities.

The department of sanitary engineering of Harvard University announces four new courses: one on demography for students in the school for health officers; one on rural sanitation for the same; one on elementary bacteriology; and one on municipal sanitary engineering. All the courses are specially adapted to students specializing in government and business administration.

The Columbia University graduate school of highway engineering presented lectures in January by such experts as W. H. Kershaw on handling of asphaltic oils, W. H. Connell on organization and methods of street cleaning, Paul D. Sargent on gravel in highway construction, Geo. W. Tillson on construction of street car tracks, J. W. Howard on European rock asphalts, and F. P. Smith on inspections of bituminous materials for highway use.

Personal Notes

Burdett Moody, formerly chief engineer of the water plant at Pasadena, Cal., is consulting engineer for the city of San Francisco in the Spring Valley water condemnation suit, working mainly for some time upon the valuation of the plant, estimated by the company's experts as high as $65,000,000.

L. Earle Thornton has been appointed city engineer of Pensacola, Fla.

Charles H. Eaglee for 9 years general manager of the Ambursen Hydraulic Construction Co., in charge of their construction work, has just become connected with the Aberthaw Construction Company of Boston, and will have charge of all dam and reservoir work for that company.

W. G. Chace, of Kerry and Chace, Ltd., Toronto, Ont., is chief engineer of the Greater Winnipeg water district in Manitoba. His experience has been with the International Railway Co. of Niagara Falls, Ont., the Temiskaming and Northern Ontario railway commission, the Ontario hydro-electric power commission and in Winnipeg with the design and construction of the municipal hydro-electric power plant, transmission line and sub-stations, besides smaller work for his firm.

Max V. Sauer is the chief of design in the Winnipeg office of the Greater Winnipeg water district and has had quite a varied experience in similar lines in the twelve years since graduation from college. The survey parties are in charge of five engineers, three of whom are college men of ten years' experience or more. They are Archie Paget with railway experience; Douglas L. McLean, with railway and hydraulic experience; A. C. D. Blanchard, with municipal experience in water, light, sewerage and as city engineer; Chas. J. Bruce, a surveyor, and George F. Richan, also a railway engineer.

The Houston plan of taxation, devised by J. J. Pastoriza, finance and tax commissioner of the city, is a striking advertisement, especially when presented as "a perpetual bonus to manufacturers and merchants."

Having been disappointed in securing Col. Goethals, the new city commission of Dayton, Ohio, which goes into office January 1, has appointed H. M. Waite, the outgoing city engineer of Cincinnati, Ohio, as city manager, with a salary of $12,500 a year.

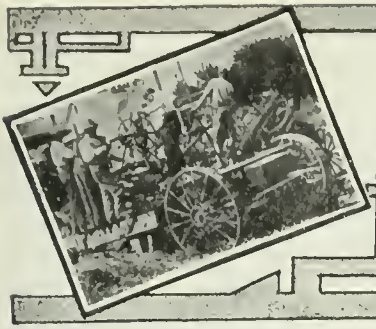
T. Chalkley Hatton of Wilmington, Del., has been chosen chief engineer of the new Milwaukee Sewerage Commission at a salary of $10,000 a year. The commission will spend some $15,000,000 in constructing and reconstructing a sewerage system and a sewage disposal plant.

Howard S. Reed, Asso. M. Am. Soc. C. E., for some years with the U. S. Geological Survey and the Reclamation Service, particularly the canals of the Roosevelt irrigation project, has opened an office for the general practice of municipal and irrigation hydraulic and water supply engineering in the Noll building, Phoenix, Ariz.

E. A. Kingsley of Little Rock, Ark., and R. C. Huston of Memphis, Tenn., have organized the Huston-Kingsley Company, incorporated engineers, with offices in both cities, to carry on the business of the two principal members of the company.

Mr. George L. Bean, who has recently severed his connection with the American Water Works and Guaranty Company owing to their financial difficulties, has been retained by Henry Floy, consulting engineer of New York City, to assist in the valuation of public utility properties, particularly water works plants. Mr. Bean was with the National Board of Fire Underwriters as hydraulic engineer for some years before going with the American Water Works Company, and has had a wide experience in making investigations, tests and reports.

Mr. Charles E. Raynes, mechanical engineer of New York City, has joined the engineering staff of Henry Floy, consulting engineer of New York City.



MACHINERY AND SUPPLIES

How Nearly a Whole Town Is Heated From One Plant

The Berwind-White Coal Mining Company has large works in and near Windber, Pa., a town with a population af 12,000, practically owned by the coal company and allied interests.

Some years ago the Windber Heating Company was formed and a large power house was built right at the entrance of the coal mine. This plant furnished power and light for the operation of the mine, electric light, power and heat for a large portion of the town. At the present time this heating company is under contract to supply heat for 58,000 feet of radiation. In all the early installations the pipe was insulated with wood covering. About a year ago one line was opened up and what was left of the wood covering was removed and J-M sectional conduit substituted. This proved so satisfactory that the company has recently opened up over 2,000 feet of steam line, taking it from the ditch and relaying it with J-M sectional conduit. Today it has in all a total of 3,325 feet of the J-M system installed.

The recent installation, of which some views are shown, is an 8-inch main line, running from the power house up a steep hill and down a stiff grade to the heart of the town, where it connects the branch mains. There is no return line on this system, live steam being carried into each building at a low point, so that the return will flow back into a trap, from which it is allowed to go to waste.

Several difficult conditions had to be met, such as the line passing thru coal veins and hard pan, thru which surface water strong in sulphur percolated. Naturally this chemical water rapidly ate the steel pipe away after having soaked thru and eaten away the old wooden protection pipe, and it was necessary to remove a considerable quantity of pipe, altho it had only been in three years. In one place, as the picture shows (Fig. 1), a hole had eaten in the pipe nearly 2 inches in diameter. In laying this pipe line it was originally found necessary to cross under the gutter of a roadway which carried mine water strongly charged with sulphur. In laying the new conduit and pipe at this point, the course of the stream was temporarily diverted while the conduit was laid across its path. A concrete dam was constructed in the gutter with the conduit imbedded in it. This prevented the backfilling from washing away, securely held the conduit in line and kept it free of danger from sulphur water.

As originally laid the pipe was allowed to take

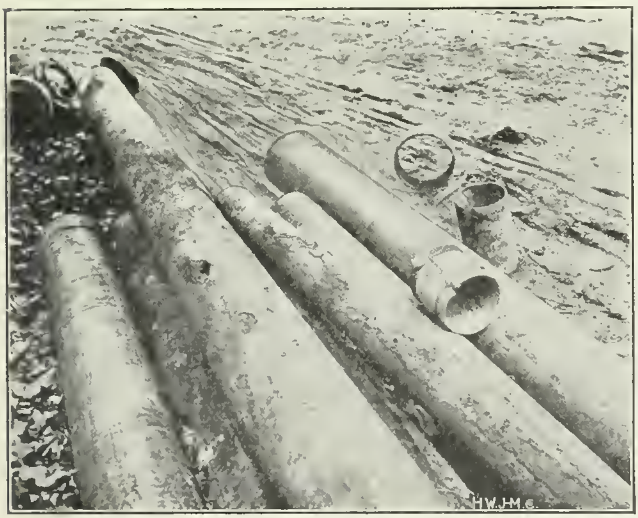


FIG. 1. STEAM HEATING PIPE *badly eaten by mine drainage which had run over it.*

the curvature of the ditch, with unnecessary strains placed on joints, resulting in their leaking. In laying the J-M conduit care was taken to secure the correct grade. The ditch was dug 3 feet wide and to the necessary depth. In the bottom of the ditch another ditch 9 inches deep and 12 inches wide was made. In this was laid a 6-inch diameter sub-drain, the bottom of which was covered with 6 inches of crushed stone of rather coarse grade. Upon this was laid a layer of fine chip stone, to form a fairly even bed for the bottom half of the tile conduit.

At every fifth section of tile was a supporting tee, with the bell of the branch down, and the base filled to the flow line of the conduit with rich concrete, as will be noted in the illustration (Fig. 2). In this concrete were set J-M roll frames with exactness as to height. These frames are designed to carry the entire weight of the pipe and permit it to move under expansion and contraction without placing any strain on the tile conduit shown in foreground of Fig. 2.

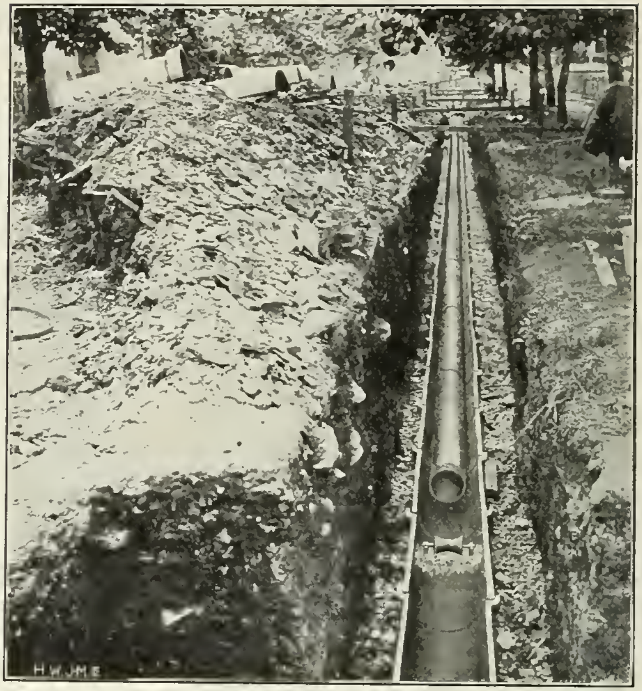


FIG. 2. METHOD OF LAYING *steam pipes for heating town, to retain the heat.*

The steam pipe was then laid and the expansion joints were placed in the line at proper intervals, to take care of the expansion and contraction of the pipe. All expansion joints were placed in manholes. Then the pipe was subjected to a hydraulic water test of 20 to 60 pounds according to the steam pressure to be carried in the line where the test was made.

The top halves of the conduit were then placed in position, the longitudinal joints being well washed with neat cement mortar and the bell joints were cemented to insure their being water-tight.

J-M asbesto-sponge filling was packed in the conduit all around the steam pipe. Crushed stone of medium size was then filled in until the bells of the second half were covered with 3 inches of stone. Then the ditch was filled up and tamped.

The manholes were made with 13-inch concrete foundation walls to a height even with the top of the lower half of conduit. The conduit was brought thru the manhole walls, so that the edges of the tile were flush with the inside of the walls. In order that the tile should have bell ends in the manholes, unions were used in laying the first sections on the down grade side of all manholes. Over these concrete foundation walls, brick walls were built and brought in at the top to the proper size to receive the manhole plates. Wherever the tile entered the manholes the pipes were covered with sleeves of J.-M sectional asbesto-sponge felted pipe covering and the openings around same closed with a shutter.

Aside from its simplicity and the facility afforded for its rapid installation, J-M sectional conduit possesses the characteristic of absolute imperviousness to water, dampness and acids. Being made from a special combination of stoneware, clay and other ingredients it forms a particularly durable protection for underground steam pipes where chemical action would attack and eat steel, wood and other materials. It is thoroly vitrified and salt-glazed both inside and out so that no moisture can penetrate it.

An additional advantage, found in the use of J-M sectional conduit is that by the nature of its construction, the weight or movement of pipes cannot injure the conduit. It can be opened up for inspection or removed and relaid without damage to the conduit. So carefully is J-M sectional conduit manufactured that the entire process extends over a period of four weeks.

J-M sectional conduit has evidently very wisely been adopted as a standard for the heating lines in this very interesting mining city, because the first experimental section laid has thoroly demonstrated to the mining company's engineers that it forms the best and most economical system of heating conduit to be had.

There seems to be no reason, with the care used in laying the lines of pipe in the conduits, the full provisions made to take care of the expansion and contraction of the pipe, the durable character of all the materials used, why the whole installation should not be permanently satisfactory.

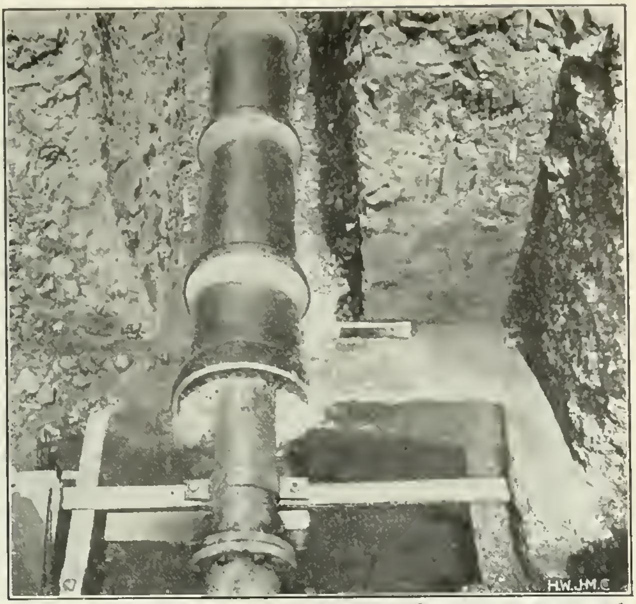


FIG. 3. METHOD OF INSULATING *steam pipes laid in the street.*

Test of Seagrave Motor Pumping Engine for Columbus, Ohio

By Chas. J. Lauer, Chief of Fire Department.

The city of Columbus, Ohio, made an official and acceptance test of the Seagrave motor-driven six-cylinder pumping engine on Monday, June 9, 1913.

This test was held on the banks of the Scioto river near Dublin avenue bridge under the supervision of the writer and Mr. W. S. Winnard, superintendent of machinery.

This engine, which is manufactured by the Seagrave Company, Columbus, Ohio, has stood a very severe test, which was exceedingly satisfactory to all concerned. The pump on this engine is of multi-stage Gorham centrifugal turbine type. The following data cover specification requirements and records of the four tests made:

SPECIFICATION *Requirements.*

Pump to deliver 1,000 gallons per minute at 120 pounds, pump pressure; 600 gallons at 200 pounds, 400 gallons at 250 pounds, all while drafting water from river.

CAPACITY *Test No. 1.*

Three lines 2⅞-inch C. R. L. hose, each 300 feet long, with 1¼-inch smooth-bore nozzles on each line.

Average pump pressure.........lbs. 190
Acerage nozzle pressure ....lbs. 58
Gallons discharged per minute..... 1,053
Duration of test ....minutes 30

CAPACITY *Test No. 2.*

Three lines 2½-inch C. R. L. hose, siamesed into standard Eastman deluge set with 2-inch smooth-bore nozzle.

Average pump pressure..........lbs. 180
Average nozzle pressure..........lbs. 67
Gallons discharged per minute...... 973
Duration of test.............minutes 30

TEST *No. 3.*

Three lines 2½-inch C. R. L. hose, 300 feet each, siamesed into a standard Eastman deluge set with 1½-inch smooth-bore nozzle.

Average pump pressure..........lbs. 200
Average nozzle pressure..........lbs. 130
Gallons discharged per minute....... 760
Duration of test.............minutes 30

TEST *No. 4.*

One line 2½-inch C. R. L. hose, 300 feet long, with 1¼-inch smooth-bore nozzle.

Average pump pressure...........lbs. 265
Average nozzle pressure..........lbs. 93
Gallons discharged per minute...... 445

All readings taken under supervision of W. S. Winnard, superintendent machinery, Columbus fire department. Hose furnished by the Columbus fire department and was old hose with very great friction loss and the lines were very crooked.

A test of shutting off nozzles on three lines of hose simultaneously was made to show the flexibility of the pump, which was very satisfactory.

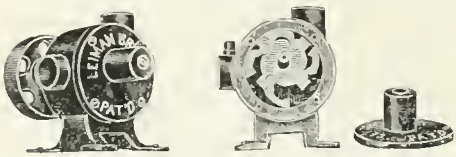
An Inexpensive Vacuum Cleaner

How many department heads have taken the time to consider the advantages to be derived from the use of a vacuum cleaning outfit? Probably some have discarded the idea, believing that the expense was too great. But a vacuum cleaning outfit, handled in the right way, can be installed with comparatively little expense, and nothing need be said in regard to the advantages to be derived from its use.

The municipal workshop or department will derive benefit not only on account of cleanliness in the plant and office, but from the use of the outfit for other work.

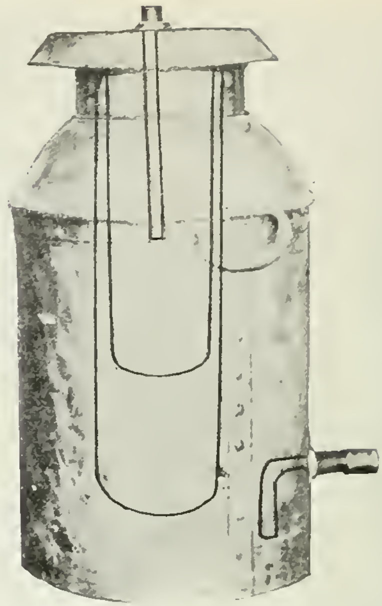
In connection with a vacuum cleaning outfit of the right sort there is generally supplied a rotary vacuum pump, such as is manufactured by Leiman Brothers, of 62 John street, New York City, which may be used for the suction in the cleaning operation, and also for blowing, and in this way becomes available for use in connection with a sand blast, blowpipes, gas furnaces, agitation, etc. In the shop the apparatus can be used for cleaning dust and dirt out of intricate parts of machinery, electric motors, etc., by blowing with the air jet, and for melting, brazing, annealing, etc.

We show herewith an illustration of how a simple dust-separating tank can be constructed. This is made of an ordinary 40-quart milk can. The cover of this can



BLOWERS *or suction air pumps for vacuum cleaning system.*

makes it an air-tight tank. A round hole is cut in the cover and a pipe connection made, as shown in detail in the sketch. The pipe or hose connecting the tank with the cleaning tool is attached at this connection. The connection from the can to the pump is made at the bottom in the same manner. The necessary screen is a bag made in suitable shape to set into the can about three-fourths of the way down, and to rest over the neck of the can in such manner that the cover will be drawn down over the top, holding it



DUST COLLECTOR *made from a milk can, which is very effective and inexpensive.*

secure. This bag may be made of canvas, canton flannel or suitable silk bolting cloth, depending on the amount of dust and dirt to be removed. The connection to the pump is made by means of a pipe nipple and union. The machine is now ready for operation, after attaching a belt to the pump from a motor or a line of shafting.

There is no doubt that a great many departments would find it profitable to install with the vacuum cleaning outfit a sand blast or gas furnace as labor-saving tools. The city departments in particular should be leaders in the matter of cleanliness, and therefore this system should appeal to them.

The pumps may be procured separately and the balance of the outfit assembled by any one with ordinary mechanical ability, or the entire outfit may be secured and the proper connections made. The pipe for blowing can be led from the pump to where the air blast is required, and used, as stated above, for the various purposes in connection with the regular routine work.

Asphalt Paving Record of West Chicago Park Commissioners

In his annual report, Mr. A. C. Shroder, superintendent and engineer of the West Chicago Park Commissioners, states:

"During the paving season of the year

1912, operations were continued with our own asphalt paving plant and employees in the laying of asphaltic concrete. The total number of square yards laid during this season aggregates 121,385, at a total cost of $77,789.26, making the average cost per square yard, 64c. The pavements were laid with an average thickness of two inches. The following is a list of roadways and drives paved during the current year with our plant:

Areas Paved.

		Square Yards.
West Drive of Independence Boulevard from Colorado avenue to Harrison street...		1095.0
Garfield Park—		
West Drive south of Madison street	14767	
West, North and Center Drives between Madison and Lake streets	23350	
North of Lake street	5021	
Total for Garfield Park		43138.0
Palmer Square Drives		21540.0
Washington Boulevard, 52nd avenue to Austin avenue		24472.0
Douglas Boulevard, Douglas Park to Independence Square		20048.0
East Drive of Independence Boulevard, Fillmore street to Independence Square		7306.0
Total area of drives paved during 1912		117599.0
Garfield Park walks	2464	
Independence and Douglas Boulevard walks	882	
Total area of walks paved ing 1912		3346.0
Douglas Boulevard maintenance		440.0
Total yardage		121385.0
Total cost		$77,728.26
Average cost per square yard..		.64

Cost of Materials.

Crushed limestone per cubic yard..	$ 1.19
Torpedo sand, per cubic yard	1.55
Bank sand, per cubic yard	1.05
Crushed granite, per cubic yard	2.95
Asphaltic cement, per net ton	17.95
Coal, average price per ton	4.65
Beach sand, per cubic yard	1.15

The following is a summary of the cost of asphaltic concrete pavements for the years 1910, 1911 and 1912:

Year.	Sq. Yds.	Cost.	Cost per Sq. Yd.
1910 ...	93,742	$63,373.99	64.59 cents
1911 ...	137,449	84,236.02	61.24 cents
1912 ...	121,385	77,789.26	64.09 cents

Total yardage paved	352,686 sq. yds.
Total cost	$225,399.27
Average cost per square yard..	63.91

Cost of Oiling Macadam Roadways in 1912.

302,700 square yards of macadam pavement were treated from one to three times during 1912. The following table shows the cost for the year:

Labor, superintendence and miscellaneous charges	1,056.28
Oil with asphaltic base, 7150 gallons at 6 cents	$ 429.00
Crude petroleum oil, 39,480 gallons at an average of .0346 cent	1,360.00
Teams, 130 days at $5.50 per day	715.00
Soap, 110 barrels at $2.50	275.00
Total	$3,835.88
Total square yards covered during 1912	302,700
Cost per square yard for year..	1.27c

Link Belt Machine Used.

The asphalt paving plants used by the West Chicago Park Commissioners are furnished by the Link Belt Company, Chicago.

The Small Town Plant

By A. W. Seng, Superintendent Municipal Water and Light Plant, Sylvan Grove, Kans.

Altho the village of Sylvan Grove has a population of but 600, it has been successfully operating its own water and electric light plant, which was installed during the months of November and December, 1911, at a cost of $22,699, by the Commercial Construction Company, Kansas City, Mo.

The city sells current to its patrons at 15 cents per kw. hr., $1.25 minimum. Water is sold at 25 cents per 1,000 gallons, $1 minimum.

Electrical service is given from one hour before sundown until 12 o'clock at night, and 5 a. m. until one hour after sunup, and Wednesday afternoons for ironing, etc, or about ten hours per day.

The city made a profit of about $200 during the months of December, 1912, and January, 1913, or a profit of about 50 per cent., but the average profit for the last six months was 33 per cent. However, most of this is used to pay for new extensions, meters, etc., and what is left goes into a sinking fund for upkeep of the plant.

Our engine and pumping equipment consist of: One 50-h.p., 2-cycle, Fairbanks-Morse oil engine,. for running the generator and pumps; one 32-h.p., single Fairbanks-Morse oil engine for pump only; one 7 by 8-in. Smith-Vaile, triplex, double-acting power pump, rated capacity 300 gallons per minute.

The power oil used is a 40-gravity distillate, which costs us 5 cents per gallon in tank-car lots.

One of the noteworthy features of our plant is the fact that the pump may be directly connected to either engine by clutch. Our engine will run pump and alternator at the same time, and when the pump is on there is not the slightest fluctuation in voltage. The particularly advantageous feature of the type of engine used is that it is exceedingly economical in operation. The engines can be started in less than five minutes' time and need scarcely any attention when running. They run with excellent regulation, having a gear-driven throttling governor, butterfly type, which regulates speed within 3 per cent. from no load to full load.

This plant has lost less than one hour's time due to shutdown and has run for more than four months at a time without a bit of trouble or stop.

The following is extracted from our financial statement for the year, January 25, 1912, to January 25, 1913:

Expense.

Fuel oil	$1,022.00
Lubricating oil	32.00
Repairs	38.50
Labor and salaries	1,555.00
Int. 5%, $35,000	1,750.00
Depreciation 4%	1,400.00
Total	$5,769.50

Income.

February 25, 1912	$128.60
March 25, 1912	93.48
April 25, 1912	141.92
May 25, 1912	161.27
June 25, 1912	170.91
July 25, 1912	236.91
August 25, 1912	197.97
September 25, 1912	266.04
October 25, 1912	231.52
November 25, 1912	319.40
December 25, 1912	330.49
January 25, 1913	321.76
Street lights	1,320.00
Water for sprinkling	240.00
Total	$4,160.27
To balance	1,636.23
	$5,796.50

Liabilities.

Bonded debt	$35,000.00
Interest at 5%	1,750.00
Expense	4,046.50
Total	$40,796.50

Assets.

Value of plant	$35,000.00
Sinking fund	300.00
Income	4,160.27
	$39,460.00
City levy	1,336.23
Total	$40,796.50

The above statement covers the first year's operation of our plant. Since January 25, 1913, we have been so rapidly increasing our line of customers that by January, 1914, the plant will undoubtedly show a 40 per cent. increase in income and efficiency. We are now operating the engines with an increased efficiency of 10 per cent., which will make a saving in fuel oil. Operating expenses have received a 20 per cent. cut, so that we expect to come out without a deficit this coming year.

Our electrical equipment consists of: One 2,300-volt, 3-phase, 37.5-k.v.a., 60-cycle Fort Wayne belted alternator; one 125-volt, 1.5-kw. Fort Wayne belted exciter; one 6-k.v.a., 2,200-volt Fort Wayne transformer; one 5-k.v.a., 2,200-volt Fort Wayne transformer; one 3-k.v.a., 2,200-volt Fort Wayne transformer; one 2-k.v.a., 2,200-volt Fort Wayne transformer; one 1-k.v.a., 2,200-volt Fort Wayne transformer; one 3-panel Fort Wayne switchboard; 104 110-volt, single-phase, 60-cycle Fort Wayne watt-hour meters.

Our one tungsten 35-lamp, 3.5-amp., series street lighting circuit is carried on three miles No. 8 W. P. copper wire; one mile 3-phase, high-tension No. 8 W. P. copper wire.

Our three miles of service lines, 110-volt, are carried on No. 6 W. P. copper wire.

Goodyear Launches Detachable Tread Tire

The Goodyear Tire and Rubber Company have brought out a new type of pneumatic automobile tire that possesses new features of great interest. It consists of a regular tire carcass—and a detachable tread. When the tire is inflated the tread can be removed easily, yet when properly inflated the two parts possess the strength and power of a one-piece tire. This makes it possible to replace either part—carcass or tread—in a few moments, anywhere, and means that practically a new tire can be obtained, if needed, at about half the usual cost.

The tread is held firmly to the carcass by the inflation of the tire. A secret construction that gives the edges of the tread an unstretchable bead, solves the problem of the necessary grip, and keeps the components safe from invasion by water or dirt.

It is worthy of note that no mechanical fastenings of any kind are necessary. This means there is nothing to impair the resiliency of the tire, or add extra weight.

This new tire gives a greater protection from punctures than other types of pneumatic tires. The tread doesn't bear the tube strain and is therefore less tense than the carcass. Tests prove that a sharp object cannot readily pass thru a soft medium into a hard one without being deflected.

The tread is built slightly square on the inside, which provides air chambers at the two points of vibration on each side of the center of the tread. This prevents the possibility of injury to the carcass through overheating.

The two parts of this tire are built separately and to exact measurements. When put together they are a perfect fit. There is no loss of power, and no danger of the tread being forced off on a curve. The tread has a wearing surface of sharp-edged, wide-based blocks, which assure real protection against skidding.

Asphalt Pavements in New Orleans

By W. J. Hardee, City Engineer, Engineering Division, Department of Public Property, New Orleans, La.

Many of our streets paved with asphalt are so paved for their full length, varying from one to three miles, but the greater yardage of asphalt pavement is on sections only of streets, varying from one to three blocks in length, so that the names of streets paved with asphalt are very numerous and would have no special significance to readers of Municipal Engineering, even if the limits within which they are paved would be stated, unless the reader would be familiar with the limits. Our first asphalt pavement was laid nearly thirty years ago by the Barber Asphalt Paving Company and to furnish not only the name of each street or part of the street paved but the year would require, under the circumstances, a very large tabulation. I am therefore confining myself more particularly to the length and yardage of asphalt pavements than the name of the street paved and the year in which the pavement was laid.

We have approximately 405,094 lineal feet of asphalt pavement roadway, embracing approximately 1,260,292 square yards. The cost of these pavements has from time to time varied, commencing with the first from $4.50 per square yard to $2.50 per square yard, which price has prevailed for the last fifteen years with slight variation either above or below, depending on local conditions surrounding the street to be paved.

All our asphalt pavement contracts provide for a five-year maintenance by the contractor. The majority of our asphalt pavements have been laid with Trinidad lake asphalt. The cost of upkeep and maintenance on this type of pavement is exceedingly low.

We own and operate a municipal repair plant, which has, during the five years of its existence, used Trinidad lake asphalt, California oil asphalt and Texas oil asphalt, altho as above stated Trinidad asphalt has been most extensively used.

The majority of our asphalt pavements are on residential streets and are therefore subjected to medium and light traffic both as to number and tonnage of vehicles, but we have in the business section of the city a number of prominent streets paved with Trinidad asphalt which is subjected to very heavy commercial traffic.

We have contracted for about 80,000 square yards of asphalt pavement which has not yet been laid, but in connection with which the preparatory work is now in progress. All our pavements are laid by contract and no portion is laid by the city.

Des Moines City Hall Furniture

The new city hall of Des Moines, Iowa, was planned and furnished under the supervision of four well-known firms of architects of that city—Liebbe, Nourse & Rasmussen; Wetherell & Gage; Proudfoot & Bird, and Hallet & Rawson. They incorporated in the designing of this building very unusual and elaborate features. The metal furniture installed was all built to order to meet the requirements of the various departments. We give in this article a brief description of some of the most important features of this metal furniture contract.

This contract was notable in the fact that it contained almost every filing device that was ever designed and made in metal. The work consisted of thirty-two cases, six counters, four bulletin boards and ninety-three clothes lockers.

The cases contained devices that were covered by doors, sliding or swinging, or steel curtains, or that were under a locking system that locked a nest or set of devices which was controlled and locked by a lever or device. Each device locked under a locking system was equipped with a hook that allowed the inserting and locking of the device after the locking system had been locked.

The swinging doors that were installed were made of heavy sheet steel reinforced with bars to insure a good working door free from all buckles and whips that occur in a large plate of steel. These doors were hung on heavy steel butts, which were riveted securely to the upright of the case and to the door itself. This overcame any possibility of the doors working loose and becoming noisy. These doors were locked by up-and-down bolts that locked in the cast at the bottom and at the top, and were controlled in the center by a heavy cast bronze handle operating a latch that was locked by a good, substantial, flat key lock. Locking the doors in this manner prevented a person with evil intent to spring the doors open, in fact, making it impossible to open the doors without unlocking the lock with the keys supplied for same.

The sliding doors were made also of a heavy gage steel sheet and were operated on steel ball-bearing anti-friction wheels, two or more to each door. These wheels traveled in track drawn of heavy sheet brass. The wheels being of steel and running in a brass track, eliminated the noise that would be obtained if the track had been of steel. Where steel tracks are used it is necessary to enamel them to prevent rusting, and this enamel is worn off by the rollers traveling back and forth, which makes a very unsightly looking piece of work. The use of brass track overcomes this and insures a very neat appearance at all times.

Cases covered with steel curtains were equipped with curtains termed "duplex." These curtains are made in two parts, one part coming down from the top and the other part coming up from the bottom. These two parts are joined together by means of heavy steel chains operating over steel ball-bearing anti-friction rollers, which makes the curtains counterbalance each other, insuring perfect ease in closing or opening same. Where the curtains meet in the center they are locked by a heavy, substantial spring lock.

The curtains are made of a series of slats and are formed out of a light gage steel, which are interlaced together, forming a flexible, dust-tight covering which slides thru channels running vertically on the uprights of the case.

The devices, such as document files, card index files, legal blank files, scoop files, etc., were mostly of special size, made to take the different size blanks, papers and forms used by the various departments. These devices were made of light sheet steel formed up in such a manner to make a rigid and serviceable drawer. All fronts of devices were paneled to give a neat appearance and also for additional stiffness.

The roller book shelves were of various sizes and were made of a frame of heavy band steel riveted firmly together supporting steel rollers in the back and brass rollers in the front, which were raised up a sufficient height from the frame to allow the books to roll and not slide, thereby making the life of the covers of the books practically everlasting. The fronts of the uprights of cases containing roller book shelves were equipped with brass rollers running the height of the upright to protect the edges of the books when they were put in or withdrawn from the case. These rollers were held in place by brass clips secured to uprights, and rollers were pivoted on same in such a manner that they were absolutely noiseless.

The counters average about thirty feet in length and contain miscellaneous devices, roller book shelves and pigeon holes. These are covered by doors, either sliding or swinging, and steel curtains. The curtains in these counters are termed "simplex," being single curtains locking in under the ledge of the counter front and when opened disappearing down in the base of the counter. These curtains are counterbalanced by weights supported by chains attached to the curtains operating over anti-friction steel rolls. This insures perfect ease in either closing or opening the curtains. The construction of these curtains is the same as the "duplex" curtains before described.

These counters were supplied in some instances with finished wood tops and with finished steel tops. Where wood tops are furnished the counter is supplied with a heavy steel top underneath the wood top to act as fire protection. The wood tops supplied were 1½ inch thick, built up of five plys made in such a manner so as to prevent the warping of same. Where tops were supplied, made of steel, extra heavy plates were used and were enameled with enamel adapted for work where the service they are put to is severe. All fronts and ends of counters were paneled with applied molding, making the appearance very neat.

The bulletin boards were made of heavy steel covered with glass doors. In the back of these cabinets cork carpet ½ inch thick was put in for the purpose of taking tacks to hold notices, bulletins, etc. The doors were secured by up-and-down bolts and were locked in the center by a lock making a three-point locking attachment, making it impossible to unlock the cabinet without the use of a key.

The lockers in this contract were made entirely of steel of heavy gages formed up in such shape that would make a rigid and serviceable locker. These lockers were ventilated by means of round perforations or louvres formed in the doors. The doors were equipped with up-and-down bolts locked in the center by a lock, making a three-point locking system which guaranteed safety against persons with evil intent trying to spring the doors open without the key. Being made of steel thruout, these lockers were absolutely germ proof.

The entire contract was enameled in an olive green shade with all device fronts and panels of cases and counters striped with neat, narrow stripe of gold. All work enameled is first covered with a filler that is absolutely rust-proof, which is baked on at a high temperature. The work then was enameled two coats of brush enamel, each coat being baked on separately and finally was covered by two coats of varnish, each coat baked on. The surface then was rubbed down with a solution and by a process to give the work a dull, waxed color.

The hardware, such as cupboard handles, drawer pulls, label holders, etc., were made of solid cast brass or pressed out of sheet brass. This trim was finished in "brushed brass," which, in connection with the "olive green" finish on the steel work, presented a very neat and effective appearance.

Operation of Diaphragm Pump

Some recent reports from contractors and others show the satisfactory use of the Atlantic diaphragm pump sold by the Harold L. Bond Co., Atlantic Ave., Boston, Mass.

One reports three weeks' work night and day without stopping, another 5 to 20 hours a day for many months doing as good work as when started with negligible expense for repairs. Many use the pump for taking water out of test pits, cellars, excavations, and the like. The floods of last spring in Indiana and Ohio gave a vast amount of work to this pump.

One pump takes the place of four men with two pumps. In another case when the pump ran continuously night and day it replaced four to eight men and use only 24 gallons of gasoline in 24 hours and but little engine oil, requiring very little attention and that at irregular intervals. Full information will be sent on request.

A New Pavement Roller

A new tandem motor road roller for rolling asphalt, brick and tarred pavements is put on the market by the Austin-Western Road Machinery Company, Chicago, Ill. The machine was exhibited for the first time at the recent American Road Congress and met with warm praise from practical road builders and paving contractors. The photograph shows the roller in operation.

As compared with earlier machines it runs steadier, has an easier and smoother reverse, and with two gear speeds and a power steering device, gives the operator better control. It does better work on account of the weight being hung lower, thus doing away with side sway and oscillation.

The machine shown is a five-ton roller,

TANDEM MOTOR ROLLER *for asphalt, brick and tarred pavements.*

with speeds of $2\frac{1}{4}$ and $3\frac{1}{2}$ miles an hour, 33-inch front and 46-inch rear rolls, each 42 inches wide, 25-gallon gasoline tank, 60-gallon sprinkling tank and 100-gallon cooling tank. The six-ton size is ready for market and the seven and eight-ton sizes will be ready in January or February.

Trinidad Asphalt Streets in Indianapolis

Practically all the streets paved with asphalt in Indianapolis prior to 1894 were paved with Trinidad pitch lake asphalt. A recent inspection of the present condition of streets of those dates gave some interesting data which are gathered in the accompanying list. All these streets are now from 20 to 24 years old. It may be remarked in this connection that all the streets 20 years old or more in the city of Buffalo, N. Y., which were described in the January number of MUNICIPAL ENGINEERING were laid with Trinidad asphalt.

CONDITION OF OLD ASPHALT STREETS IN INDIANAPOLIS, IND.

Mississippi street (now Senate avenue), Washington to Ohio, laid 1890—5,377 yards. About half repaired and needs more.

Tennessee street (now Capitol avenue), Ohio to Washington, laid 1891—4,961 yards. Resurfaced 1911.

Meridian street, Twelfth to Fourteenth (now Twentieth to Twenty-second), laid 1891—3,000 yards. About half repaired; balance good condition.

Pennsylvania street, Fifteenth to Sixteenth (now Twenty-third to Twenty-fourth), laid 1891—2,333 yards. About one-fourth repaired; good condition.

Ohio street, Tennesee to Mississippi streets (now Capitol avenue to Senate avenue), laid 1891—2,140 yards. About one-third repaired; good condition.

Market street, Illinois to Tennessee (now Capitol avenue), laid 1891—1,775 yards. About half repaired and needs more.

Seventh street, Alabama to Mississippi (now Senate avenue), laid 1891—11,290 yards. About one-fourth repaired; good condition.

Pennsylvania street, New York to St. Clair, laid 1892—9,925 yards. About half repaired; good condition.

Kentucky avenue, Washington street to I., D. & W. R. R , laid 1892—9,759 yards. About half repaired and needs more.

New Jersey street, Twentieth to Twenty-fourth, and Eleventh to Thirteenth, laid 1893—8,853 yards. About one-third repaired; good condition.

Talbott avenue, Fourteenth to Seventeenth (now Twenty-second to Twenty-fifth), laid 1893—4,984 yards. About one-third repaired; good condition.

Second street (now Eleventh street), Alabama to Central avenue, laid 1893—1,718 yards. About one-half repaired; good condition.

Prospect street, Dillon to Reed (now Shelby to State avenue), laid 1893—10,682 yards. About one-fifth repaired; good condition.

Massachusetts avenue, College to Bellefontaine, laid 1893—4,171 yards. About half repaired; good condition.

Pennsylvania street, Virginia avenue to Maryland, laid 1893—2,526 yards. About one-third repaired; good condition.

Arsenal avenue, Washington to Michigan, laid 1893—9,067 yards. About one-sixth repaired; good condition.

Illinois street, New York to St. Clair, laid 1893—14,206 yards. About one-half repaired; fair condition.

Unusual Truck Tire Mileage

The Union Transfer Company, which handles practically all the Pennsylvania Railroad Company's transfer business in Philadelphia, Baltimore and Washington, has solved the problem of getting the greatest possible mileage out of their motor truck tires.

One conspicuous instance of unusual tire mileage on their trucks is a transfer truck equipped with Goodrich wireless motor truck tires. They began hauling baggage in June, 1911. After the truck went to work, the owners were able to forget there was such a thing as motor truck tire to think about, because the tires on this truck never called for any attention until they had been in service nearly two years.

In January, 1913, the first replacement was necessary, when one rear tire which had run 12,900 miles was changed. In April following the other rear tire was taken off with 17,000 miles to its credit.

The front tires continued in service until May and September of the same year, when they were removed, having run 18,800 and 25,300 miles respectively.

Since the rear tires were changed, the truck has run 12,000 miles, and the tires are good for more.

In speaking of this unusual record, Mr. Brouse, the B. F. Goodrich representative in Philadelphia, said: "The secret of the whole matter lies right in the handling of the truck. It has been operated under good road conditions; it is never overloaded and never overspeeded. The driver resists the temptation to use the car tracks as a speedway. Any motor truck in normal service, handled as the Union Transfer Trucks are handled, should develop fully as satisfactory mileages."

Thompsonville, Ct., Hook and Ladder Truck

Thompsonville, Ct., has just recived its new hook and ladder truck built by the Knox Automobile Company, of Springfield, Mass., one of the finest vehicles of this type in service.

The motor driving the vehicle is of the standard Knox four-cylinder type with large reserve power and strong hill climbing ability. All the grades in the section covered by the apparatus were taken easily on the installation tests.

Briefly, the specifications of this vehicle are as follows: 40-gallon chemical tank; 200-foot hose; 55-foot, 45-foot, 35-foot, 25-foot, baby extension ladders, one each; two 24-foot, 12-foot roof ladders; one front bumper.

It also has an electric lighting system, electric self-starter, speedometer, clock, siren horn, sand horn, New Departure bell, full equipment of tools; in fact, it embodies everything necessary for the handling of a first class piece of fire apparatus. All tools are easily accessible and are carried in holders. The apparatus is fully adaptable to any size town or city and is a first class city service truck.

Circular Arc Corrugated Iron Culverts

The two accompanying photographs show two culverts of part circular form constructed for street work by the California Corrugated Culvert Co., the local

representative at Los Angeles, Cal., of the National Corrugated Culvert Manufacturing Co. The arch of these culverts is made of corrugated sheets of American Ingot Iron which is claimed to be 99.84 per cent. pure iron and therefore noncorrodible in ordinary use, but still further protected by galvanizing.

The lower part of these culverts is made of concrete with horizontal bottom of the concrete base and the top or surface on which the water flows sloping from sides toward center, which is 2 inches below the sides. A 2 by 2 strip is set in the edge of the concrete on each side, which is removed after the concrete has set, thus making a shoulder for the bearing of the edges of the corrugated iron. This shoulder should be very firm and solid and the use of a small angle iron in the corner of the shoulder to serve as a bearing for the arch of the culvert is recommended. After the corrugated iron arch is set, the space between its upper surface and the shoulder is filled with cement grout.

PART CIRCLE *American ingot iron culvert, thirty-inch base, ten-inch rise. Note heavy traction road machine carried by culvert.*

PART CIRCLE *American ingot iron culvert in Fresno, Cal.*

These part-circle culverts are made in sizes ranging from 7 inches base and 2 inches rise to 84 inches base and 42 inches rise (semi-circular) with metal of 16 to 10 gage.

Full information about the culverts can be obtained from the Armco Publicity Bureau, Cincinnati, O., B. G. Marshall, National Corrugated Culvert Mfg. Co., Middletown, O., or the California Corrugated Culvert Co., 409 Leroy St., Los Angeles, Cal., or West Berkeley, Cal.

Aztec Asphalt Pavements in Scranton, Pa.

The city of Scranton, Pa., in the past has been partial to asphalt pavements, about two-thirds of its mileage of durable pavements being of that material. According to the city engineer it gives general satisfaction and has the preference of property owners over other classes of pavements on account of its first cost as compared with others.

The specifications for asphalt are such that good asphalts of all brands can be used. Under them over four miles of streets have been reported as laid with Aztec asphalt. The accompanying table, prepared by the city engineer shows the data concerning the pavements laid with Aztec asphalt in 1912 and 1913, the first four streets named in the table having been laid in 1912 and the others last year.

The prices paid for these pavements are very reasonable, the asphalt pavements costing from \$1.78 to \$1.90 per square

yard. Five streets marked with stars are part asphalt and part stone block, and the prices given, $1.95 to $2.46, are the average prices for the entire streets, and are higher than the streets having asphalt surface alone because of the higher cost of the stone block surfaces. The yardage given in the table includes the asphalt alone, omitting the area of stone block.

of testing asphalts, water-proofing, bitumens, oils and paints, and the inspection of roads and pavements. Will also be in position to draw up specifications and supervise construction of pavements, roads, bituminous floors and bituminous sidewalks.

The new plan for road and paving inspection which was devised by Mr. Pullar last year, will be considerably elaborated

	Length, Ft.	Sq. Yds.	Cost per Sq. Yd.
Price St., N. Main Ave. to N. Hyde Park Ave.	389.4		$1.85
N. Hyde Park Ave., Lafayette St. to Swetland St.	889.9	1,308.4	1.85
Swetland St., N. Main Ave. to N. Rebecca Ave.	1,895.8	6,082.3	1.85
Court St., Albright Ave. to Diamond Ave.	1,041.5	3,684.4	1.78
Prospect Ave., Locust St. to Fig St.	1,198.5	4,723.2	1.78
Willow St., Pittston Ave. to Prospect Ave.	572.5	2,255.0	1.78
Maple St., Cedar Ave. to Pittston Ave.*	434.5	1,319.6	2.26
Moosic and Front Streets	436.3	1,968.5	1.90
Kressler Ct., Centre St. to Linden St.	894.0	1,542.8	1.85
Lee Ct., Spruce St. to Centre St.	363.0	466.7	1.85
Monroe Ave., Ash St., to Poplar St.	526.0	1,992.3	1.85
Oakford Ct., Mulberry St. to Vine St.	526.7	895.3	1.85
Dupont Ct., Olive St. to Pine St.	512.6	858.3	1.85
Vine St., Kellum Ct. to Taylor Ave.	194.5	761.8	1.85
Walnut St., Capouse Ave. to Washington Ave.	1,184.5	5,485.1	1.80
Dupont Ct., Linden St. to Mulberry St.	527.0	931.5	1.85
Hitchcock Ct., Linden St. to Mulberry St.	438.0	770.8	1.85
Hitchcock Ct., Linden St. to Mulberry St.	526.0	907.6	1.85
Moir Ct., Linden St. to Mulberry St.	526.5	921.2	1.85
Pine St., Clay Ave. to Webster. St.*	365.8	739.1	2.45
Poplar St., Monroe Ave. to Quincy St.*	410.2	1,008.3	2.46
Elm St., Lacka. River to Cedar Ave.*	1,851.7	6,293.5	1.95
Mulberry St., Prescott Ave. to Arthur Ave.*	1,629.3	1,134.4	2.38
Totals	17,333.2	46,000.1	

*Price per square yard was for combination asphalt and stone block pavement on a concrete base, yardage given above is asphalt only.

H. B. Pullar Co.

The firm of Pullar & Enzenroth, Engineering Chemists, Detroit, Mich., has been reorganized, and in future will be known as the H. B. Pullar Co., Engineering Chemists.

Mr. T. C. Ford, B. S., Ch.E., A. M., formerly chief chemist for the American Asphaltum & Rubber Co., of Chicago, will become an active member of the new firm. Mr. Ford has for the last five years been closely associated with Mr. Pullar, and is thoroughly familiar with the testing of bituminous materials, and has had a wide experience in the actual building of many miles of roads and pavements thruout the United States and Canada. Mr. Ford was one of the first four engineers to graduate from the special post-graduate course of Highway Engineering of Columbia University, New York City.

The new firm will continue its business upon, and members of the firm believe that this plan for the inspection of roads and pavements, the testing of materials entering into them and the keeping of detailed records, will be of great interest to engineers and other officials interested in highway work.

The new firm will retain its location at 378 Woodward avenue, Detroit, Mich.

Permanency Is Keynote in Modern Road Building

By Iverson C. Wells.

Permanency is the keynote of all modern construction work. Build today that posterity may benefit tomorrow is the cry in all public improvement. Temporary makeshifts no longer answer. We have learned the lesson of true economy. We know that building well today means less expense in the long run.

In the great movement for better roads that extends from coast to coast and from the Great Lakes to the Gulf one hears the same cry, permanency, and that is the goal the highway commissioners and the road builders of the nation are striving to reach.

What is a permanent highway?

A permanent highway is one that is built of material that is durable, one that resists wear, that resists the destructive forces of nature, that withstands the ravages of time.

No road that requires constant repairs to keep it in a usable condition, that necessitates resurfacing or that must be rebuilt after a few years is a permanent road. A highway that does not outlast the bonded indebteduess that made it possible is a "gold brick" to the community that bought it.

There are two materials that make for permanent roads, granite block and vitrified clay brick. Either one of these materials is durable and wherever you see a road that has withstod heavy traffic conditions for years you will find that one or the other has entered into its construction. Roads built of clay brick 500 years ago in Holland are still doing service today. Streets paved with clay brick in London 300 years ago are still carrying the burden of the heavy traffic of the world's greatest metropolis. These roads are permanent roads.

A highway that only lasts from two to three years is not a permanent highway and yet the country is streaked with miles of just such roads because of a mistaken idea of economy.

In Cleveland, Ohio, and Cuyahoga county, the commonwealth in which Cleveland is located, there are several hundred miles of vitrified brick highways. Some of these were built more than a quarter of a century ago, but because they were constructed of permanent material they have not cost the taxpayers one cent in repairs and are good for many years to come.

In Terre Haute, Ind., there are brick paved streets that were constructed more than a quarter of a century ago and not one cent of repairs has been placed on them and they are as good today as they were when they were laid and they will continue to be of service for many years to come.

Vitrified brick is artificial granite. Man converts clay into this artificial granite by the same process that nature uses in making its product—by the application of intense heat, only he accomplishes his work in hours where nature has taken thousands of years.

Vitrified brick being cheap and durable and obtainable almost anywhere, is a popular material.

While vitrified paving brick is a most durable road material, it must be used

CENTER ROAD *in Cuyahoga county, Ohio, laid in* 1909, *fifteen feet wide, concrete curbs, sand cushion. One of the cross-country roads which intersects a large number of the main highways of Cuyahoga county, and is therefore subject to heavy traffic.*

SOUTH WOODLAND ROAD, *Cuyahoga county, Ohio, from center of Chagrin River road, in Orange and Warrensville townships. Fourteen feet wide, four-inch concrete base, concrete curbs.*

properly. Even a street or road constructed of Bessemer steel would give way if it were not properly laid. Poorly constructed brick streets or highways do not give the taxpayer the full value of his investment.

Built right, a brick street is as smooth as sheet asphalt, and improves in this quality as the years roll by. The streets of Cleveland, some of the most exclusive boulevards being of brick, are proof positive of this statement.

Built right, a brick street is sanitary, is no noisier than others, and has the advantage of being permanent.

There is but one method recognized by the National Paving Brick Manufacturers' Associaton for the construction of a No. 1 brick street or highway. Most of Cleveland's streets and the miles of highways in Cuyahoga county are built under the specifications indorsed by this Association.

Briefly stated, this form of construction calls for, first of all, proper drainage for the roadbed. The roadbed then must be rolled with a heavy steam roller. On top of this six inches of concrete is laid and permitted to harden. A cushion of sand is placed on the concrete and this is well rolled to form a smooth base for the brick. On top of this the vitrified brick are laid and a cement filler composed of one part Portland cement and one part fine sharp sand is poured between the interstices. On each side of the street expansion joints are placed and a curbing of either stone or concrete.

With a street laid in this manner a city has builded for the future, and the item of cost ceased when the last brick was laid.

In highway construction 4 inches of concrete usually forms the base, as the traffic conditions on the country roads are not as severe as in the cities.

The United States government has indorsed this form of construction and used it exclusively in its road construction in Panama. The government also will build several miles of vitrified brick road in Ohio as a part of the great national highway system and as a model for similar construction work, and has given that state financial assistance for the construction of the remaining miles of the national highway across the state.

Contrary to a popular idea, brick paved streets or highways cost but little more than, and quite often not so much as the best constructed streets or highways of other materials. They have the economical merit of permanency and freedom from repairs.

The Smith Mixer

The new catalog, No. 300, of The T. L. Smith Co., Milwaukee, Wis., is a work of art both in the telling of its story and in printing and illustrating it. Each two pages of the booklet are devoted to one of the points of excellence of the mixer for its various uses or to one of its appliances.

For concrete the double cones, discharge by gravity, single central drum ring, heavy frame, power dump, batch hopper, loader, extensible loader frame, encased gearing, geared loader, and special forms of machine are detailed.

For bituminous materials the hot mixer, combined mixer and heater, and its economy are detailed.

Besides the leaders and hoppers, the appliances described are side-gate cars, and four types of elevators for carrying concrete materials and the mixed concrete.

The catalog is well worth the card it will take to bring it.

Trade Notes

The Rock Island Bridge and Iron Works, Rock Island, Ill., have been awarded contract for all structural steel for Iowa Biscuit Co.'s. Burlington building, 260 tons in all; John Thye, Burlington, general contractor.

F. P. Wilcox, district manager of the Koehring Machine Co., has removed his offices to 214 E. 10th St., Kansas City, Mo., where he will handle a full line of contractors' supplies, including the Koehring mixers.

Notice has been received of the twentieth Luten decree, F. R. Gaines, of Kentucky, being the infringer this time.

The plant of The Goodyear Tire & Rubber Co., Akron, Ohio, covers 50 acres, and has a floor space of 1,550,605 square feet, or 35 acres, giving employment to 6,500 people. The power plant has a turbogenerator capacity of 8,500 horse power, steam boiler capacity of 12,000 horse power, and an engine capacity of 7,250 horse power. It is possible for the Goodyear factory to manufacture 10,000 automobile tires a day in addition to the immense quantity of motor-truck, motorcycle, bicycle, and carriage tires that are regularly turned out. The mechanical rubber goods department, which was started less than a year ago, is growing rapidly, and the prodncts of this department, such as belting, hose, packing, etc., are fast becoming recognized by the trade as equal in quality to the other products of the Goodyear Company.

The Cleveland, O., branch of the H. W. Johns-Manville Co. has recently been obliged to provide larger quarters for several of its subsidiary offices. The Columbus office and contract department are now located on the ground floor of the new seven-story fireproof Peters power building, 45 West Long street, with large warehouse facilities half a block distant. The Toledo office and warehouse have been moved to 213 Water street. This office has just completed a pipe-covering, stack-lining and cork-tiling job in the Second National Bank Building, Toledo, which possesses many unique features. Other Cleveland branch sub-offices are located in Akron (717 Second National Bank Building), Dayton (259 Fourth Street Arcade), and Youngstown (502 Stambaugh Building). Resident representatives are stationed at Lima, Massillon, Greenville and other points in Ohio, also at Huntington and Parkersburg, W. Va. Their work is supplemented by a large corps of traveling men. Last, but not least, the Cleveland branch has just closed a long-term lease for another larger warehouse on Front street which, when remodeled, will give the branch larger and better storage and shipping facilities than ever.

The Raymond Concrete Pile Co. will furnish approximately 2,700 concrete piles for the foundation of the 12-story addition to the Coca Cola Building, Baltimore, Md.; also approximately 200,000 lineal feet of Raymond concrete piling for foundation of retaining walls, abutments, etc., in connection with their Rock Island track elevation work in Chicago; foundations of abutments near Cooks, Wash., on Spokane, Portland & Seattle Railway; 1,500 concrete piles in foundation for the 16-story reinforced concrete building for Robert Gair Company, Brooklyn, N. Y.; concrete piling for the foundation of the new high school, Moline, Ill.; 2,400 concrete piles in foundation of new 19-story building for the Hallenbeck-Hungerford Realty Corporation, Lafayette and White Sts., New York; approximately 600 concrete piles for the foundation of new buildings for the F. W. Devoe & C. T. Reynolds Co., 9th and Smith Sts., Brooklyn, N. Y.

The MacArthur Concrete Pile & Foundation Co., 11 Pine street, New York, N. Y., has been awarded a contract covering the foundation of the retort building for the New Haven (Conn.) Gas Light Co. where about 600 pedestal piles will be driven; also one covering the concrete pile and reinforced mat foundation for the Brockton Gas Light Company's new gas holder, Brockton, Mass.; and covering foundations for the White Service Company's improvement on 57th St., near 12th Ave., New York City.

A. Reiche, formerly general manager of the Orenstein-Arthur Koppel Co., Koppel, Pa., who has served for many years in

the above capacity and under whose supervision the plant has grown to be one of the largest and best equipped of its kind, and numerous branch offices in the States and in the West Indies have been established, has severed this connection to assume the position of managing director of a large German concern, manufacturers of locomobiles and agricultural machinery. His successor is Erich Joseph, who has also been connected with the Orenstein-Arthur Koppel Co., for a great many years, recently as New York manager.

The Des Moines Bridge & Iron Co., of Pittsburgh, Pa., and Des Moines, Ia., opened a contracting office at 50 Church street, New York City, on January 1, 1914. Mr. J. E. O'Leary, one of the company's contracting engineers, is in charge of the office. This office will handle the business in the coast states north of Virginia and in Eastern Canada. The Des Moines Bridge & Iron Company makes a specialty of the design and construction of hemispherical bottom steel tanks on steel towers for municipal, railway and industrial work.

Trade Publications

The Mississippi steam siphon for lifting small quantities of water small distances for portable engines and their tanks, and the like, is described in a circular of F. W. Shuls, Galion, O.

Standard specifications for making wear, dust, and waterproof floors are issued by the Master Builders' Co., Cleveland, O.

The manufacture of reinforced concrete poles, piles and pipe without the use of forms by the Jones process and patents is fully described with a prospectus of the National Reinforced Concrete Pole, Pipe, and Pile Co., of Denver, Colo.

Jeffrey coal and ashes handling machinery and single roll coal crusher are described in recent booklets of the Jeffrey Mfg. Co., Columbus, O.

The advantages of the Bayer front end tube blower are set forth in a circular of the Bayer Steam Soot Blower Co., St. Louis, Mo.

The Luten design bridges under construction in October, 1913, are shown in a 16-p. booklet which must be intended as general advertising of the name since neither name nor address of the National Bridge Co., Indianapolis, Ind., controlling the Luten patents, is given.

Reinforced spiral steel pipe is the subject of catalog 4 of the Standard Spiral Pipe Works, Chicago, Ill.

The Bessemer Gas Engine Co., Grove City, Pa., publish *The Bessemer Monthly* to give information about the use of their products.

The Grinnell Automatic Sprinkler Bulletin bearing date of January, 1914, is a handsome booklet of 16 pages, fully illustrated, published by the General Fire Extinguisher Co., Providence, R. I., which is full of information about the use of automatic sprinklers for putting out fires at their beginning. Ships and hotels receive special attention as classes of risks in which the automatic sprinkler is rapidly being applied.

Culverts of American ingot iron is the subject of an illustrated booklet of the California Corrugated Culvert Co., West Berkeley, and Los Angeles, Cal.

Water towers is the subject of a 1914 booklet of the Chicago Bridge and Iron Works.

The Linder steel reversible wheel road drag and steel reversible road grader are shown in a handsome circular of the Linder Grader Co., Matthews, Ind.

The Decarie Incinerator Co., Minneapolis, publish two booklets with much information about their method of garbage disposal, entitled "Incineration" and "The Mayor has an Interview with an Expert."

The Richardson Scale Co., Chicago, Ill., and Passaic, N. J., sends illustrated circulars of their automatic coal scales, for weighing large quantities of coal, coal for boilers and coal on conveyors.

The Frazier Machine Co., McKeesport, Pa., advertises a convenient brick carrier which is capable of ready adjustment to the work.

H. W. Johns-Manville Company issue a complete little pamphlet regarding the Audiffren-Singrun refrigerating machine for ice making and refrigerating which is practical for small work, such as domestic use, clubs, cafes, hotels, dairies, hospitals, etc.

Hand Book 41 of the Abendroth & Root Manufacturing Company, Newburg, N. Y., is devoted to Root spiral riveted pipe.

Instruction Book No. 3056 of the Fort Wayne Electric Works, Fort Wayne, Ind., is devoted to Type A Form A oil transformers, and Bulletin 1147, second edition, describes the same and methods of installing them. Bulletin 1145 describes Type ML three-bearing, belted, direct-current generators with balance wheels.

The road machinery catalog of the Wheeling Mold and Foundry Company, Wheeling, W. Va., comes in a loose-leaf binder and describes their forced feed crusher, conveyor for the same, stone elevator and screens. Their five and seven-ton tandem road rollers are now ready for delivery.

The Chain Belt Company, Milwaukee, Wis., in their December circular, show the great Allentown, Pa., viaduct and the St. Croix, Minn., bridge, in the construction of which chain belt mixers were used.

CONTRACTING NEWS

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Beaver Falls, Pa.—Until February 19, for brick paving of Hillside avenue in Patterson Heights Boro (Beaver Falls postoffice). The work includes 4,000 yards' paving, 2,400 lin. ft. concrete curbing, grading, etc. Carl S. Donaldson, engineer Beaver Falls.

Cincinnati, O.—February 13, until noon, for improvement of Wooster pike from Bamford Hills to the Miami river bridge at Milford in Columbia township. Albert Reinhardt, clerk board Hamilton county commissioners.

Clinton, Iowa—February 10, until 8 p. m., for two street improvements as follows: Tenth avenue, 9,940 sq. yds. of vitrified brick, concrete with a bituminous coat on top, creosoted wood block or asphaltic concrete paving; 4,000 lin. ft. combined curb and gutter. Ninth avenue, 7,300 sq. yds. of vitrified brick, concrete with a bituminous coat top, creosoted wood block or asphaltic concrete paving; 3,800 lin. ft. combined curb and gutter. Certified check $1,000. Frank W. Leedham, city clerk; J. G. Thorne, city engineer, 317 Howes block.

Fowler, Ind.—February 16, until 1 p. m., for construction of a macadam road on Benton-Newton county line. S. R. Sizelove, auditor Newton county.

Frankfort, Ind.—Until February 10, for the construction of ten roads in Jackson, Perry, Michigan, Sugar Creek and Union townships. C. F. Cromwell, auditor of Clinton county.

Mitchell, S. D.—February 6, until 10 a. m., for grading and improving highways in Davison county. Certified check 5 per cent. of bid. Date of completion, September 1, 1914. F. A. Zangle, county auditor.

Plymouth, Ind.—February 18, until 2 p. m., for improvement of certain highways in Union township and paving of one street in the town of Culver. George F. McCoy, auditor Marshall county.

Sioux Falls, S. D.—February 16, until 9 a. m., for construction of pavement as follows: On Phillips avenue from south line of Seventh street to south line of Thirteenth street. Estimated quantities: 14,000 sq. yds. of pavement outside of street car tracks; 2,300 sq. yds. of pavement along street car tracks. Material: Granite block, creosoted wood block, asphaltic concrete, bitulithic, portland cement concrete and dolarway. Certified check $2,000. And on Phillips avenue from south line of Thirteenth street to south line of Eighteenth street, about 9,500 sq. yds. of pavement. Materials: Creosoted wood block, sheet asphalt, asphaltic concrete, bitulithic, portland cement concrete, dolarway and tarvia macadam. Certified check $1,000. Walter C. Leyse, city auditor.

Spokane, Wash.—Until April 1, for surfacing 6½ miles of normal road from Sunset boulevard to Meadow Lake. R. W. Butler, county auditor.

Waseca, Minn.—February 6, until 2 p. m., for construction of state rural highway No. 25. Approximate quantities are 35,420 cu. yds. of grading, 16,230 lin. ft. of turn piking, 11,560 cu. yds. of graveling, 37 concrete culverts and two concrete bridges. Length of highway, 11 miles. Estimated cost, $26,-606.20. Certified check 10 per cent. of bid. Theodore Peterson, county auditior.

CONTRACTS AWARDED.

Burlington, Wash.—To Cascade Construction Co., Seattle, for paving Garl street at bid of $10,373.84 and of Oak street at bid of $5,992.82.

Columbia City, Ind.—To H. P. Holman of Rochester, for paving Jackson and Walnut streets. Contract price, $39,108.

Olympia, Wash.—To J. H. Peterson, St. Johns, Ore., for construction of Pacific highway, at bid of $12,687.76. To Quigg Construction Co. of Wenatchee, Wash., for construction of Waterfront road at bid of $51,732.

Ottawa, Ill.—The $280,000 contract for the paving of West Ottawa was transferred from the James A. Sackley Co. of Chicago to John Cherry of Jacksonville, Ill.

Peoria, Ill.—To McElwee & Bushnell of Peoria, for paving alley between Elizabeth, Ellis, Main and Chambers streets, at bid of $1,459.80, and Glendale avenue from Jackson to Spring, at bid of $21,403.25.

Port Angeles, Wash.—To Lewis, Wiley & Morse, Seattle, at $194,600, for grading, filling, curbs, trestle work and walks on Railroad, Oakes and Laurel streets.

Richmond, Cal.—To Shattuck, Eddinger & Co., at $250,000, for construction of municipal tunnel and roadway to harbor front.

St. Marys City, Md.—To the Wm. P. McDonald Construction Co., Mount Vernon, N. Y., for paving 5.8 miles of road between this city and Leonardstown. Bid, $37,361.

Tampa, Fla.—To Edwards Construction Co. of this city, for thirty miles of paving in Pasco county, at $118,555.

Venice, Cal.—To Braun, Bryant & Austin of Santa Monica, at $50,149, for improvement of Compton-Santa Monica road from St. Marks boulevard to city limits.

CONTEMPLATED WORK.

Anderson, Ind.—The paving of various streets in Park Place is being urged by property owners. Mr. Funk, city engineer.

Bradentown, Fla.—Manatee county commissioners have called an election for March 26, to vote on $335,300 bonds to construct hard surfaced roads.

Coquille, Ore.—Construction of 30-ft. road, with 16-ft. hard surfaced concrete roadbed, at cost of $30,000, has been authorized by Coos county court.

Galesburg, Ill.—Ordinance is being considered by council for new pavements at an approximate cost of $90,000. F. M. Connelly, city engineer.

Milwaukee, Wis.—The paving of seven streets and alleys has been recommended by council committee on streets. Estimated cost $46,500. J. A. Mesiroff, city engineer.

Rock Island, Ill.—Board of local improvements has planned to pave 13th street with asphalt from First avenue to Seventh avenue. Wallace Treichler, city engineer.

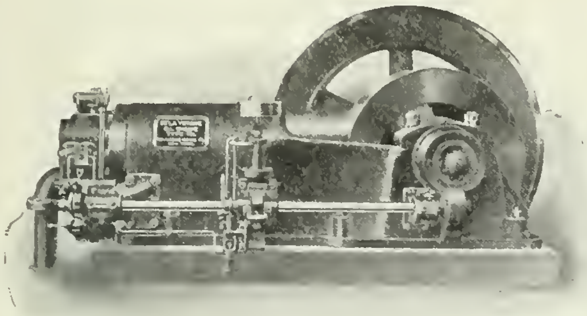
Sheboygan, Wis.—This city contemplates 75,000 sq. yds. concrete paving the coming season. Bids will be called for at various times in the year. C. U. Boley, city engineer.

St. Johns, Ore.—The paving of Willamette boulevard from Burlington street to St. Johns avenue at a cost of $19,000, and of Hatman avenue from Oswego to Central avenue, at a cost of $7,478, has been authorized by the city council. C. E. Andrew, city engineer.

Tacoma, Wash.—Pierce county commissioners have prepared plans for 17.18 miles of paved roads, including mountain-canyon road, 6.34 miles; the Puyallup-Orting road, 5.28 miles; the road from Sumner to the county poor farm, 1.56 miles, and the Pacific highway, Union avenue to Country Club, 4 miles.

Taylorville, Ill.—City will shortly ask bids on construction of approximately $100,000 worth of street paving, including 41,622 sq.

De La Vergne Oil Engines



are the most economical form of power known. The cost per horsepower hour is only a small fraction of a cent.

They run on the cheapest and heaviest grades of crude oil and also on waste residual tars which cannot be economically used in any other known way.

There is no handling of coal, ashes or any standby losses.'

Over 30,000 are in Successful Operation

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Such facts should be given consideration by the intending purchaser, as the season's profits may depend on the plant you have.

IT WILL COST YOU NOTHING TO INVESTIGATE. WRITE US.

THE EAST IRON & MACHINE COMPANY

LIMA, OHIO.

yds. of brick and 4,362 sq. yds. of concrete pavement. J. W. Dappert, city engineer.

Wallace, Ida.—Advertisements for bids for paving of district No. 1 will be made in the near future. Bitulithic will probably be used. Mr. Merriam, city engineer.

SEWERS.

BIDS REQUESTED.

Bogota, N. J.—Feb. 9, until 8 p. m., for constructing 4.4 miles of vitrified sewers, from 8 to 24 inches in size, with Y branches, manholes and flush tanks. Wm. N. Smith, mayor; Harold P. Ross, boro clerk.

Fairport, N. Y.—Feb. 11, until 8 p. m., for constructing 6,000 ft. of sewer, ranging in size from 18 inches to 8 inches, with 2 siphons, manholes and accessories. R. L. Williams, village clerk.

Kelliher, Minn.—Until Feb. 9, for laying approximately 2,900 ft. of 8 inch sewer mains. T. Milton Fowble, engineer, 34 Union block, St. Paul.

Lamoni, Iowa—Until Feb. 10, for constructing 23,500 ft. of 8-inch sewer, average cut 5 to 14 ft., 7,700 ft. 10-inch pipe sewer, average cut 5 to 10 ft. with Imhoff tank. Cost about $20,000. Bruce & Standeven, Omaha, engineers. J. F. Jones, town clerk.

Ortonville, Minn.—Feb. 16, until 8 p. m., for construction of sewer system, including general sewer, district and joint district sewers and laterals. Certified check 15 per cent. of bid, made payable to H. L. Zwiener, city treasurer. E. Scheibe, city clerk.

Peotone, Ill.—Feb. 3, until 3 p. m., for construction of system of vitrified tile pipe sewers, with brick manholes and catch basins, a concrete bulkhead and concrete settling tank. Approximate quantities 1 concrete outfall bulkhead, 1 concrete settling tank, 1,336 lin. ft. of 36-inch sewer, 1,810 lin. ft. of 30-inch sewer, 3,140 lin. ft. of 24-inch sewer, 1,680 lin. ft. of 18-inch sewer, 1,220 lin. ft. of 15-inch sewer, 6,310 lin. ft. of 12-inch sewer, 15,720 lin. ft. of 10-inch sewer, 103 brick manholes, 200 brick catch basins. Certified check 10 per cent. of bid. Aug. E. Harken, president board of local improvements.

CONTRACTS AWARDED.

Asbury Park, N. J.—T. W. K. Finn & Co., of this city, for construction of sewer system. Contract price $9,893.

Buffalo, N. Y.—To Frontier Contracting Co., Ellicott Square, Buffalo, for construction of sewer in Long avenue, at $12,890.

Fernwood, Pa.—To Cantrell Construction Co., Real Estate Trust Bldg., for 2 miles of sanitary sewers. Contract price, $12,600.

Joliet, Ill.—To Joseph P. McGovern, of this city, for construction of Second ward sewer system, at bid of $22,222.64 Other bidders were: Robert Shannon, $24,955.90; Foley Construction Co., Evanston, $25,764.50; Wm. Moran & Co., $26,415.75.

CONTEMPLATED WORK.

Osage, Iowa—E. E. Harper, Grand avenue, Temple, Kansas City, Mo., is preparing plans for a sewer system, $75,000.

San Diego, Cal.—Plans have been revised by Fred Lockwood, city engineer, for construction of a sewer system in the Ocean Beach section. Estimated cost, $10,000.

Scranton, Pa.—City Engineer Wm. Schunk has completed plans for two relief sewers, one to cost $78,500, and the other $79,500.

SEWAGE DISPOSAL PLANTS.

BIDS REQUESTED.

Bogota, N. J.—Feb. 9, until 8 p. m., for construction of two disposal plants, including necessary piping, grading, etc. Certified check, $2,000. Wm. N. Smith, mayor; Harlan P. Ross, boro clerk.

Fairport, N. Y.—Feb. 11, until 8 p. m., for construction of sewage disposal plant, consisting of following: Screen chamber, settling tanks, sludge bed and accessories, and involves removal of about 900 yards of earth, placing of about 230 yards of concrete, together with cast iron and tile sewers and drains, etc. R. L. Williams, village clerk.

Kelliher, Minn.—Until Feb. 9, for construction of a disposal plant. T. Milton Fowble, engineer, 34 Union Block, St. Paul.

CONTEMPLATED WORK.

Gary, Ind.—City Engineer A. P. Melton recommends the installation of a sewage purification system.

Sedalia, Mo.—Plans and specifications are being prepared by Engineers Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., for complete sewage disposal works for southwest Sedalia.

WATER WORKS.

CONTRACTS AWARDED.

Valliant, Okla.—To Davis & Baun, of Caddo, Okla., for construction of waterworks system, at $32,700.

Winchester, Ill.—To C. M. Hanes, Jerseyville, Ill., for construction of municipal waterworks system. Contract price, $23,075.00.

CONTEMPLATED WORK.

Bruning, Neb.—City will probably receive bids in from four to six weeks for installation of waterworks and an electric light plant. Grant & Fulton, Lincoln, Neb., engineers.

Cedar Rapids, Iowa—Bonds for $125,000 have been voted for a dam for water works system. Ira G. Hedrick, engineer, Kansas City, Mo.

Chelsea, Ia.—Plans and specifications are being prepared by Engineer E. E. Harper, Grand avenue, Temple, Kansas City, Mo., for waterworks system.

Coquille, Ore.—Improvements and extensions to water system here will be made shortly. Estimated cost $13,400. P. M. Hall, Lewis, city engineer.

Imperial, Cal.—Citizens have voted $29,000 bonds for installation of a waterworks system. I. B. Funk, city engineer.

Manhattan, Cal.—Bids will be opened in about 10 weeks on proposed waterworks system. Frank A. Lathrop, engineer.

Moline, Ill.—Bids upon the $109,000 water main for the East End will be advertised for by Board of Local Improvements at a date in near future. F. A. Dawson, city engineer.

Moorestown, N. J.—George Pfeiffer, engineer, Second and Market streets, Camden, N. J., is preparing plans and specifications for an addition to the waterworks.

Moulton, Iowa—Plans and specifications are being prepared by Engineer E. E. Harper, Grand avenue, Temple, Kansas City, Mo., for waterworks system.

New York Mills, Minn.—Village contemplates the installation of a waterworks system in the spring; estimates on probable cost are being secured.

Oneida, N. Y.—City Engineer J. M. Hutton is preparing plans for proposed extension of Sylvan Beach water system; estimated cost $15,000.

Perry, Iowa—$35,000 has been voted for the extension and improvement of the waterworks plant. Adrian Cross, city clerk.

Spotswood, N. J.—Mayor Arthur B. Appleby advocates installation of municipal waterworks system; estimated cost, $16,000.

Washington, N. C.—Plans have been prepared by Engineer Gilbert C. White, Char-

lotte, N. C., for waterworks and electric light plant, estimated to cost $100,000; work includes 1,000,000-gallon filter plant, 500,000-gallon storage reservoir, steam pumps, boiler plant, 500 k.w. electric light and power plant; bonds to be sold after which plans will be sent out and work advertised. H. B. Charles, superintendent.

BRIDGES.

BIDS REQUESTED.

Americus, Ga.—Feb. 15, until 9 a. m., for construction of two bridges of reinforced concrete for Sumter county. W. J. Watson & Co., engineers, Charlotte, N. C.

Beaver City, Neb.—Feb. 26, until noon, for construction of bridge across the Republican river, south of Cambridge, Neb. Bids will be received on alternate designs as follows: First, one concrete girder bridge composed of nine 32-foot 6-inch spans, 20-foot roadway with concrete piers and abutments. Second: One concrete arch bridge composed of two 50-foot arches, two 55-foot arches and one 60-foot arch, 20-foot roadway with concrete piers and abutments. Third: One steel bridge composed of two 135-foot high truss riveted spans, 20-foot roadway, with either concrete or wood block floors and concrete piers and abutments. Certified check, $1,000 made payable to J. P. Nickerson, county clerk, Furnas county.

Cleveland, O.—Feb. 21, until 11 a. m., for construction of bridge work per Report No. 3244. Culvert, Bliss Road Euclid township. Certified check, 10 per cent. of bid. Ed. G. Krause, clerk board of Cuyahoga county commissioners.

Gold Beach, Ore.—Until April 8, for construction of a reinforced arched plan concrete bridge across Chetco river. Bidders are to submit their own designs. For further information address J. M. McCoughell, surveyor, Curry county.

New Orleans, La.—Feb. 25, until 11 a. m., for the erection of a Strauss trunnion bascule bridge, over the entrance to the Southern Yacht Club pier on the line of the New Basin Canal Shell road. Certified check, $500. A. G. Rinks, commissioner department of public finance.

Waseca, Minn.—Feb. 5, until 2 p. m., for building two bridges, repairing one bridge and two reinforced concrete culverts. Certified check, $100. Theodore Peterson, county auditor.

CONTRACTS AWARDED.

Aberdeen, S. D.—To Minneapolis Steel Machinery Co., for six county bridges to be built in spring. Bid $11,215.00.

Danville, Ill.—To East St. Louis Bridge Co., East St. Louis, at $7,540 for construction of 150-foot steel bridge over Middle Fork of Vermillion river at Johnson ford.

Des Moines, Iowa—To Iowa Bridge Co. for construction of bridge over Raccoon river near Valley Junction. Contract price $3,225.

Geneva, Neb.—To Standard Bridge Co., Omaha, Neb., for construction of bridges in Fillmore county during 1914.

Joplin, Mo.—To O'Hagan & Lake, of Kansas City, for construction of Broadway viaduct at bid of $96,133.00.

Mandeville, La.—To Ernest Faure, for rebuilding three bridges across Bayou Castaign.

Racine, Wis.—To Worden-Allen, Milwaukee, for bridge work in connection with Dover Drainage canal, at $9,500.

York, Neb.—To Western Bridge & Const. Co., of Omaha for construction of all steel and wooden bridges in York county in 1914.

CONTEMPLATED WORK.

Chattanooga, Tenn.—Hamilton county has voted a bond issue of $500,000.00 for erection of bridge across river at Chattanooga, Tenn. Bridge engineers are invited to submit competitive designs and estimates by Feb. 18. For further information address Theo. F. King, chairman; L. B. Bryan, secretary, of Tennessee River Bridge committee.

Chicago, Ill.—Construction of a viaduct double-decking Franklin street from Kinzie to South Water street over Chicago river is being considered by council. L. E. McGann, commissioner of public works.

LaCrosse, Wis.—Board of public works has been instructed to call for new bids for constructing a steel or reinforced concrete bridge at St. Andrew street. E. E. Hoffman, city clerk.

Muncie, Ind.—Board of county commissioners of Delaware county will receive bids in spring for the repair and extension of following bridges: High street, estimated cost, $8,500; Washington and Elm streets bridges, cost, $7,000, and West Jackson street, $6,500. S. H. Weber, county surveyor; F. M. Williams, auditor.

St. Paul, Minn.—A new $1,000,000 bridge to extend from Seven corners directly to the southern end of the present High bridge has been proposed. Oscar Claussen, city engineer.

AUTOMOBILES.

FIRE APPARATUS.

Auburn, N. Y.—Chief E. J. Jewhurst, recommends the purchase of another piece of motor apparatus.

Bridgeport, Conn.—Town chief's cars may be purchased; also three tractors for hook and ladder trucks. Edward Mooney, fire chief, 175 Williams street.

Cincinnati, O.—Fire Chief Bunker has recommended the motorizing of the ladder equipment and improvement of alarm service. He also asks for one additional auto pumping engine, one auto combination wagon, one extra marshal's auto, two small automobiles, for the fire alarm and hydrant service and one auto fuel truck. Total cost $122,250.

Great Falls, Mont.—Feb. 2, until 8 p. m., for one combination motor-driven police patrol and ambulance for police department. Certified check 2 per cent. W. H. Harrison, city clerk.

Ithaca, N. Y.—Chief John A. Fisher recommends purchase of two pieces of motor apparatus, including a city service truck, and 3,500 feet of hose.

Springzeld, O.—City Manager Charles A. Ashburner plans to motorize the street cleaning department.

Toledo, O.—The purchase of a motor patrol wagon and ambulance at cost of $5,000 and of an eight passenger touring car to cost $5,000 is being considered by the safety department. Mr. Kapp, safety director.

Westboro, Mass.—Board of fire engineers recommends the purchase of an automobile combination chemical wagon. Thos. H. Treadway, chief engineer.

GARBAGE DISPOSAL.

BIDS REQUESTED.

Highland Park, Mich.—Until February 16, for the installation and completion of a garbage incinerator plant; capacity one ton per hour designed to accommodate a future plant with a capacity of two tons per hour. L. D. Beckley, superintendent of public works.

Lockport, N. Y.—Feb. 16, until 8 p. m., for construction of an incinerator plant, buildings consisting of two 10-ton units with capacity of reducing 20 tons of garbage per day of 24 hours, also for furnishing and erecting a complete garbage reduction and refuse incinerator plant and buildings of

Concreting in Cold Weather

is a common practice with big contractors today. The prosecution of work on concrete structures through the winter months involves no difficult engineering problems nor excessive costs, but does increase the volume and profit of the year's business by lengthening the construction season to twelve months, and holding the contractors' organization intact.

We will send free to you, upon request, our book "Concreting in Cold Weather" which illustrates and describes the best winter practice.

This Book is Full of Practical Suggestions — Send for a Copy

Universal Portland Cement Co.

same capacity as incinerator plant. Certified check, $2,000. Peter S. Hall, superintendent department of public safety.

LIGHTING.

Bowling Green, Ky.—City council plans to enlarge and improve municipal electric light plant to provide additional current for an ornamental street lighting system. James H. Wilkerson, superintendent.

Clayton, Ala.—Bonds for $5,000 have been voted to be used in improving the municipal electric light plant. M. D. Morton, superintendent.

DeGraff, Minn.—An election will soon be held to vote on question of bond issue for construction of municipal electric light plant.

Fordville, N. D.—The village of Fordville is contemplating installation of combined electric light plant and fire protection system and invites correspondence with parties and firms doing this sort of work. Address Secretary Commercial Club, Fordville, N. D.

BUILDINGS.

BIDS REQUESTED.

Cincinnati, O.—Feb. 17, until noon, for erection of hospital building. Work will embrace the following departments: 1. General conditions. 2. Excavation and concrete foundations. 3. Brickwork. 4. Carpenter work. 5. Iron and steel work. 6. Tin, galvanized iron and steel work. 7. Plastering and "Stonekote." 8. Terrazzo floors. 9. Painting and glazing. 10. Plumbing and gas fitting. 11. Electric wiring. 12. Hot water heating system. 13. Lighting fixtures. 14. Vacuum cleaning system. 15. Dumb waiter. 16. Refrigerators. 17. Kitchen equipment. 18. Sterilizing equipment. 19. Incinerators. 20. Fly screens. 21. Telephones. 22. Clock. 23. Elevator. Certified check, 10 per cent. of bid. Frederick S. Spiegel, president board of hospital commissioners.

Grand Rapids, Mich.—Feb. 16, until noon, for general construction, plumbing, heating, ventilating and wiring of the South High School. Certified check, 2 per cent. of bid, payable to president of board of education. H. N. Morrill, business manager, board of education.

Granada, Minn.—Feb. 3, until 10 a. m., for erection of school building, also installation of heating, plumbing and ventilating. Certified check, 3 per cent. of bid. Kirby T. Snyder, architect, Suite 751 Plymouth Bldg., Minneapolis, Minn.; C. C. Chamberlain, clerk board of education, District No. 30, Martin county.

Kingsville, Tex.—March 1, until noon, for erection and completion of a fireproof court house and hospital. Certified check, $3,000, made payable to Ben F. Wilson, county judge. Atlee B. Ayres, architect, Bedell building, San Antonio, Tex.

Lyons, Iowa—Feb. 10, until 8 p. m., for constructing a brick and stone fire station. Certified check 5 per cent. of bid. John H. Ladehoff, architect, Clinton, Iowa; Frank W. Leedham, city auditor.

New Orleans, La.—Feb. 26, until noon, for construction of a one-story brick building. The principal items of contract are as follows: Excavation, 20,000 cubic yards; round piling, 56,000 lineal feet; sheet piling and bracing, 240,000 feet B. M.; concrete, 3,000 cubic yards; structural steel, 52 tons; steel rods, 300,000 pounds. Certified check, $2,500. Geo. G. Earl, general superintendent; F. S. Shields, secretary, of sewage and water board, room 508, City Hall Annex.

Riceville, Iowa—Feb. 12, until 1 p. m., for erection of an addition to the Riceville school. A. G. Dunton, secretary of school board.

PARKS.

Indianapolis, Ind.—The Indianapolis Park Board will expend $74,782 in the east park district during 1914. Dr. Henry Jameson, president of board.

MISCELLANEOUS.

BIDS REQUESTED.

Baudette, Minn.—Feb. 12, until 8 p. m., for the following work, erecting complete ready for operation, one boiler, one engine and direct-connected alternating generator with belted exciter, switchboard panel, boiler feed pump, steel smoke stack with brick stack base and horizontal smoke connection to connect with boiler now in plant with all proper connections and accessories delivered and erected in engine and boiler room of the water and light plant. Certified check, 10 per cent. of bid. Franz W. Schmidt, acting clerk.

El Paso, Tex.—Feb. 12, until 3 p. m., for waterworks machinery as follows: One steam driven air compressor, 4,000 to 5,000 cubic feet per minute capacity; one steam driven, crank and fly-wheel, outside center packed plunger pump, capacity 4,000,000 to 5,000,000 gallons in 24 hours; two water tube boilers, 180 to 200 horse power each; one surface condenser, capacity 15,000 pounds of steam per hour. Two or more internal combustion engines of sufficient power to drive the compressors and pumps mentioned below; one or more air compressors of from 3,000 to 4,000 cubic feet total capacity; one or more power pumps of 3,000,000 to 4,000,000 gallons capacity or in lieu of the power pump; one or more centrifugal pumps of the same capacity as the power pumps. Certified check, 10 per cent. of bid. C. W. Fassett, city clerk.

Fergus Falls, Minn.—March 24, until 2 p. m., for furnishing certain road tools and machinery. Certified check, $100, payable to treasurer of Otter Tail county. For further information address Wm. Lincoln, county auditor, Fergus Falls.

Helena, Mont.—March 2, until 8 p. m., for two 600-gallon tank street sprinklers, f. o. b. Helena. Certified check, 10 per cent. of bid. D. J. McConnell, city clerk.

Indianapolis, Ind.—Feb. 19, until 10 a. m., for one steam roller. W. T. Patten, auditor Marion county.

Indianapolis, Ind.—Until Feb. 4, for 500 tons of asphalt to be delivered during 1914. B. T. J. Jeup, city engineer.

Kansas City, Mo.—Feb. 16, until 2 p. m., for exclusive contract for operating a cafe and vending stands at the refectory and refreshment booths in Swope Park for season of 1914-1915. Certified check, $200. T. C. Harrington, secretary board of park commissioners.

Manhattan, Kans.—Feb. 17, until noon, for construction of certain open ditches and an earth levee. Bids are solicited for the work in sections and for construction of all work. Total estimated amount of excavation and embankment, 136,000 cubic yards. Certified check, 6 per cent. of bid. Date of completion December 1, 1914. H. B. Walker, drainage engineer, State Agricultural College, Manhattan, Kans., is supervising engineer of the district.

CONTEMPLATED WORK.

Indianapolis, Ind.—The construction of a retaining wall along south bank of Fall Creek, from College avenue to Thirtieth street, is being considered by park commissioners and board of public works. Estimated cost, $80,000. Dr. Henry Jameson, president board of park commissioners.

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

PART OF THE MOTOR EQUIPMENT *in the Pittsburgh Fire Department. This city now has sixteen pieces of Knox equipment, consisting of ten combination cars, like those shown in the right of the picture, and five Knox-Martin Tractors attached to hook and ladder trucks and steamers.*

VOL. XLVI. MARCH, 1914. NO. 3.

INDUSTRY.

If you have great talents, industry will improve them; if moderate abilities, industry will supply their deficiency. Nothing is denied to well-directed labor; nothing is ever to be attained without it.

—Sir Joshua Reynolds.

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MOTOR DUMPING TRUCKS

AMERICAN AND GERMAN TYPES

Convenience and adaptability of the dumping apparatus to the uses of the motor truck are prominent factors in the design of modern vehicles for carrying bulky materials. This brief article gives illustrations of a few prominent results of intelligent designs in America and Germany.

THE modern motor dumping truck for handling coal, sand, ashes or garbage is a most economical and labor-saving device and it may be of interest to note some of the types of dumping cars used in this country and in Germany. The accompanying diagrams show five American designs of tipping gear adopted by leading motor truck builders.

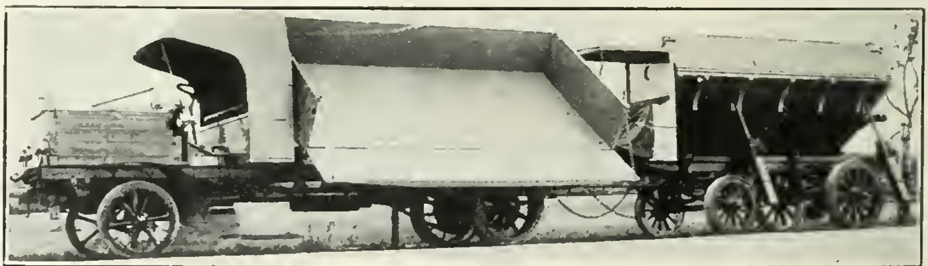
The photograph (Fig. 2) shows a motor van of the Buessing type designed at Braunschweig, Germany, in which ashes and garbage can be collected by the same motor truck without mixing. Dumping can be done on either side from two or four compartments. The photograph (Fig. 3) shows a similar German truck for ashes for dumping on either side with a trailer also dumping at side for the separate collection of garbage. The accompanying illustration (Fig. 4) shows a German end-dumping truck for handling sand.

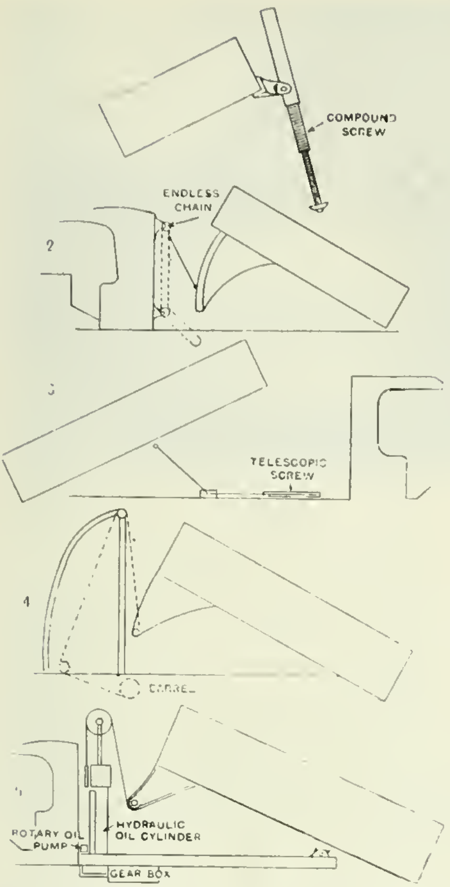
In all industrial enterprises, in agriculture, in the army, whenever the question of transportation is one of great importance, the motor van is rapidly replacing the horse-drawn vehicle, and is destined, moreover, to be a most useful substitute for the railway in conveying material and goods safely and cheaply. The motor van is distinguished by its remarkable ease and freedom of motion, notwithstanding its 3 to 10-ton loads. Transportation by motor van insures a considerable saving of expense as compared with conveyance by railway, and also a considerable saving of time, as the troublesome loading and discharging of goods into or from railway cars, storage in depots and other delays are avoided.

The German motor trucks of the Buessing type with 4 and 5-ton chassis for heavy motor truck and road train service are equipped with gasoline engines of 35 and 40 horsepower. They have spring connecting rods between frame and rear axle and double suspension of the front axle. The frame is supported on the plate spring ends with ball pivots.

The straight frames of all vehicles are fitted with longitudinal bearers of

A GERMAN MOTOR TRUCK AND TRAILER *for ashes and garbage collection, dumping on either side.*





TIPPING GEAR *for various American motor trucks:* (1) *Peerless,* (2) *Mack,* (3) *Locomobile,* (4) *Alco,* (5) *Pierce-Arrow.*

U-rolled section and the transverse bearers are made of pressed sheet steel. Frames of this kind, besides great bearing power, supply a considerable resistance to the torsion arising and are not heavier than pressed sheet steel frames.

The roller bearings and ball pivots serve at the plate spring ends of the rear springs for supporting the frame. Strong spiral springs between the frame and front plate springs absorb violent shocks.

The 4-cylinder engine supplying the driving power was designed especially for reliability in service, economical consumption of fuel, steady motion and strength. The controlled inlet and outlet valves are mounted on separate valve seats, so that when the faces of the valve seats wear the whole cylinder need not be replaced, but only the worn valve seat.

The carbureter is distinguished by its economical consumption of fuel with no sensitive automatic parts.

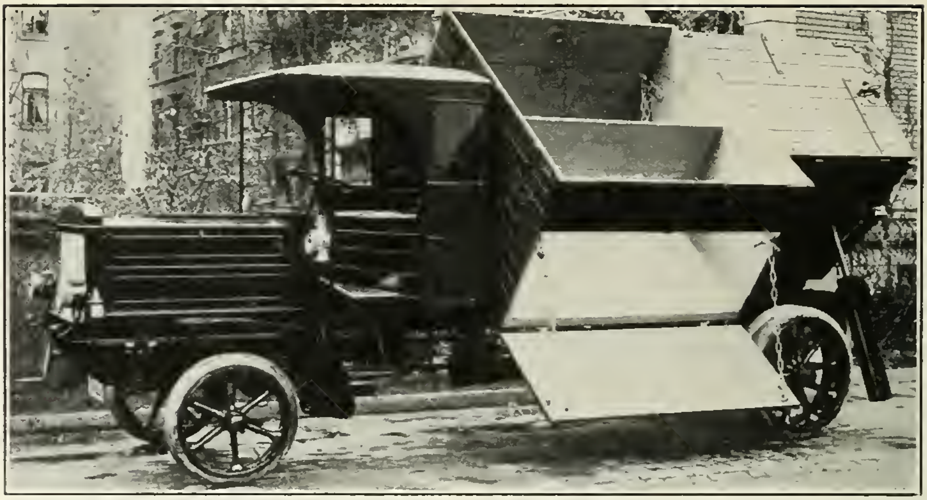
The fuels used are gasoline, benzole, heavy petrol and similar heavy fuels. As to governing, it may be stated that the speed is regulated by throttling the gas mixture, either automatically by a centrifugal governor or by the driver himself. The throttling means operated by the driver are connected to the rods of the governor in such a manner that the driver can change the speed of the motor only when the number of revolutions is below normal.

For ignition a magneto serves as source of current and is mounted on the motor in an accessible and easily interchangeable manner. This ignition is absolutely reliable, it is claimed, and is also sufficient under all circumstances for starting the motor.

Water circulation is by centrifugal pump, and the radiator comprises a system of interchangeable flat tubes and is closed at top and bottom by a water box. This German motor is supplied with positive lubrication by oil pumps, which feed the oil to the lubricating places proportionately to the speed of the motor. With regard to long-distance journeys, these pumps always deliver fresh oil with full lubricating capacity to the piston pins, cylinder walls and crank shaft bearings. After passing thru the bearing parts the unused oil is collected below in the crank case, where it serves for cooling the small or top ends of the connecting rods.

The motor is connected to the transmission by a detachable cone clutch, which is operated from the driver's seat by a clutch pedal. The clutch is automatically disengaged by using the foot brake. The power is transmitted from the clutch by a flexible shaft to the transmission gear and differential gear and thence by chains to the rear wheels.

To obviate the starting of the machine by unauthorized persons a lever with a padlock is provided locking the foot pedal of the clutch.

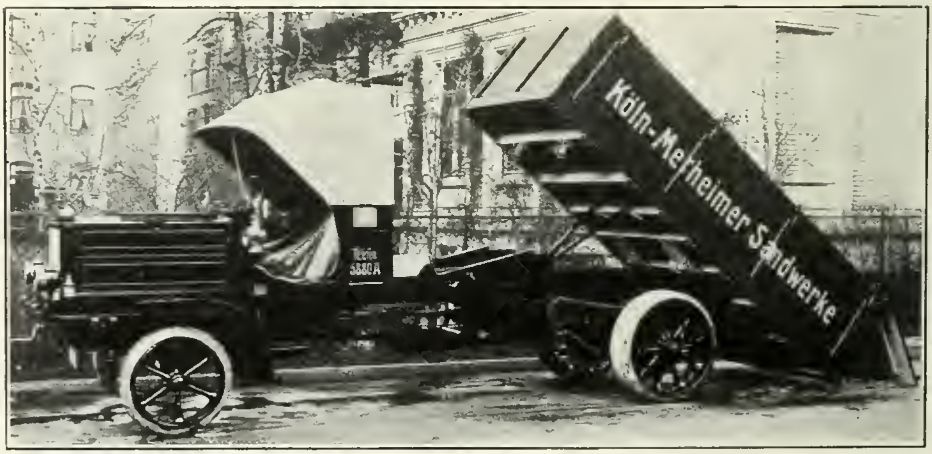


GERMAN MOTOR TRUCK *with four compartments for separating ashes and garbage, dumping on either side.*

Each vehicle has two independently acting brakes, each being capable of braking the vehicle within the shortest possible space and bringing it to a standstill on steep roads. Special care has been bestowed on a satisfactory distribution of the load, so that the rubber-tired wheels are not overloaded. The rear wheels have much less load than the permissible maximum load of other similar types, while the front wheels are loaded correspondingly higher and therefore have a much stronger section than that usual for similar types of cars. This proper adjustment of the load contributes in a high degree to the preservation of the rubber tires and results in an economical service.

These German trucks are fitted with cast steel wheels for rubber tires and with devices allowing the mounting of a non-skidding device. On the motor truck the chassis for useful loads of 4 tons and 5 tons have narrow rear-wheel tread so that no difficulties arise in driving thru gateways. The trucks can also be readily driven on worn-down roads in the track left by other vehicles, and iron tires are often used on trucks of low speed.

BUESSING DUMPING MOTOR TRUCK *for hauling sand, with rear dump.*



PROTECTION of GIRDERS from LOCOMOTIVE SMOKE

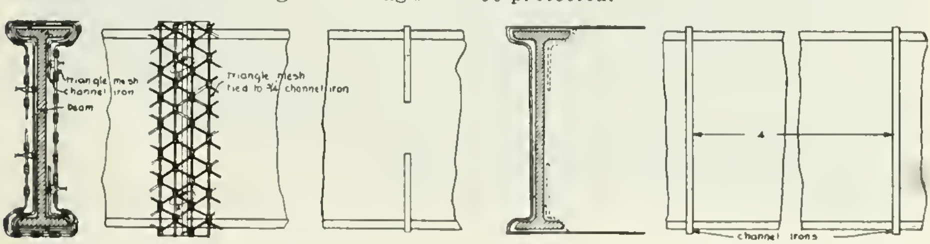
By H. K. McCay, City Engineer, Baltimore, Md.

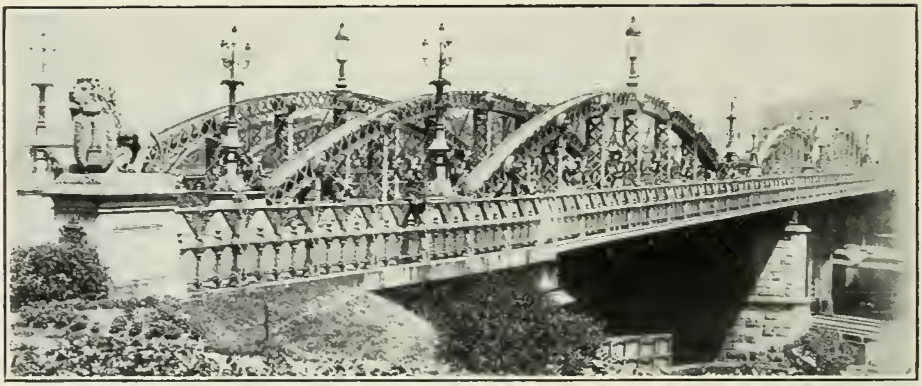
This brief illustrated description of the latest effort of the city of Baltimore to protect steel viaducts over railroad tracks from the detrimental action of the gases and cinders from locomotives shows the advances which have been made in solving this difficult problem. The efficiency of the method and the quality of the work done will be tested very quickly, for it takes but a few months to produce very serious effects upon an unprotected girder.

THE city of Baltimore is divided by a stream of water which flows from the northwest to the southeast, thru the most populated districts of this city. The various railroads have utilized the valley of this stream for the purpose of ingress to and egress from the city, laying their tracks along and parallel therewith. Union station, used by the Pennsylvania, Western Maryland and Northern Central railroads, is practically on the banks of this stream. In order to carry the north and south streets in Baltimore across this stream and across the railroad tracks it was necessary to construct at a great deal of expense, five bridges, namely: Guilford avenue, Calvert, St. Paul and Charles streets, and Maryland avenue. Most of these bridges span the railroad tracks at a height which prevents the gas from the engines destroying the steel, but on two bridges, namely, the Calvert and St. Paul street, the clearance is such that the blasts from the engines destroy any protection that is put over the lower members to protect them.

The Calvert street bridge is a magnificent structure, 62 feet in width, with a total length of about 600 feet. The spans are the bow spring type of truss, and made almost entirely of wrought iron. This bridge was built in the year 1878, and cost approximately $220,000. There is a clear span over the railroad tracks of about 146 feet, and a clearance over the Pennsylvania tracks of 23 feet. I found, as stated above, that the lower members of this bridge became badly corroded from the gases of the locomotives, as many as five hundred of these engines passing under this bridge each day. It had been the practice of the city engineer's department to paint these bridges each year, either with coal tar paint or with the very best red lead paint obtainable. I also found it was nearly impossible to use the ordinary scaffolding to allow time for the paint to harden, therefore, I constructed a closed scaffolding, and swung the same beneath the bridge, cleaned off the lower

SKETCH *showing method of attaching the coating of cement to the girder to be protected.*





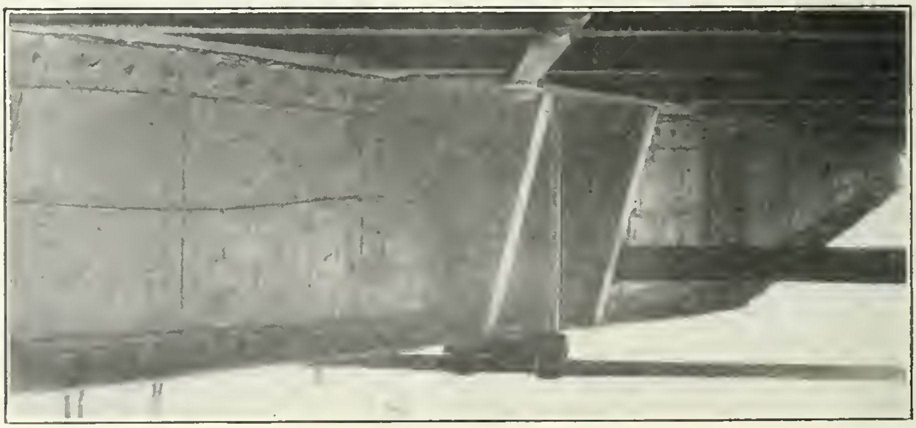
CALVERT STREET BRIDGE *over railroad and creek. A steel bridge, where girders beneath the floor were always in serious danger of corrosion by locomotive smoke.*

members very carefully and repainted with two coats of paint, allowing the scaffolding to remain as a protection for a week or ten days until the paint thoroly hardened. In spite of all this protection, it was found that the paint would not stand the blast from the engines, and the lower members, in order to preserve them, had to be painted each year.

I therefore decided that I would encase the lower members of the bridge in concrete, and careful computation was made as to whether the weight of the concrete would alter the stresses and strains as calculated for this bridge. I found, by removing some ornamental castings, which were of no vital moment to the bridge, that a comparatively thin coat of concrete could be placed on the bridge without increasing the stress or strain, and, if anything, improve the stability of the lower members, thereby reducing to some extent the vibration.

The lower members of the north span consist of nine built-up steel girders, with a surface area of approximately 5,000 square feet. The specifications called for concrete to be put over these members to a thickness of 1½ inches. Sketch No. 1 shows the method of holding the reinforcement to these girders. These girders were carefully cleaned by means of sand blasting and acids, so that all of the old

METHOD OF SURROUNDING GIRDER *with wire to serve as support to retain cement coating in close union with the girder, which was thoroly cleaned of all dirt, rust scale and corrosion before applying the protective material.*



paint was removed, and the steel surface carefully exposed. Wire mesh reinforcement was carried all around the beams, held as shown in Sketch No. 1, and a coat of "gunite," 1½ inches in thickness, was applied; the gunite following the contour of these beams.

Cut No. 2 gives a view of the bridge before treatment.

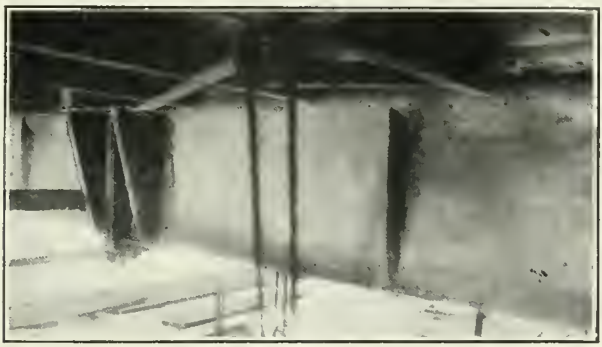
Cut No. 3 shows the girder on which the reinforcement has been placed preparatory to putting the gunite over the same This reinforcement is held away from the face of the steel by means of ½-inch iron rods, as it was found that the channel method was not satisfactory.

Cut No. 4 shows the same girders after the gunite had been placed on the same by the cement gun, the photograph taken with particular reference to the corner of the reinforcement, showing how the gunite follows the contour of the girder.

The total area, as mentioned above, was about 5,000 square feet for the north span of this bridge, and the contract was let at $1.25 per square foot. An additional area has recently been advertised and the contract let at an expense of 95 cents per square foot.

The grout placed by means of this gun proved very dense and thick and there is absolutely no danger of gases from the engines penetrating the steel thru this grout and I feel satisfied that the city of Baltimore has gotten rid of a very expensive renewal item by the adoption of this method.

I have gone into the details of this work rather more thoroly than necessary so that any other engineer having such a problem may have the advantage of my experience along these lines.



GIRDER PROTECTED BY CEMENT COATING. *Note the corners and how the coat follows closely the contour of the girder.*

RELIEVING TRAFFIC ON CONGESTED STREETS

By Max J. Welch, Los Angeles, Cal.

The automobile has greatly complicated some of the problems of street traffic, especially at street intersections and when standing along the curb. This brief article makes some excellent suggestions, applicable to conditions in quite a large number of streets in our large cities, some of them directly and some with modifications to suit local customs and peculiarities.

THIS discussion and the drawing which accompanies same show a proposed scheme of arrangement of street car tracks, such that pedestrians are not required to cross the trail of automobiles when the pedestrians are mounting and alighting from street cars.

In highway traffic it is customary for the vehicle which travels at the higher rate of speed to pass the vehicle of a slower rate of speed to the left. In the days when street cars traveled faster than the horse and wagon the present system of having the street car tracks in the center of the street was correct.

The automobile has come to stay. The speed of the automobile always will exceed the speed of surface street cars. It is reasonable that the automobiles should pass the street cars to the left-hand side, or the opposite side from which passengers mount and alight from the street cars.

The pessimistic critic who is always devising laws to limit the speed of automobiles is not in harmony with the fast age in which he is living. The point about automobile traffic is not to congest by holding down the speed, but to relieve the traffic by providing safe means for the speedy exit of automobiles.

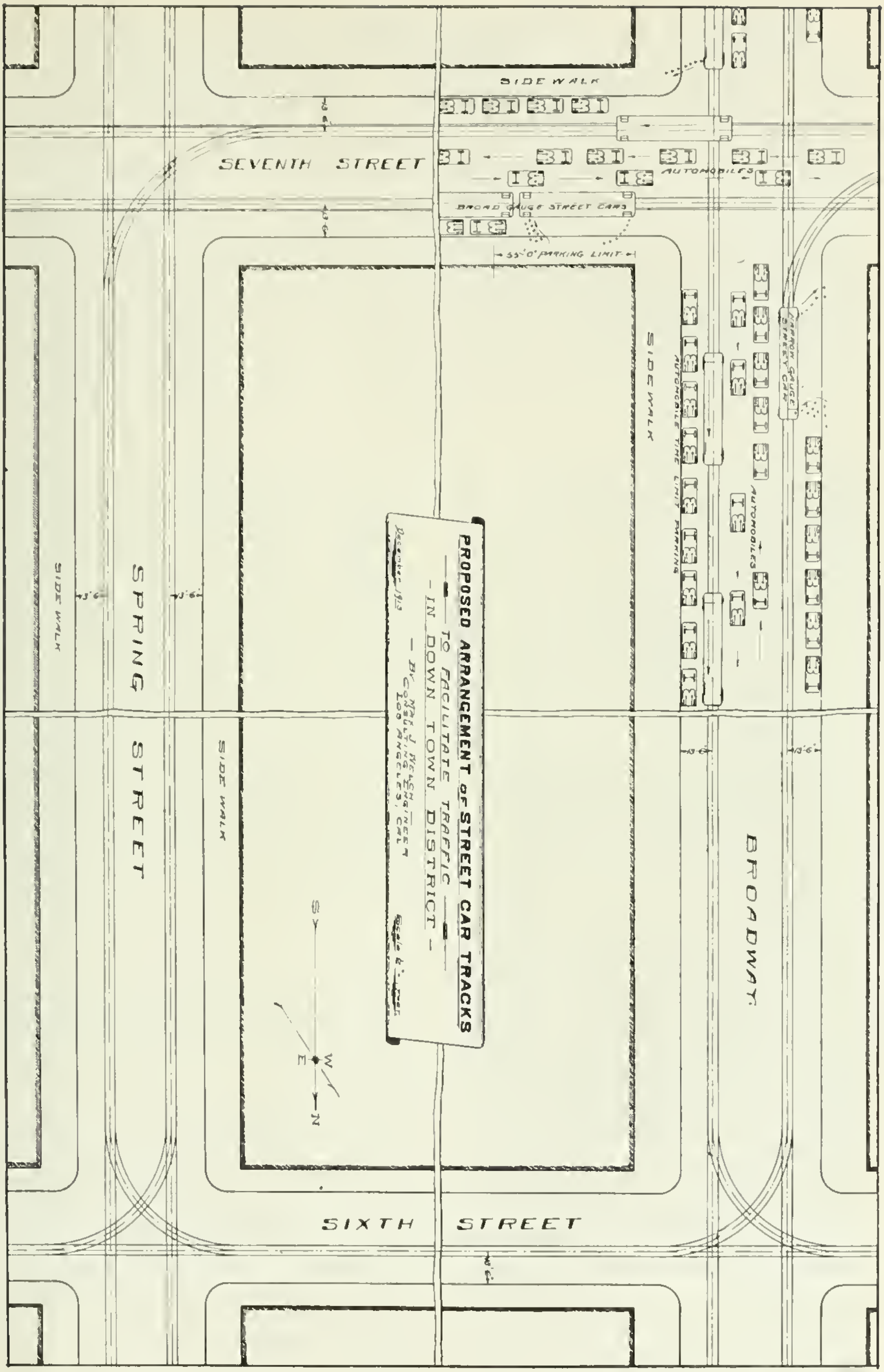
The drawing shows the center of the street car tracks to be 13 feet and 6 inches from the street curb. For a fifty-five-foot street this allows about three feet clearance between all vehicles passing in the center of the street.

The upper left-hand corner of the drawing shows how passengers may alight from cars without being molested by automobile traffic. It is a common occurrence for elderly people, under the present system, to be entirely unable to mount the street cars on account of congestion of automobiles in front of the steps of the street cars.

The drawing also shows the adaptability of the loop system of street car tracks to the downtown district. Note the arrangement of using only one track on the very narrow streets, for example, Sixth street. The narrow streets are used for looping purposes only. Any car, in coming into the downtown district, can have three sides of the loop in the less congested or outlying district and one side of the loop in the congested district.

It is not the purpose of this discussion to impose upon any corporation the expense of tearing up and rearranging all of its trackage. The object is to have a municipality keep in mind a more modern arrangement of street car tracks, have these tracks designed according to well-defined lines; then, when repairs are necessary, change from the old to the new system.

[Mr. Welch has not mentioned one point in his drawing which will be of interest in cities where the gage of the city car lines does not conform to the gage of the suburban or interurban lines. It will be noted that the tracks on Seventh street are laid with a third rail just outside the outer rail of the city line so that both broad and narrow-gage cars, as he terms them, can be run on that street. A little more space between tracks is required on this street than on the other streets on this account.—EDITOR.]


PROPOSED ARRANGEMENT of STREET CAR TRACKS
TO FACILITATE TRAFFIC
IN DOWN TOWN DISTRICT
SEVENTH STREET
SIXTH STREET
SPRING STREET
BROADWAY
SIDE WALK
AUTOMOBILES
BROAD GAUGE STREET CARS
55'-0" PARKING LIMIT
AUTOMOBILE TIME LIMIT PARKING
S
N
E
W

HIGH PRESSURE GAS FOR STREET LIGHTING

By T. Sington, Manchester, England.

The development of high-pressure gas has been more extensive in England than in this country, where the competition with electricity has not been developed so strongly. With the cheapening of gas and the exploitation of incandescent burners is coming the use of higher pressures in gas mains and successful competition with electricity for street lighting. This paper suggests some of the reasons why still greater development may be expected in this direction.

High pressure gas illumination for important streets has been extremely successful in London, Paris, Berlin and large principal towns such as Birmingham; in several cases the installations have been less successful; it may therefore be interesting to draw attention to only partial success, in order that the system wherever introduced may always give the best results possible.

All the practical advantages claimed for electrical lighting, such as simplicity of switching operations, possibility of dispensing with lamp lighters, great economy of cost and so on, are actually obtained by the use of gas high pressure installations.

Complaint of extensive and highly dangerous leakage of high pressure gas is only made possible by neglect on the part of main-layers and is easily avoidable. All mains after being laid must be made subject to severe tests and any subsidence prevented by bedding the mains where necessary on a foundation of concrete.

No detrimental effect is caused by foggy or heavily smoke-laden atmosphere on the gas mantles, resulting in any diminution of candlepower. Ordinary foggy weather does not effect them at all, also not the ordinary smoke of a manufacturing district. During extraordinarily bad weather street lamps may be burning both day and night, thus eliminating any remote possibility of smoke settling on the mantles. It is also important to note that the rays of gas lamps penetrate fog considerably better than those of electric lamps.

The great objection to electric street lighting is the intense glare of the arc lamps, which electrical experts are anxious to reduce, as it tells against their system. In this respect gas lamps are superior for the eyes, because the source of light is immensely larger than the arc of the electric lamp. There is still ample scope for both gas and electrical light engineers to experiment with the object of improving the distribution of light. Such experiments if they resulted in nothing else, would also probably lead to improvements tending to lengthen the effective life of the gas mantles, which are at present insufficiently protected from the weather. Some experts assert that all sources of light should be screened down so that their intrinsic brilliancy does not exceed that of the sky, which has been estimated at about 3 candlepower per square inch.

The measurement of light and illumination has now become a science, the degree of accuracy of which is only limited by the personal error of the observers using the photometric instruments. Street photometry can measure within an accuracy of 5 per cent. of the direct candle-power measurements and within 7 per cent. of the horizontal illumination measurements. To measure the illuminating effect of high pressure gas lamps a portable photometer may be used for rough measurements, fitted with a Bunsen screen; also the type known in Europe as the Universal photometer, the accuracy of which is very high, as the flicker attachment is used for direct measurements, thus reducing to a minimum any error due to variation in color of light source. The artificial illumination of streets being carried out by means of light sources fixed at intervals along a street, results in a varying degree of illumination, depending on the distance from the light sources, and as that illumination is proportionate not to the distance only, but to the square of the distance, and the angle at which the light falls on the surface, it will readily be seen that much depends not only on the candlepower of the lamps, but even more on the way they are spaced along the street and the height at which they are erected. With the object of bringing all the factors, namely candlepower, distance and height, into a common factor for comparison, it is becoming the practice to compare the illumination of streets by ascertaining the minimum horizontal illumination at any part of the street on a screen 3 feet above the ground level. This minimum factor is considered the important one, as it embodies all others; also because, if the minimum illumination is sufficient for the pedestrian and road traffic, the illumination thruout the remainder of the street must be sufficient.

¶ TESTS OF HIGH-PRESSURE GAS ILLUMINATION *of streets show high results in service and in efficiency.*

In order to test high pressure gas illumination of streets satisfactorily, a series of tests should be made extending over a period of several weeks, including photometric measurements of candle-power and illumination, which should be carried out every consecutive night, weather permitting. Periodic measurements of the gas consumption and gas pressure should be made, to check those recorded by the gas meters and recorders installed. Whilst tests are being made the lamps in the street under examination must be operated precisely in the manner usual in ordinary practice; adjustments and alterations being only permitted when found to be absolutely necessary.

The following details of actual tests, made on high pressure gas street lamps, will give point to what has been stated above. The lights tested are known as the Keith high pressure gas lanterns, each containing three inverted high pressure mantles supplied with gas raised to a pressure of 55 to 60 inches of water by means of a compressor plant placed in an adjoining street, the pumps of which were driven by electric motors.

¶ METHODS OF PLACING LAMPS *may be similar to those used for electric lights and they may be even lowered for trimming.*

The lamps were suspended from span wires. A tower ladder was used to adjust, trim and clean the lamps. Lowering gear could alternatively be used. The central hanging of light sources has many advantages to recommend it, where powerful light units are necessary, as in very busy thorofares. The most important are that the lamps can be erected at a considerable height, so that they do not come into the line of vision of either pedestrians or drivers of vehicles using the street; furthermore the lighting of the footpaths is much more even than when the light sources are carried on poles erected at the edges of the footways. A further advantage is that poles being needed for supporting the span wires, the footway is freer from obstacles to the traffic. The only serious disadvantage is the inaccessibility of the lamps. In the case of high pressure gas lamps, the lowering gear may cause trouble with the joints. It has therefore been suggested that the lamps could be supported from brackets attached to the buildings.

The average height of the lamps tested was 26 feet 6 inches and the average distance apart 107 feet; that would mean forty-nine lamps to the mile of street. Most of the photometric measurements were made at the following angles: For the maximum illumination from the rays 45 degrees from the horizontal and for the minimum 20 to 25 degrees from the horizontal. Very numerous measurements extending over several weeks gave the following results: Average candlepower at 20 to 25 degrees from the horizontal, 1,750; average at 45 degrees from the horizontal, 1,670. Average minimum horizontal illumination derived therefrom on the pavement 0.39 foot-candles; the average maximum horizontal illumination on the pavement, 1.9 foot-candles.

¶ ITEMS OF COST *of English installations will be some guide in the estimation of cost of work in this country.*

The costs excluding capital charges on lamps and special mains were made up as follows: Of the cost of low pressure gas delivered to the compressor plus the cost of compressing; the cost of mantles and renewable parts; labor charges of lighting, extinguishing and renewing parts. The cost of the low pressure gas delivered at the compressor slots amounted to 25 cents per 1,000 cubic feet; to which has to be added the cost of compressing, 4 cents per 1,000 cubic feet, making a total cost of 29 cents per 1,000 cubic feet delivered into the high pressure mains. Careful consumption tests showed that the consumption per mantle was 26.5 cubic feet per hour, equal to 79.5 cubic feet per hour for each lamp, giving a cost per hour for high pressure gas of 2.294 cents per hour. To this must be added the cost of mantles, globes and labor, making the total 3 cents per hour. The capital cost of plant and apparatus, including lamps, lanterns, poles, suspension and all accessories amounted to $240.00 per lantern apart from cost of the high pressure gas mains and compressor plant. The capital cost per mile of street would therefore amount to $11,760.00. During the time the tests were being made the maximum variations of any one gas lamp were from 2,058 candlepower to 686 candlepower and for all the gas lamps tested from 2,475 candlepower to 686 candlepower. It was stated above that the gas lamps cost 3 cents per hour, equal to $60.00 per lamp per annum of 2,000 hours. That would amount to a cost of $3,240.00 per mile of street. The capital costs per mile of street would amount to $12,177.60.

¶ HEIGHTS OF LAMPS, *number of burners, cost of compression of gas, are items of great importance in estimating the results to be expected.*

High pressure gas lamps used for street lighting, have on occasion been found not to give the full results expected, thru not being properly installed or adjusted. It is of extreme importance that the correct height should be ascertained. The height given above, 26 feet 6 inches, is too great to yield the best results; it only gave 27 candles per cubic foot of gas. When placed at a more suitable height the efficiency should be at least 50 candles. Lamps placed at a height of 20 feet with only two burners, adjusted to a proper efficiency, would give a light equal to, if not better, than the three-burner lamps discussed above. The life of a mantle was found to be 400 hours, therefore, each three burner lamp would require 15 mantles per annum of 2,000 hours. The capital outlay has been found to be as follows: Per lamp, $58.00; for installing same, wages, poles, suspension gear and other smaller items, $180.00. To obtain the lowest working costs it is necessary that the compressor should be worked to its full capacity. The cost given above for compression is too high because the compressor was not worked to its full load. The flexible connection to a high pressure gas lamp requires careful watching. It may be faulty and occasion loss of either pressure or gas.

AGGREGATE FOR CONCRETE ROADS

At the conference on Concrete Road Construction one of the committees made a report on the aggregates to be used in the concrete. Mr. Sanford E. Thompson, the chairman of the committee, is one of the foremost experts in the theory and practice of concrete construction because he is expert in both. He shows in the report given herewith what are the reasons for failures in concrete road construction and what are the limitations of the materials and methods of construction which have been used thus far.

THE successful development of the concrete pavement depends upon: (1) Materials, and (2) Workmanship.

It is not so much a question as to whether concrete is a suitable material for roads in comparison with other paving materials, as it is a comparison between concrete and concrete. The durability depends upon the character of the concrete.

Suppose we were to build a brick pavement. Assume that we start with a poor foundation; we lay the brick at unequal distances apart; we half fill the joints; and for the brick we use a soft, light brick. Will the pavement stand? Suppose all the workmanship is satisfactory and the brick alone is poor, shall we expect the pavement to be durable? Certainly we cannot condemn brick pavements in general because such a pavement as this does not last.

But is not this exactly what many people may expect of a concrete pavement? They lay on a poor foundation, improperly mix and place the concrete, and use materials that will not make concrete good for any purpose. They may, in fact, properly prepare the foundation, mix the materials thoroly and in correct proportions, but provide sand that is fine and stone that is soft, and then they condemn not this pavement in particular but concrete pavements in general.

It must be remembered, however, that the general public has a perfect right to condemn concrete pavements in general if a large number of concrete pavements are poorly built or are built of poor materials.

Letters from a large number of cities having concrete roads show general satisfaction with this type of pavement. Adverse criticism usually comes from cities where the specifications and descriptions of work indicate either poor materials and incorrect proportions or improper methods of construction.

Simple rules covering the most essential requirements for aggregates are as follows:

1. For fine aggregate, use only sand or other fine aggregate that has been actually tested for mechanical analysis and tensile strength of mortar, and is free from fine particles.
2. Use coarse grained sands or hard stone screenings with dust removed.
3. Use sand or other fine aggregate that is absolutely clean.
4. For coarse aggregate, use hard stone, such as granite, trap, gravel, or hard limestone.
5. If bank gravel or crushed stone is used, always separate the sand or screenings and re-mix in the proper proportions.

If local conditions prevent following any one of these rules, adopt some other material than concrete for your pavement.

Briefly taking up each one of these points:

1. Actual laboratory tests are necessary for fine aggregates, because it is impossible for the most expert builder to al-

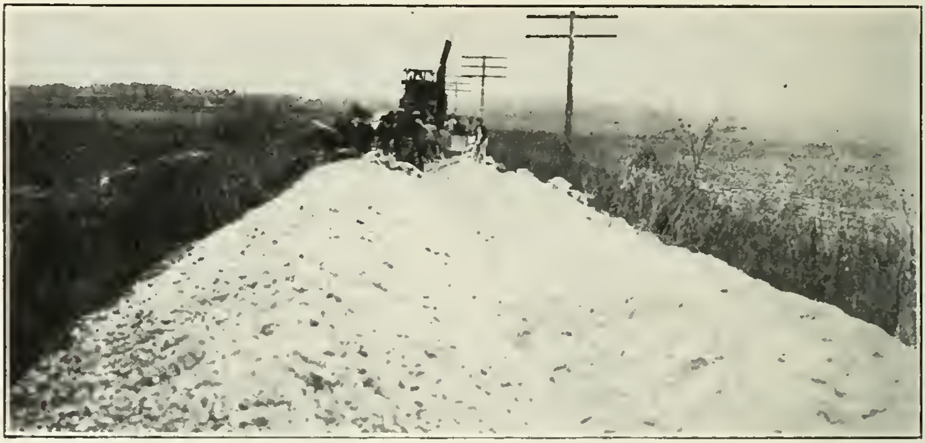
ways distinguish by appearance between good and poor sands. Sand may be coarse, of good color, well graded, and apparently perfectly clean, and yet because of a minute quantity of vegetable matter may show practically no strength when made into mortar or concrete. Case after case has been found where good looking sand had to be rejected on laboratory test or, if used, produced defective concrete.

Note that two tests are given in the specifications—for fineness and for tensile strength of mortar.

2 Coarse sand is necessary not only for strength and density, but to prevent the formation, on or near the surface, of a layer of fine material, consisting of a mixture of dust and cement which has no durability. Mortar made with fine sand or sand having a large proportion of fine grains of silt, hardens slowly and is especially objectionable in cold weather. This prevents it attaining proper strength before the road is thrown open to traffic. A sand having a considerable proportion of fine particles may possibly show high briquet tests, and yet the mortar not have good resistance to attrition or wear.

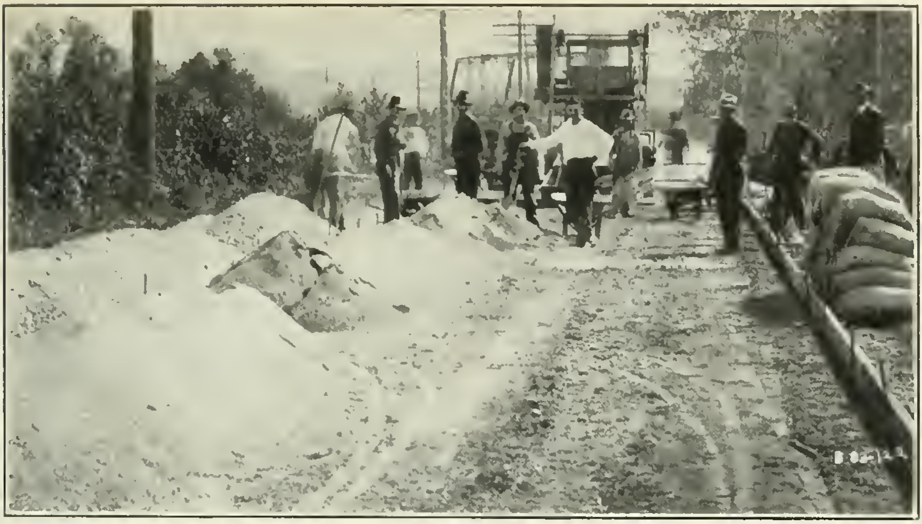
As indicating the necessity for coarse sand, even when the mortar made from it is high in strength, various cases might be cited; one, for example, in Wisconsin, where the sand mixed into mortar showed high tensile strength, and yet, because of 10 per cent. of silt in the sand, the surface of the road was entirely unsatisfactory, and had to be covered with a bituminous wearing surface after less than a year's service. A natural sand of limestone composition frequently shows high strength in mortar, but may be poorly adapted to pavements because of an excess of fine grains.

3. Sand must be absolutely free from vegetable or organic matter, or it is liable to harden not at all or too slowly to be serviceable. Frequently, sand may be entirely satisfactory in appearance, and yet be worthless for concrete. Defective sand of this type is apt to be taken from too near the surface of the ground, so that it contains a very small percentage of vegetable loam. At least 2 feet of top soil and loam should be removed before using the sand, and in many cases it is necessary to take off as much as 4 or 5 feet, while occasionally no acceptable sand can be found in the entire bank because of the penetration to a great depth of the deleterious vegetable material.



GRAVEL AND WASHED SAND *aggregates deposited on the grade for feeding the concrete mixer shown in the background, on the Ellerton grade, near Bloomfield, Ind. Photographed by Engineer of Universal Portland Cement Company.*

In one case, in Wisconsin, the materials were distributed along the entire length of the road that was being improved. The laying of the concrete was discontinued before the road was completed, and for several months traffic drove over the sand



CONSTRUCTING CONCRETE ROADWAY *in Miami County, Ohio, with mixed sizes of gravel and washed sand. Sprinkling roadbed and materials prior to mixing and placing. Photographed by Trussed Concrete Steel Company.*

and gravel that was later used in the construction of the concrete pavement. The portion first built was good, while the other part was very defective. The cause of the difference, evidently, was due to the dirt and manure that had become mixed with the aggregates.

4 A coarse aggregate of hard quality is necessary to resist the wear and abrasion of hoofs and wheels. Failures of concrete roads have been caused simply by the softness of the coarse aggregate. In one instance, for example, shells were used for the aggregate, and the road went to pieces as soon as it was subjected to wear.

All stone, like shale, slate, shells, and soft limestone, must be rejected; while trap, granite, and conglomerate, are especially suitable materials. A hard limestone, such as that occurring in certain localities along the Hudson river, which is sold in New York as trap rock, is satisfactory for concrete roads. A hard limestone cannot be cut with a knife and the specific gravity is high, say, over 2.70.

Gravel does not bond quite so strongly with cement as does broken stone. When properly screened and free from dirt, however, and remixed with sand in the proper proportions, a good surface can be made even for a one-course pavement.

5. Many roads that are now being built will prove worthless because of the use of sand taken directly from the bank without screening. If the gravel contains as much as 40 per cent. of stones and very rich proportions are used, say one part cement to 3½ parts bank gravel, a fair concrete can sometimes be produced, but it is always cheaper in such cases to screen the gravel and remix the sand and stone in proper proportions. There will be, for example, a saving of ¼ barrel, or 1 bag, of cement per cubic yard of concrete by using proportions one part cement to 2 parts sand to 3 parts screened gravel, instead of using the unscreened bank gravel in proportions 1:3½. This difference will more than pay for the additional cost of screening the sand and rejecting part of it. At the same time, the result will be more uniform and the surface more durable because of the stones which take the wear. When an excess of sand is used in the mixture, as is the case with run-of-the-bank gravel, the mortar rises to the top when the concrete is placed and the wearing surface is less resistant than a mix that is uniform thruout.

If the rules given above are followed, and at the same time proper foundations, proportions, and workmanship are obtained, the concrete pavement will prove durable and will resist ordinary traffic.

Tentative specifications for aggregates are presented as follows:

FINE AGGREGATFS.

Quality—Fine aggregate shall consist of sand or screenings from hard, durable gravel, granite, trap, or other hard rock. It shall be clean, coarse, hard, free from dust, loam, vegetable, or other deleterious matter. Fine aggregate containing frost or lumps of frozen materials shall not be used.

Samples for Test—Average samples of fine aggregate weighing not less than 10 pounds shall be taken from the bank or pile and tested, before the acceptauce of the material, for fineness and for tensile strength in mortar. Individual average samples shall be taken from each bank to be used, and new samples taken in case of a change in the character of any one bank.

Receptacles for shipment to laboratory shall be such as to retain the natural moisture in the sand.

Fineness—The size of the fine aggregate shall be such that the grains pass when dry a screen having ¼-inch openings. In the field a ⅜-inch mesh or, in some cases, a ½-inch mesh screen may be used for this separation.

Not more than 10 per cent. of the grains below the ¼-inch size shall pass a sieve having 50 meshes to the linear inch, and not more than 2 per cent. shall pass a screen having 100 meshes to the linear inch.

Tensile Strength of Mortar—Mortars composed of one part Portland cement and 3 parts fine aggregate, by weight, when made into briquets shall show a tensile strength at least equal to the strength of 1:3 mortar of the same consistency, made at the same time, and with the same cement and standard Ottawa sand. The sand shall not be dried before being made into briquets, since this sometimes improves its quality, but correction shall be made for moisture when weighing the materials.

Tensile tests may be made at ages of 72 hours, 7 days, and 28 days. At early periods the strength need not attain the full ratio of 100 per cent. to standard sand mortar, provided this is attained at a later period. In no case, however, shall sand be accepted for pavement work whose strength in 1:3 mortar at the age of 72 hours is not at least 80 per cent. of the strength of the standard sand mortar.

Screening—If bank gravel or crushed stone is used, it must be screened and remixed in the proper proportions.

If the sand does not fulfill the above requirements for fineness, it shall be washed or else screened when dry over a 10-mesh screen placed at such an angle as to remove the particles finer than a No. 50 sieve.

Washing—Fine particles may be removed by washing with a large volume of water in a box provided in the bottom with perforated pipes and arranged for the silt and water to flow off thru a trough from the top of the box and the sand to be drawn out from below.

COARSE AGGREGATE.

Quality—The coarse aggregate shall consist of clean, hard, durable, granite, trap, conglomerate, gravel, or other hard rock, free from dust, loam, vegetable or other deleterious matter. In no case shall coarse aggregate be used which contains frost or lumps of frozen material.

Coarse aggregate containing soft particles shall be rejected.

Coarse aggregate shall not contain a large proportion of flat or elongated particles.

Fineness—For one-course pavements, the size of the coarse aggregate shall be such as to pass an inclined or rotary screen having 1½-inch circular openings and be retained on a similar screen having ⅜-inch openings.

For 2-course pavements the size of the coarse aggregate for the bottom course shall be such as to pass an inclined or rotary screen having 2-inch openings and be retained on a similar screen having ¼-inch openings. (This assumes a perfect bond between the first and second courses.)

NATURAL MIXED AGGREGATES.

Natural mixed aggregates shall not be used as they come from the bank or crusher, but shall be screened and remixed in the proper proportions.

THE MAINTENANCE OF CONCRETE ROADS

METHODS AND COST OF REPAIR

The Committee on Methods and Cost of Repairing and Maintaining Concrete Roads, appointed to report to the Chicago Conference on Concrete Road Building, was composed of three members, each of whom made his own report.

By EDWARD N. HINES, Chairman,
Detroit, Mich.

The first is by Edward N. Hines, chairman of the Board of County Commissioners of Wayne County, Michigan, which is responsible for the greatest development of concrete road construction which has yet been made. He is quite frank in his statement of the work that has been necessary, but unfortunately is not able to give the whole cost of the repair and reconstruction which has been necessary because the pavements so treated were still under the contractors' guarantees and were repaired without expense to the county.

IN preparing and presenting a report on Methods and Costs of Repairing and Maintaining Concrete Roads, we assume that it has to deal with the metaled surface rather than the shoulders, ditches or sides, and with this end in view we are presenting the individual experience of the members of your committee to whom this subject has been assigned.

With the opportunity to make a field study, having partly in charge at least the many miles of concrete roads in Wayne county, some of which are now in their fifth year of service, it seems to me that the actual experience and methods followed are of more value than any laboratory experiment or theoretical discussion. We, in Wayne county, have followed two methods in maintaining the concrete roads, the first of which consists in filling the open expansion joint on the roads first built before the development and use of the armor joint, and in the filling with a mastic such longitudinal and transverse cracks as have developed.

A crew consisting of seven men and a team, provided with a tar kettle, is utilized for the work. The foreman is paid $5 a day, the team and driver $5 a day, the "tar man" $3 a day, two laborers at $2.50 each and two laborers at $2.25 each. The tools used consist of two wire bristle brooms, a wheelbarrow, a couple of shovels and a tar bucket with a round spout. Tarvia X is now used exclusively. A lighter grade was first tried out, but did not give such permanent results as the heavier grade. Two men are utilized to sweep all cracks clean with the wire brooms, after which the man with the tar kettle fills the cracks with the tar which is heated to about 225 degrees Fahrenheit. An excess of tar is poured in so that it extends an inch or so beyond the edge of the crack. It is then allowed to stand in the crack for a few minutes to prevent it from "bubbling" out in case the sand is wet. The sand, which should be dry and coarse, is spread with a shovel over the crack and into the tar, and the whole is left for traffc to iron out. The excess tar and sand is worn away rapidly leaving a smooth, even surface, over which no jolt is apparent in passing either with a horse drawn or motor driven vehicle. This method of repair prevents the edges of the concrete from spalling and chipping, and no water can get thru to the subgrade to freeze and heave in cold weather.

The work is preferably done on hot, dry days. It has been suggested to us that the better time to handle this work would be in the late fall when the cracks would be open the widest due to contraction, but the results we have secured in the summer months have been so satisfactory that we have not tried out the latter plan. The small pit holes which are due simply to some foreign substance getting into the concrete like clay, wood or some fragment of inferior rock which might chance to be a part of the aggregate, are treated in the same manner. As to the cost of this method, I desire to present a verbatim report of the engineering staff, Messrs. George A. Dingman and George F. Key, to the Board of County Road Commissioners:

Michigan Ave. Road	Tar....20 bbl. at	$6.00	$120.00		
17 miles	Labor..10 da. at	22.50	225.00		
	Sand...18 yds. at	2.00	36.00	$381.00	
Grand River Road	Tar....14 bbl. at	6.00	84.00		
10 miles	Labor.. 6 da. at	22.50	135.00		
	Sand... 8 yd. at	2.00	16.00	235.00	
Gratiot Road	Tar.... 3 bbl. at	6.00	18.00		
1½ miles	Labor.. 2 da. at	22.50	45.00		
	Sand... 4 yd. at	2.00	8.00	71.00	
Jefferson Road	Tar.... 6 bbl. at	6.00	36.00		
1¾ miles	Labor.. 2 da. at	22.50	45.00		
	Sand... 4 yds. at	2.00	8.00	89.00	
Van Dyke Road	Tar.... 5 bbl. at	6.00	30.00		
2 1/3 miles	Labor.. 1½ da. at	22.50	33.75		
	Sand... 4 yd. at	2.00	8.00	83.00	
Mt. Elliott Road	Tar.... 3 bbl. at	6.00	18.00		
1½ miles	Labor.. 1½ day at	22.50	33.75		
	Sand... 4½ yd. at	2.00	9.00	60.75	
River Road	Tar....10 bbl. at	6.00	60.00		
7 miles	Labor.. 5 da. at	22.50	112.50		
	Sand...12 yd. at	2.00	24.00	196.50	
Eureka Road	Tar.... 4 bbl. at	6.00	24.00		
4¼ miles	Labor.. 2 da. at	22.50	45.00		
	Sand... 4 yd. at	2.00	8.00	77.00	
Wayne Road South	Tar.... 1 bbl. at	6.00	6.00		
½ mile	Labor.. ½ da. at	22.50	11.25		
	Sand... 1½ da.	2.00	3.00	20.25	
Woodward Ave. Road	Tar.... 5 bbl. at	6.00	30.00		
2¼ miles	Labor.. 2 da. at	22.50	45.00		
	Sand... 6 yd. at	2.00	12.00	87.00	
51 miles	Total			$1,300.50	

A percentage was added to cover engineers, inspectors and the depreciation of machinery and building and other "overhead" charges, totaling approximately $1,450. (See page 39, Seventh Annual Report.) This report covers the fiscal year of the Board from October 1, 1912, to September 30, 1913, inclusive. The greater part of this mileage was treated for the first time. Once a year is often enough to go over the work and touch it up here and there, as we have found by experience that the bulk of the repairs previously made is intact.

We have not had as good success in treating the entire surface of a road where the concrete from any cause has not stood the wear. One-half mile of concrete on Fort road, built by Porath & Son, about 800 feet on Grand River road, built by the Owosso Construction Company, and one and three-quarters of a mile on Gratiot road, out of the 80 odd miles of concrete road in Wayne county, are not up to the standard of the balance of the construction, and they have been surfaced with Dolarway, a special grade of Tarvia and Tarvia X. The surfaces of Fort and Gratiot roads were both rough, having been built in cold weather, and opened for traffic before the concrete had thoroly hardened. Fort road was surfaced by the contractor before the board would accept the road and make the final payment. It carries a fairly heavy mixed traffic, not as great, however, as either Grand River or Gratiot roads. A special grade of Tarvia was used, furnished by the Barrett Manufacturing Co. The road was first swept by a street sweeper which was followed by men with wire brooms. About one-half gallon of bitumen to the square yard was used, and the whole covered with coarse sand and rolled with a ten-ton roller. This repair was made early in the summer and was not touched in any manner for a period of two years. By this time it had scaled off in spots quite badly, and was gone over again in the summer of 1913, using Tarvia X and a washed roofing gravel about one-quarter of an inch in size. We have no record of what the first cost was to the contractor, as we paid nothing for it.

Gratiot road was surfaced at no cost to us by the Dolarway people in the spring of 1912. By the summer of 1913 about half of the original coating had scaled off, at which time we patched it up, using a special grade of Tarvia and Tarvia X. The Tarvia X has given the better result to date. Washed roofing gravel was used with the bitumen. This work was also rolled with a ten-ton roller. Gratiot road carries an average traffic of over 1,000 vehicles a day. (On the last count made one week in August and one week in September the average traffic per day was 1,210, of which 36 per cent. was motor traffic and 64 per cent. horse drawn vehicles.) The surface of the road is wavy, and we have found it necessary to go over the work two or three times during the summer, touching up small spots here and there where it had scaled off. The cost of the work done by our board is in the neighborhood of 9 cents a square yard.

By J. S. McCULLOUGH, City Engineer, Fond du Lac, Wis.

The second member of the committee, J. S. McCullough, is city engineer of Fond du Lac, Wis., and has been the engineer for some excellent concrete paving work. The streets are still in the hands of the contractors, however, and his report is restricted to statements of methods of filling cracks and repairing cuts in pavements for trenches of public utilities and plumbers.

The repairs on our pavements to the present time have been taken care of entirely by contractors who built the pavements, and are part of their obligation, under our contract. The pavements are guaranteed for 5 years, and our oldest work was 5 years old this past summer.

The method of repairing cracks is similar to that in use in Wayne county. Both asphalt and Tarvia have been used, but we find Tarvia gives the better results.

We have had some work of replacing pavement cut out for installing service pipes, such as sewers, gas, and water, also a long piece for installation of telephone conduit. The telephone work was done by contract by the telephone company; all other repair of such excavations has been done by the city thru its repair gang.

The excavation is made by the public utility after receiving permit from the Board of Public Works. Excavation is required to be back filled with gravel, sand, or crushed stone to subgrade of pavement. Our men then proceed to trim the edges of hole so walls of cut are as near perpendicular as possible, and is washed with a grout of cement and water.

Mixture same as original pavement is then put in and finished same as original work. Traffic is kept off until concrete is hard. Where the work has been carefully done we have had good success in making such patches. The cost will not exceed that of replacing brick that are cement grouted and, in fact, what records we have would indicate that concrete pavement patches can be replaced cheaper than the brick.

By F. P. WILSON, City Engineer, Mason City, Iowa.

The third member of the committee is F. P. Wilson, city engineer of Mason City, Iowa, one of the earliest of the modern users of concrete paving. His rules for the construction of concrete streets are thoroly practical and he points to the results of his work as proof of the necessity of following them.

Mr. Hines' experience as given in his paper on the topic, "Methods and Costs of Repairing and Maintaining Concrete Roads," I have carefully read, and the contents of the same describe methods I have used on the maintenance of cement city streets and I consider them most practicable and economical methods for maintaining a concrete road or pavement. If the roadway or pavement is given a careful inspection at least twice a year and all the defects filled with Tarvia X and coarse, clean sand, free from loam or clay, put on the road or street when the same is perfectly dry, clean and free from any foreign substance, when the temperature of the weather is at least 80 to 90 degrees Fahrenheit, good results will follow and the concrete road or pavement will last indefinitely and the cost of maintenance will be reduced to a minimum.

It has been my experience as an engineer during the past 6 years in the design and construction of approximately 300,000 square yards of cement paving for city streets that to reduce the cost of repair and maintenance to a minimum, the following rules should be carefully carried out in the construction of cement streets or roads:

1. To have the subgrade thoroly drained, where it is necessary, by using farm drain tile not less than 4 inches in diameter, after which the subgrade should be rolled and compacted with a heavy steam roller until it is perfectly solid over its entire surface.

2. After the subgrade has been prepared, great care should be taken to keep it wet, before placing the concrete, as a dry subgrade draws the moisture from the concrete mixture and is thus harmful.

3. Have a first class Portland cement that will stand the tests required by the American Society of Civil Engineers.

4. Have a sharp, clean sand, which does not contain more than 2 per cent. of loam.

5. Have a good hard stone or gravel, free from dust, loam or clay and crushed so that it runs from ¼ inch to 1½ inches in size, 66 per cent. of the stone to be the coarser and 34 per cent. the finer of the stone aggregates.

6. The fine aggregates and coarse aggregates should be thoroly mixed with an up-to-date batch mixer, until all the stone is coated and is of such consistency that all that is required is to level off the mass so that the concrete runs into place, no tamping being required and a dense compact volume is obtained.

7. Have an expansion joint 1 inch in width left next to the curb on each side of the street, this space to be filled with an asphalt filler. Have transverse expansion joints ½ inch in width left every 37 feet 6 inches at right angles with the curbs, these expansion joints to be protected on either side with steel plates, 2½ inches in depth, ¼ inch in thickness, with

FINISHING THE SURFACE *of a concrete pavement in Miami County, Ohio, with wooden float. Gravel shoulders will be placed along the side, Trussed Concrete Steel Company's joint protection.*

a shear member 6 inches in length cut out of the sides of the plates at equal distances and bent at right angles and extending into the concrete, these steel plates to be not less than 15 feet in length. Between these plates place a three-ply tar felt paper especially prepared for the expansion joint.

8. Finish the surface of pavement with a wood float, made of a coarse grained soft wood, so as to give a uniform rough surface which will give a good foothold.

9. The curing of concrete pavement is one of the most important features and on it depends the durability and strength. The pavement, immediately after it is laid, should be covered and protected from the sun, and as soon as it is hard enough, should be sprinkled daily and kept wet not less than eight days.

10. Concrete paving, where the width of roadway is more than 20 feet between curbs, should be reinforced with No. 7 American wire, to eliminate cracks or cracking.

11. A concrete pavement, after it is laid, should be protected and the traffic kept off for at least three weeks, so as to give it a chance to thoroly harden.

12. To obtain a first-class result in the construction of concrete streets, also to reduce the maintenance of the same to a low cost, every detail as heretofore described must be followed. The methods described I have followed in the good old State of Iowa and other states in the Northwest in the construction of concrete streets, and the results speak for themselves.

COVERING CONCRETE PAVEMENT *in Greene County, Indiana, to cure. Photographed by Universal Portland Cement Company.*

Voltage Regulation in Electric Distribution System

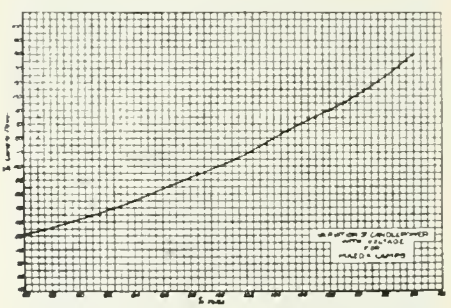
By G. G. Post, Electrical Engineer,
The Milwaukee Electric Railway and Light Co., Milwaukee, Wis.

Mr. Post has explained in his interesting paper prepared for the Wisconsin Electrical Society a subject but little known outside the fraternity of electrical engineers in a manner which leaves little to be desired. The necessity of uniformity in current supplied to any consumer is generally recognized and the methods of securing this uniformity are here explained in sufficient detail to be clearly understood, but Mr. Post has minimized the practical difficulties in applying the methods so that the process seems easier than it really is.

ONE of the best assets a public utility can have is satisfied consumers. One of the most important factors in satisfying the consumer, aside from reasonable rates, is good service; and, one of the most important factors in rendering good service, is good regulation. Fluctuating voltage results in variations in the intensity of light, which is sure to annoy consumers and bring complaints.

Plate No. 1 shows the relation between light impressed voltage for tungsten lamps. Roughly, 2 per cent. variation of voltage means 8 per cent. variation of light.

The Railroad Commission of Wisconsin has ruled (Rule 25) that "each electric utility operating in a city having a population of 1,500 or more shall adopt a standard voltage for the entire constant potential system and shall maintain the voltage within 3 per cent. of such standard on all lighting circuits during lighting hours; on power circuits and during other than lighting hours, the voltage shall be maintained within 10 per cent. of the standard. All other electric utilities shall maintain their voltage regulation on all constant potential circuits during lighting hours so that the maximum voltage furnished any consumer shall not be more than 6 per cent. above the maximum voltage at the consumer's cut-out."

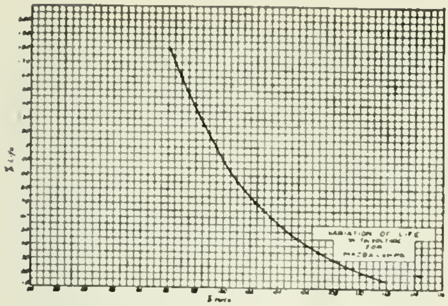


VARIATION OF CANDLE POWER, *left-hand scale, with the voltage of current, bottom scale, for Mazda lamps, is shown by this curve.*

Rapid variation of voltage well within 3 per cent. of normal will however, be extremely annoying to certain consumers, if frequently repeated; while if the fluctuation is sufficiently gradual, it will probably not be noticed.

Continued low voltage will bring complaints more surely than continued high voltage. Consumers desire light or illumination and will generally overlook the shorter life of lamps caused by high voltage, if the service in other respects is good. Some consumers, however, understand the relation between life of lamps and voltage, but they are few.

Plate No. 2 shows plainly the effect of high voltage in reducing the life of tungsten lamps and indicates that 2 per cent. increase of voltage over long periods will reduce the life 25 per cent. In other



VARIATION OF LIFE *of Mazda lamps in hours, left-hand scale, with voltage of current, bottom scale, is shown by this curve.*

words, those companies which are furnishing free renewals or renewal allowances will have their renewal expense increased 25 per cent. if they increase their voltage 2 per cent. without increasing the voltage rating of their lamps accordingly.

Close regulation in the case of power consumers is not as essential as in the case of lighting consumers, but under the conditions usually existing, it is found necessary to connect some lighting consumers to power circuits. This means in general that if the regulation is maintained sufficiently close for satisfactory lighting, there will be no cause for complaint from power consumers.

It has, therefore, been found necessary for central station companies to devote a large amount of time and study to the development of proper and sufficient methods for obtaining the regulation of voltage required in order to furnish satisfactory service.

There are two general methods in use for regulating the voltage at the consumer's cut-out:

First—Regulation of the station bus-bar or generator voltage.

Second—Regulation of the individual feeders.

Sometimes a combination of the two methods is adopted.

The regulation of the generator or bus-bar voltage is satisfactory where only one feeder supplies the distributing system or where all feeders have approximately the same voltage drop and supply loads having similar characteristics. Generator or bus-bar voltage can be regulated either by hand adjustment of the field rheostats or automatically by means of Tirrill regulators. Regulation of individual feeders is necessary in A. C. plants, where the feeders are of different lengths and supply loads of widely differing characteristics. It often happens in such cases that the bus-bar voltage can be regulated to supply good regulation on one feeder, allowing feeder regulators to regulate the remainder of the feeders. An example of this combined method exists in one of the power plants of the Milwaukee Electric Railway and Light Company, where there is a heavy power feeder which, if equipped with feeder regulators, would require an expenditure of approximately $2,500. Instead of going to this expense it has been found practical to regulate the bus-bar voltage so that the pressure on this feeder is maintained within satisfactory limits while the remainder of the feeders are taken care of by their individual regulators.

With the above general remarks the subject naturally divides itself into two divisions:

First—Regulation of D. C. systems.

Second—Regulation of A. C. systems.

In D. C. plants of 150-kw. and less, automatic regulators of the Tirrill type, operating directly on the generator fields, can be used to advantage. Such regulators introduce little added complication; and, since the load is carried over only one or two feeders, the regulator can be set to maintain close regulation at the consumer's cut-out. This is done by ascertaining from the records obtained by means of portable charts the proper voltage to be carried on bus-bars for various loads on the system.

In plants of over 150-kw., Tirrill regulators can be used, but in order to use them it is necessary to provide exciters which add a complication not otherwise required. It has become the practice in large D. C. systems to regulate by hand, and this is especially true where generators must be arranged to supply two or more sets of bus-bars operating at different potentials.

Feeders having similar characteristics

as regards voltage drop and load are connected to the same bus-bars and the bus-bars are regulated accordingly. In such a system it is necessary to provide means of throwing any feeder from one set of bus-bars to the other and to carry any particular feeder on the bus-bars which will give the best voltage at the consumer's cut-out.

Different voltages on two sets of station bus-bars can be maintained by the use of boosters. In larger stations the result is attained by operating generators on each set of bus-bars absolutely independent of each other.

In order to secure the greatest degree of reliability in the service, distributing mains of D. C. systems are usually tied together in one network. It is evidently necessary to provide the station operator with some means of determining when it is necessary to transfer a feeder from the high bus to the low bus or vice versa. This is accomplished by means of pressure wires brought back from the centers of distribution of each of the feeders. If a feeder is connected to the high bus and the load goes off causing the voltage to rise at the center of distribution, the operator is made aware of the fact by the reading of the voltage obtained from the pressure wire and transfers the feeder from the high to the low bus. If the feeder is connected to the low bus and the voltage at the center of distribution decreases, due to increased load, the operator transfers the feeder from the low to the high bus.

OPERATOR'S DESK, *where line voltages are read. This is the pulse of the system and tells where regulation must be made and how much.*

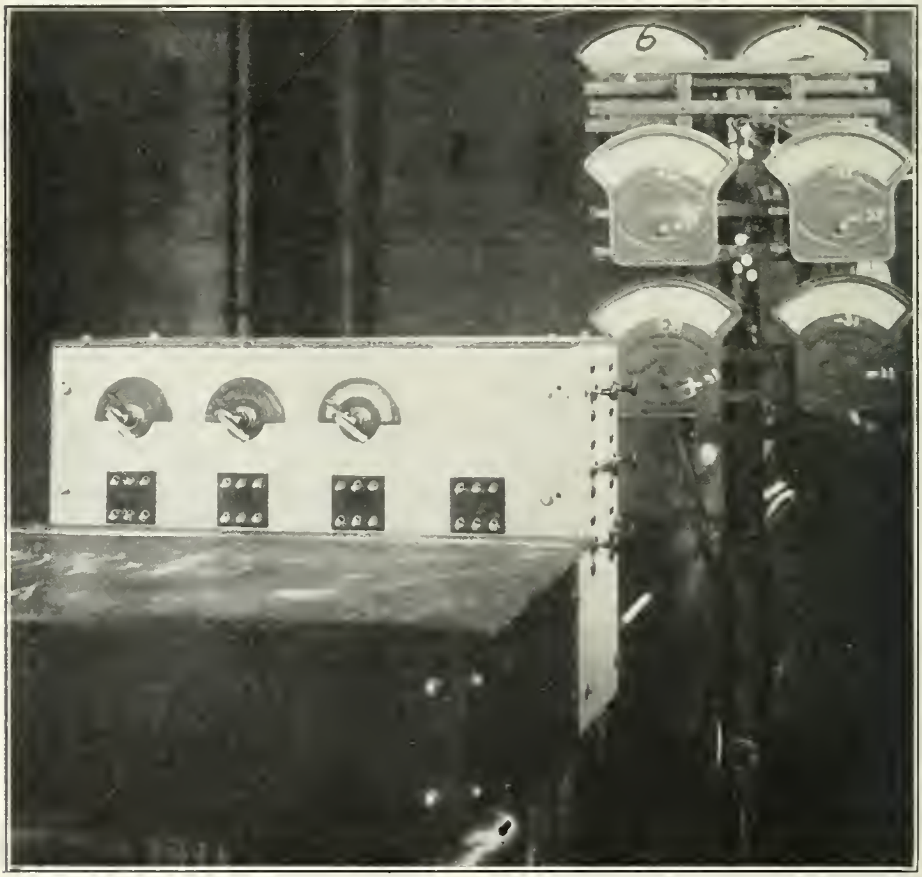


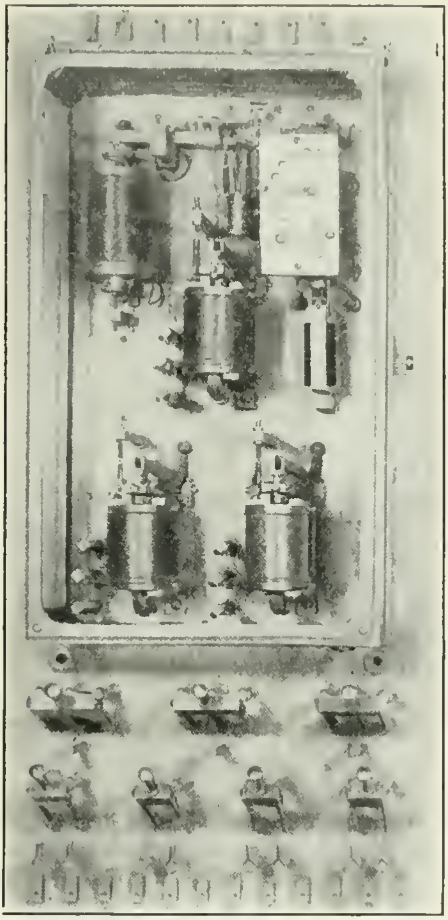
Plate No. 3 shows the operator's desk at the power station where voltage readings are taken. The regulating points are determined by the voltage setter from the indications of portable charts set at various points on the system, and those points are selected as the regulating points which give the best average results at the consumers' cut-outs.

The regulation of the small A. C. system is accomplished in the same manner as that of the small D. C. system. It is simply necessary to obtain by means of portable graphic instruments records of the voltage at various points on the system and maintain the voltage of the bus-bars at a value to give constant potential at the center of distribution which will give the best average results at the consumers' cut-outs.

In large A. C. systems, involving many feeders, the regulation is usually accomplished by means of feeder regulators connected to individual feeders.

Plate No. 4 shows a general view of a Tirrill regulator used on A. C. machines. The regulator shown operates on the exciter field short-circuiting the field rheostat when the voltage tends to drop and cutting the exciter-field rheostat into circuit again when the voltage tends to rise, thereby maintaining proper potential. By properly adjusting the instrument, the bus-bar voltage can be carried at any predetermined value within the limits of the instrument. If it be required to regulate the bus-bars for any particular feeder, the compensating winding of the regulator is connected in series with the secondary of a current transformer on the feeder to be regulated. This automatically results in increasing or decreasing the voltage on the bus-bars in accordance with the load on the feeder being regulated.

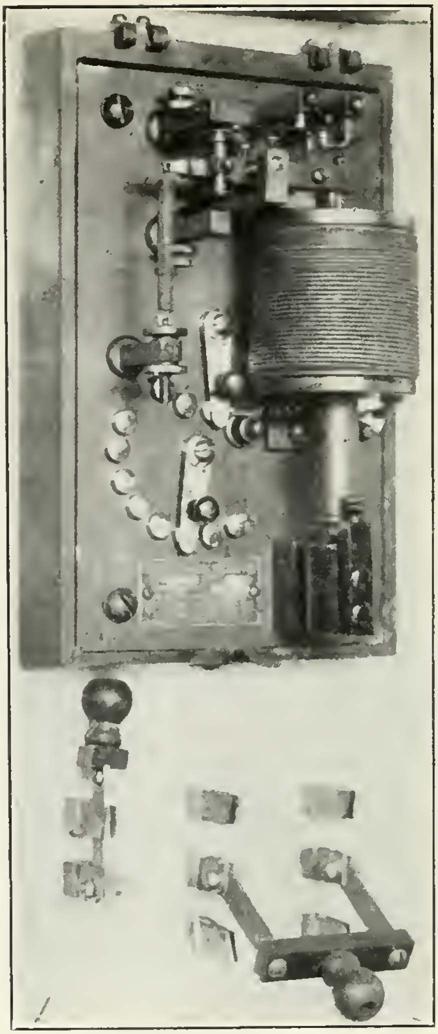
In general, the regulation of each feeder becomes a little problem in itself. The voltage setter ascertains from his voltage charts the causes of poor regulation and adjusts his station regulators accordingly or suggests changes in the distributing system to accomplish the desired results. Hand-operated feeder regulators are very little used at the present time, and most feeder regulators are automatic in their action. They are generally equipped with an operating motor which is controlled by a specially constructed relay or contact-making voltmeter.



TIRRILL AUTOMATIC REGULATOR *of voltage in bus-bars of feeder system.*

Plate No. 5 shows the contact-making voltmeter manufactured by the General Electric Company. These instruments are equipped with contacts which control the relay connected with the control circuit of the operating motor and cause the regulator to increase or decrease the feeder voltage in accordance with the load on the feeder or the voltage on the bus-bars.

There are two general types of feeder



CONTACT-MAKING VOLT METER *to control the operating motor of automatic feeder regulator.*

regulators, known as the switch type and induction type. The switch type is relatively little used on account of the excessive number of moving parts and trouble due to burning of contacts.

In the use of a three-phase, four-wire system of distribution, there is apt to be considerable drop in the neutral of the feeders if the loads on the various phases are unbalanced. This is provided for by installing a current transformer in the neutral wire of the feeder and connecting a line-drop compensator in the secondary of the current transformer in such a way that the secondary voltage of the compensator reacts on the potential coils of the contact-making voltmeters. It will be noticed that the effect will be most pronounced on the phase which is unbalanced.

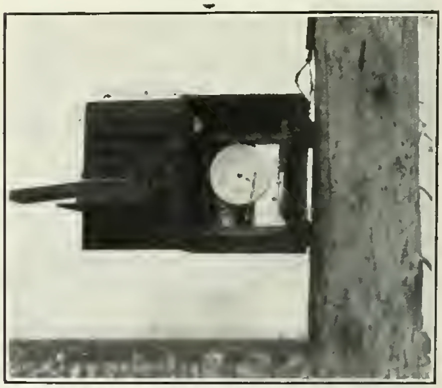
In making systematic voltage surveys, it is often found impracticable to set the portable charts on customers' premises, owing to the annoyance of repeated visits by employes of the company. It has, therefore, been found advisable to install special boxes on poles located at the approximate centers of distribution and connect them with the secondary system so that charts can be set in the boxes and observations taken without in any way interfering with consumers.

Plate No. 6 shows a general view of one of these boxes with the door open and the portable voltmeter used for checking the chart when installed and removed.

In order to illustrate the conditions encountered by the voltage setter a number of charts are given herewith, showing the voltage obtained before and after adjustments have been made or corrections applied:

Chart No. 1-A—Shows the result of over-compensation.

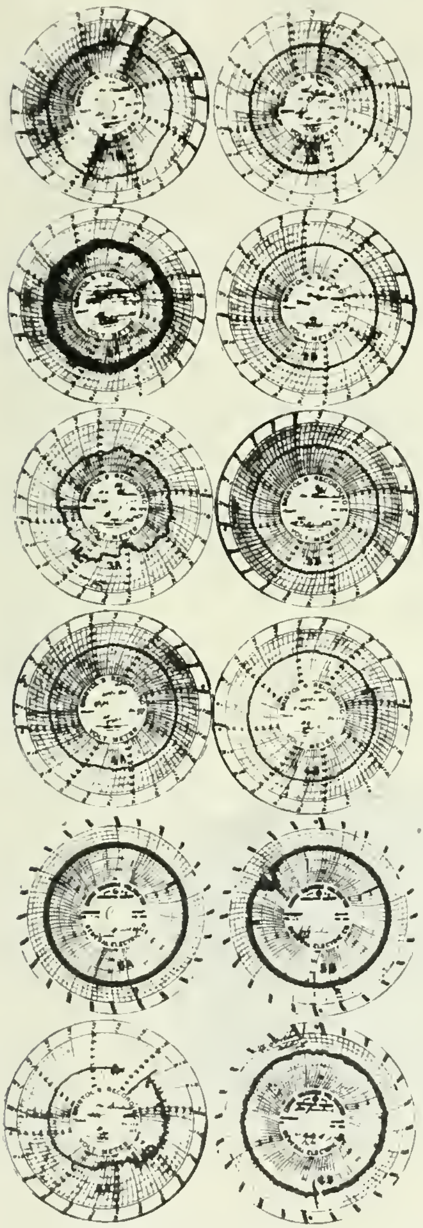
Chart No. 1-B—Shows the voltage taken in the same location, after proper adjust-



BOX SET ON POLE *to hold instruments for taking line voltage charts on consumers' lines when making voltage surveys, without entering private premises.*

ments have been made on the station regulator.

Chart No. 2-A—Shows rapid fluctuations in voltage, due to primary drop, caused by the automatic frequent starting and stopping 150-h.p. three-phase A. C. induction motor.



CHARTS SHOWING EFFECT OF REGULATION *"before and after," in order of description in next column: Nos. 1a and 1b to 6a and 6b.*

Chart No. 2-B—Shows the regulation on the feeder after the branch of the feeder supplying lighting customers had been transferred to another circuit.

Chart No. 3-A—Shows the voltage on a secondary line due to a transformer fuse being blown.

Chart No. 3-B—Shows the regulation at the same point after the fuse had been replaced.

Chart No. 4-A—Shows a slight drop over the lighting period, due to primary drop.

Chart No. 4-B—Shows the conditions at the same point after rearranging the overhead to eliminate the drop.

Chart No. 5-A—Shows the regulation in a certain location under normal operating conditions.

Chart No. 2-B—Shows the regulation on sulting from the blowing of a transformer fuse and the drop in voltage which resulted, due to feeding over four blocks of secondary line.

Chart No. 6-A—Shows voltage conditions when a secondary fuse had blown on a 25-kw. transformer in a manhole.

Chart No. 6-B—Shows the same after the fuse had been replaced.

Chart No. 7-A—Shows the voltage at a consumer's cut-out, due to feeding over about four blocks of secondary wire.

Chart No. 7-B—Is taken from the same section but close to the transformer, showing that the feeder regulators were properly set. This may be taken as an example of how the voltage setter determines whether poor voltage conditions are due to line drop or to the setting of feeder regulators.

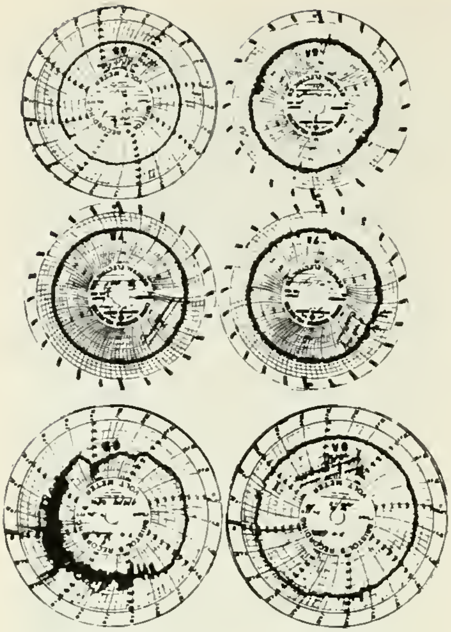
Chart No. 8-A—Shows the regulation of an under-compensated feeder.

Chart No. 8-B—Shows the same feeder after the compensation had been corrected.

Chart No. 9-B—Shows the regulation in a certain section of the D. C. district when it was being fed from a 500,000 C. M. cable.

Chart No. 9-A—Shows the regulation after the feeder had been changed to 2,000,000 C. M. capacity.

While many of the illustrations given



CHARTS *7a, 7b, 8a, 8b, 9a and 9b, taken to show effects of regulation as described in text.*

refer to a relatively large system, the principles brought out are general and will apply in all systems where standard equipment is used. The Railroad Commission of Wisconsin has ruled (Rule 26) that "each utility furnishing electric service shall provide itself with one or more indicating voltmeters, and each utility serving more than 250 consumers shall have one or more graphic recording instruments, these instruments to be of a type and capacity suited to the voltage supplied."

It has been found possible in Milwaukee and suburbs to obtain good voltage regulation by using approximately one portable graphic chart for every 750 consumers. A number of the suburbs in which the company operates, have less than 250 consumers, and even then it is found advisable and necessary to keep one chart in operation. In addition to this, graphic voltmeters should always be installed on station and substation busbars, in order to show whether the voltage conditions observed on the system are due to line conditions or not.

GOOD LIGHTING *of a Business Street.*

PARR SHOALS POWER DEVELOPMENT

FOR COLUMBIA, S. C.

By George G. Shedd, Supervising Engineer, Augusta, Ga.

This description of the development of a water power to supply Columbia, S. C., with electric light and power is a continuation of the paper in the February Number, describing the work on Stevens Creek, Georgia, and shows the methods of carrying on the work which were used at both plants, giving many pointers of value in any large construction undertaking.

THE Parr Shoals water power development is located about 1½ miles upstream from Peak and Alston, South Carolina, and 27½ miles above Columbia.

The drainage area at this point is estimated to be 4,570 square miles, and is in its upper part mountainous, largely covered with forests. The lower part is flatter and a considerable portion is under cultivation.

Very good records of run-off are available, particularly at Alston, from 1896 to 1907. The lowest recorded average weekly flow occurred in October, 1907, and was 1,260 cubic feet per second. The lowest average monthly flow occurred in October, 1904, and was 1,614 cubic feet per second. The greatest flood on record, occurred August 27, 1908, and from local information, was about 32.7 feet above the extreme low water mark at Alston of 1907. The discharge is estimated to have been about 222,000 cubic feet per second.

Based on past records, and a weekly load factor of 33 1/3 per cent., the delivered horsepower at Columbia will be only occasionally less than 20,000 horsepower.

The development consists principally of a dam, with a total length of about 2,740 feet, including the power house, a power house 300.5 by 51.6 feet in plan, a tailrace which is obtained simply by widening and deepening the original east river channel, a double circuit steel tower transmission line, 26 miles long, to Columbia, and a substation at Columbia.

The dam is constructed of cyclopean concrete thruout. The spillway section is of the ogee type, 2,000 feet long, with an average height of about 39 feet, and a maximum height of about 55 feet. A short section of non-overflow dam, with its crest 15 feet above the spillway is constructed between the power house and the east shore, and an earth embankment with a maximum height of 15 feet and total length of 300 feet, has been built on the west shore.

The dam contains six sluice gates adjacent to the power house, with a clear opening of 7 by 9 feet each. These have a combined capacity of about 14,400 cubic feet per second, with head-water at the crest of the dam, and tail-water at normal level. The operating devices for the sluice gates are located within the dam, and the crest of the dam is fitted with the flashboard sockets, which will later be used for 5 feet of flashboards.

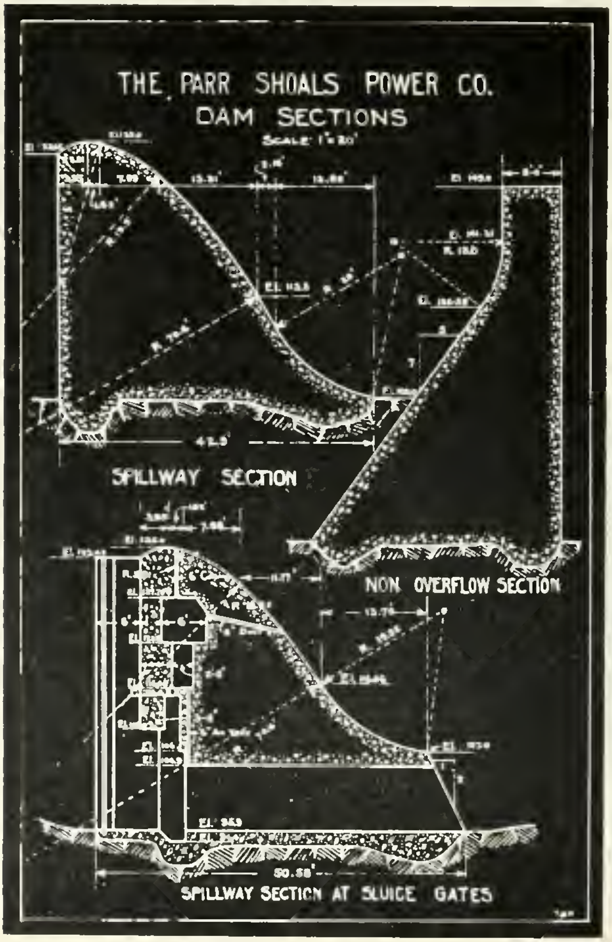
The dam is designed to pass safely a flood considerably in excess of the maximum flood on record, which would have caused a depth of about 9 feet over its crest.

The concrete for the dam has been mixed in proportions of one part portland cement, three parts sand and six parts broken stone. In the concrete has been imbedded about 7 per cent. of plums, consisting of large, sound pieces of rock, or boulders, in many cases weighing 6 or 8 tons each.

The foundation is principally of an excellent quality of granite and schist, and methods similar to those described in the February number for Stevens Creek were used in preparing the bottom.

The power house is designed for an ultimate installation of eight vertical type units of 3,100 k.v.a. each, and two vertical exciter units of 300 k.w. each.

The substructure is a combination of cyclopean and reinforced concrete masonry, and the superstructure is a steel frame, with brick walls. The roof for the main portion of the building is of hard pine, and that for the low portion, or gallery, is of concrete. Both are waterproofed with five ply tar and gravel covering.



The turbines are of vertical shaft 86-inch diameter, single runner, downward discharge type, set in reinforced concrete, scroll case flumes, and have draft tubes molded in concrete, so proportioned that the velocity is gradually decreased to 5 feet per second. The flumes are controlled with large steel gates, 14 by 25 feet, hinged at the bottom, and operated by means of a traveling hoist, running on tracks on the head wall.

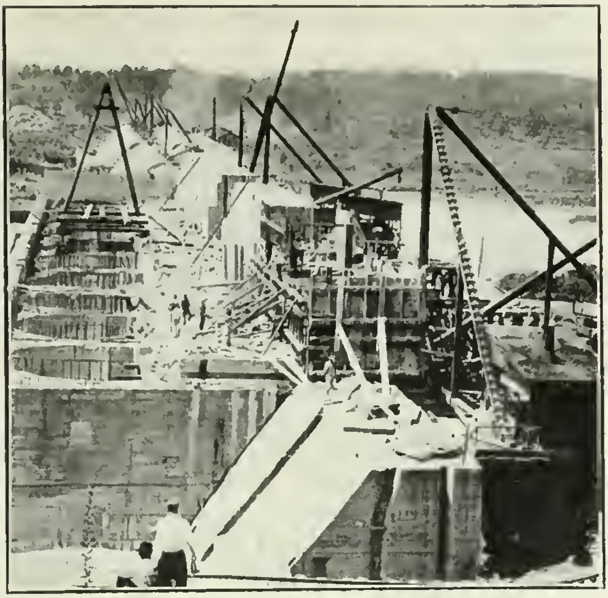
Two filler gates, 4 by 7 feet each, are provided in each unit. Screen racks are also provided, supported by reinforced concrete piers, and protected at the top with a reinforced concrete curtain wall.

The turbines are designed to run at a speed of 100 r.p.m. and will furnish 3,600 b.h.p. at 35 feet head with an efficiency of 86 per cent.

The governors are located on the main floor, and arranged to be controlled from the switchboard, altho hand control is also provided. They are of the oil pressure double floating lever type, with a central oil pumping and pressure system, operating normally at 165 pounds pressure. They are designed to control the speed within very narrow limits, and eliminate entirely any hunting or racing tendency which causes so much wear and tear on the gate rigging.

The electrical apparatus of the first installation consists principally of five vertical type, revolving field, 3-phase, 40-cycle, 2,300-volt, 3,100-k.v.a. (at 75 per cent. power factor) generators, two vertical type 300-k.w., 300-r.p.m., 125-volt exciters, three transformers, 6,200-k.v.a., 3-phase, stepping up from 2,300 volts to 66,000 volts.

The transmission line is being built at present to Columbia, and consists of Milliken type, galvanized steel, double circuit

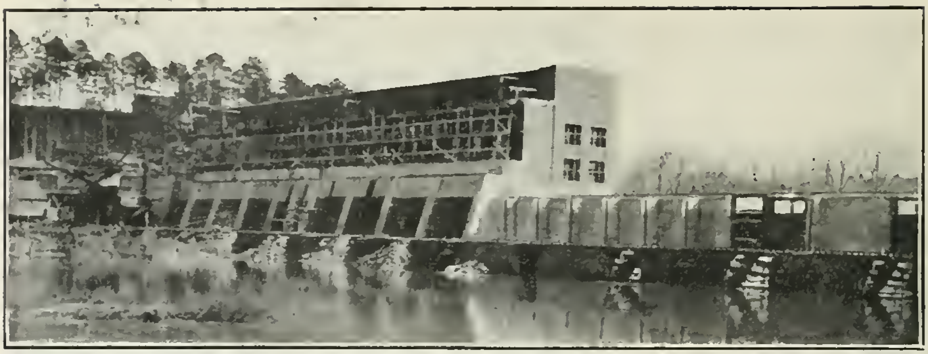


POWER HOUSE *substructure on August 11, 1913. Note completed spillway sections of dam in the background.*

towers. The towers are spaced approximately 9.5 to the mile, with a height to the lowest cross-arm of 50 feet. In the city, latticed steel poles are used, spaced about 200 feet apart. Stranded medium hard drawn copper wire No. 1/0, 17-strand is used for power circuits, with a ground wire of 5/16-inch, 7-strand copper-clad wire of 30 per cent. conductivity. A telephone circuit of No. 10 copper-clad wire is run on a separate pole line, 35 feet from the center line of towers, with poles spaced 40 feet to the mlie. Thomas suspension No. 118 insulators, four in series, for suspension sets, and five in series for all strain sets, are used on power circuits.

A substation located in Columbia has been built, which will also act as a distributing station for the present hydro plant and steam plant of the Columbia Railway Gas & Electric Company. All the power generated by these two plants, and the plant at Parr Shoals will be distributed from this station. There will be two distributing voltages 13,000-volt, 40-cycle, 3-phase, and 3,400-volt, 40-cycle, 3-phase. The latter is the present distributing voltage and phase of the Columbia Railway Gas & Electric Company. The building is of brick, with steel frame and concrete roof.

Authorization to proceed with the project was received in the latter part of June, 1912. Construction forces were immediately organized, camps built, wagon roads and railroads constructed in order to deliver material and plant as cheaply as possible. As the project was away from settlement of any size, it was necessary to provide accommodations for practically the entire force. At Parr Shoals the maximum of about eleven hundred men employed at one time with their families made a total population to provide for of about 1,500 people. Bunkhouses were provided for unmarried laborers, and houses having from one to five rooms were built and rented to the married men for from $2.00 to $12.00 per month. Four permanent houses were built on each job, for the future use of the power house operators, and were used during construction by the superintendents and engineers. Boarding houses, a butcher shop, bake shop, refrigerating and ice plant, and commissary were built. Great care has been taken to safeguard the health of the camps, pure filtered water and sewerage systems were provided, and a hospital, fully equipped, with a resident physician always in attendance. A sanitary inspector enforced all sanitary regulations. The wisdom of these precautions has been proved by the remarkable freedom from sickness in the camps. Malaria was very prevalent in the vicinity, but by using methods similar to those found so effective at Panama, this has given no trouble. For the protection of the camp, a fire brigade was organized, telephones and electric lights are also provided, and to keep the men contented, athletc sports have been encouraged, such as base ball, foot ball, tennis and trap shooting.



PARR SHOALS POWER HOUSE, *December 15, 1913, from upstream. Comparison of the two photographs will show the rapidity of construction.*

Work was started on the cofferdam at Parr Shoals the latter part of July. The first enclosure was completed in November, covering the site of the power house, sluice gates, and a section of the dam. The design adopted for the upper coffer consisted of a series of rock filled crib piers with 12-foot openings between, which were later closed by stop logs, or open cribbing, with the upstream face sheathed and toefilled. Later, and before the final closure was made, these openings were shot out, and the water passed thru to the sluice gates and temporary openings which had been left in the dam for this purpose. The balance of the cofferdams were usually a solid rock-filled-crib section, as this type can be built cheaper, and faster than the piers. A small amount of earth-filled-crib cofler was used. The coffer ranged in height from 6 feet to 27 feet, but usually was from 14 to 17 feet high.

Quarries and sand pits were opened, and very efficient stone-crushing and concrete-mixing plants were set up, having a capacity of 1,000 cubic yards of well mixed concrete per day. From the mixer the concrete was dumped in 2¼-yard buckets on flat cars, in trains of from four to six, and hauled by dinkies to site of work, and deposited in place by stiff-leg derricks. Eight locomotives of various tonnages from ten to forty, were used in this and on other features of the work.

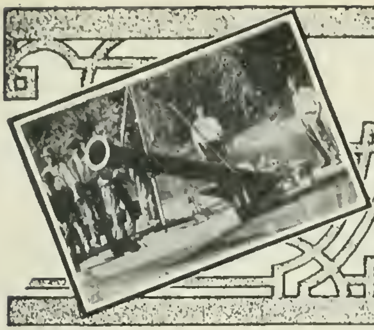
Concrete work commenced on February 5, 1913, and has continued practically uninterruptedly to date, practically closing the Parr Shoals dam except for temporary openings which cannot be closed until the work of raising and relocating about 5 miles of Southern Railway is completed.

The general scheme adopted was whenever possible to start the various features of the work at such times as would bring their completion as nearly as possible to the date of delivering power. In this way one of the most expensive items, that of interest during construction, is reduced to a minimum. Work on the substructure of the power house was started first; then the sections of dam, containing sluice gates aud temporary openings, followed by the main dam, substation, transmission line, power house superstructure, and finally power house equipment.

The plant is ready to deliver power, only about a year and a half from date of beginning work, a very short time for a development of this magnitude.

Mr. E. W. Robertson, of Columbia, is president of the Parr Shoals Power Company.

The entire work of engineering and construction except the raising of the Southern Railway is being handled by The J. G. White Engineering Company, of New York, and assistance in financing has also been given by them.



EDITORIAL

FLOOD CONTROL LEGISLATION.

The legislature of Ohio has recently passed "The Conservancy Act of Ohio," which is intended to provide the machinery for the formation of "conservancy districts" for the purpose of preventing floods, regulating stream channels, reclaiming overflowed lands, providing for irrigation and regulating the flow of streams by means of excavating and changing water courses, building reservoirs, canals, levees, walls, etc., and to maintain, operate and repair the same. The general plan of the bill is not far different from that of drainage laws generally, except that the powers conferred are somewhat more extensive. The method of establishing districts by petition of individuals or a public corporation is ample, and the financial and administrative duties of the board of directors are set forth wth sufficient detail for all ordinary purposes.

Experience under similar laws suggests two sources of possible difficulty. Any court of common pleas within whose jurisdiction any part of the area of the district is located may be selected as the one to whom a petition may be presented. An area may be covered by more than one district if it belongs properly to more than one. While the judges of the courts are instructed by the bill to keep watch of duplications of petitions and double inclusion of territory and to meet and adjust any difficulties which may arise on account of contests over or duplications of jurisdiction, it is evidently possible for serious conflicts to arise between parties operating on different plans and attempting to head each other off.

Again, there is no check upon the competency of the service of the boards of directors and their employes and no provision is made for proper consideration of the rights and needs of districts above or below any district formed. Neither is there any method of fixing what the proper limits of a district should be, and but one, apparently inadequate, method of settling claims for damages made by parties outside the district.

These difficulties are ordinarily not serious in a drainage law, because the ordinary drainage district extends little beyond the county in which the principal part of its area lies, and by providing that the court within whose jurisdiction the major part of the area lies shall be the recipient of the petition, there can be no conflict of jurisdiction. And the ordinary drainage problems are local problems, affecting little area outside their own district. But this proposed Ohio law is broad enough to take in a river system covering several counties or any part of such a drainage area.

In order to correlate such large projects properly there should be some provision in the law whereby the suitability of the boundaries of the district, the sufficiency of the plans, and their conformity with the necessities of adjoining districts and localities farther below and perhaps above, can be passed upon by a state board having power to consider the problems of the state and of its various main streams and their watersheds. Such a board could aid largely in securing competent service for the drainage districts organized under the proposed law as well as in making all the work in the state conform to the necessities of the state.

BUILDING AND MAINTAINING ROADS FOR THE TRAFFIC.

To prevent excessive wear of its new roads the commissioner of highways of the state of New York has adopted rules and regulations for their use, which contain such restrictions regarding weights and speeds as the following:

No projections of flanges, rings, lugs, etc., beyond tire surfaces; no vehicle weighing more than 14 tons; no weight on tire of more than 800 pounds per inch of width; no vehicle more than 90 inches wide except traction engines 100 inches; speed limits of 6 miles for vehicles with metal tires weighing over 6 tons and 12 miles with rubber tires, and 15 miles for vehicles of 4 to 6 tons weight.

These regulations seem to steer between the two limits of demand, on the one side that the traffic should be limited to the character of the road surface absolutely, and on the other that the road should be so constructed that it will stand any traffic which may offer, and thus to approximate the most economical and practical system.

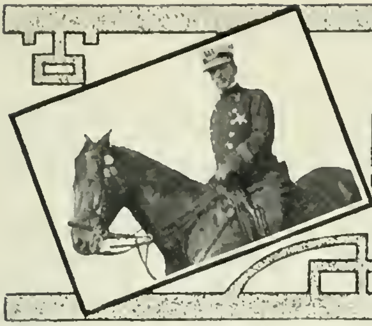
Limitation of traffic to the character of the road restricts development of the traffic, keeps farm products out of the best markets at the best times, restricts the kinds of such products which can be grown, by making traffic more or less difficult and increasing its expense.

Meeting the demands of the heaviest traffic imaginable enforces the construction of the most expensive pavements and bridges and thus costs more than the benefits possible in the utmost development of the traffic, with the exception perhaps of some such cases as hauling of mine or factory products.

The best results are obtained by following a middle course, the exact location of which must be determined by the demands of the locality, and the upper limits of allowance of high cost pavements are set by the New York regulations. These really apply to main roads and the branch roads and neighborhood roads do not require such high limits. Indeed, it might be well to limit still more the weight and speed of vehicles used on the less traveled roads, particularly the speed until such time as the economics of the question have been fully developed and we know more than we do now of the effect of road improvement upon the development of the country and the future increase in traffic.

Much money has been wasted by building roads too good for the traffic to be carried and quite as much money has been wasted by building roads too light for the legitimate traffic developed by the improvement, which must afterwards be rebuilt at large additional cost. We have learned some expensive lessons on this line.

The state of New York may still waste money if it attempts to build all its state and county roads equal to the standard practically set by the regulations mentioned, for the amount of such traffic over many will not warrant the highest class of road surfaces. It will even be better to increase the cost of maintenance as may be necessary for the small amount of such traffic carried if a double set of traffic regulations is not deemed advisable.



QUESTION DEPARTMENT

Method of House Numbering

McDonald street begins four blocks south of George street, the east and west center line, and runs south. Should the house numbers begin with 100 or with 500? Similarly, Nelson street begins six blocks south of George street. Should its house numbers begin with 100 or with 700?

M., Town Engineer,
———, N. S.

If the numbers are to show the number of blocks from the central axes of coordinates the house numbers should run without reference to the point of beginning of the street and, according to the system used in the town, McDonald street house numbers should begin with 501.

It is noted that the numbers begin with 101 at George street, the east and west base line, so that Number 200 is one block from that street, 300 is two blocks away, etc. This has the advantage that the numbers in the first block are all 100 plus, those in the second block 200 plus, etc. The writer prefers the method of beginning numbers with 1 at the base line, because then they represent the distance from the base line street, 250 being 2½ blocks from the base line, etc.

The real difficulty in the town under consideration is the method of numbering East River road. This is a diagonal street beginning at the same point that McDonald street begins, four blocks south of George street, the east and west base line, and one block east of East River, the north and south base line. If it is to be considered as an east and west street, tho it runs southeast, its house numbers should begin with 200 under the town system, but if it is to be considered as a north and south street its numbers should begin at 500, the same as McDonald street. This must be determined according to the relative importance of the streets, or possibly by the name.

East George street runs east from the river. East River is apparently a street on the east side of the river and runs north and south and would be numbered as other north and south street are numbered. East River road, running southeast beginning one block east of East river, would probably be most easily kept straight if it were numbered as a north and south street. This double use of "East" will make difficulties in any event.

Where Should the Coagulant Be Added to Water

We should be glad if you will give us some information on a subject that is of vital importance to the city and citizens of this city at this time. This city uses water from one of its rivers for all domestic and manufacturing purposes. The water is pumped up into a reservoir and settling basin, from which it is filtered thru sand filters into a clear water basin, using an average for the year of a little over one grain of alum in solution per gallon of water for coagulation. Of course, the amount of alum added, from time to time, depends upon the condition of the water in the river. This alum solution at present is allowed to enter the flow pipe leading from reservoir to sand filters. It has been recommended that this alum should be added to the water just before it flows into the settling basin to allow some little time for proper coagulation. A so-called expert recommends that this alum be allowed to enter the suction pipe to the pumps at the river, thereby allowing the solution to flow with the water thru the pumps and 1,600 feet cast-iron pipe discharge before entering the settling basin. The question is, will not this alum solution going into the pumps and discharge pipe, day after day, be of serious injury to both pumps and pipe?

Your impartial reply to this will be greatly appreciated.

M., City Clerk,
———, Ga.

We shall be glad to publish statements from our readers of their experience in this matter.

The office of the alum being to coagulate certain classes of impurities in the water and put them in condition to settle out, it is apparent that the same should be added before the water has entered the settling basin. In this manner the solids which clog the filters will be removed in large part in the basin and the filters will be relieved of much work, will not be clogged so soon and need not be cleaned so often. Whether the reservoir should be used as a settling basin or whether special basins should be provided for the settling process must be determined from knowledge of the kind and purpose of the reservoir, ease of cleaning, etc., concerning which the question gives no information.

It is desirable to mix the alum with the water as thoroly as possible before the settlement is begun, and passage thru the pumps would do this, but passage thru the 1,600 feet of main might permit settlement in it which would clog the main and require cleaning at intervals. It is customary to add the coagulating chemicals just before the water enters the settling basin in such manner that they are thoroly stirred into and mixed with the water.

Makers of Patrolmen's Equipment

I wish the addresses of concerns making or selling police goods, such as clubs, cuffs and general patrolmen's equipment,

H. D. J., ———, Me.

Manufacturers of uniforms can doubtless supply all that is desired, such as M. C. Lilley & Co., Columbus, Ohio; Olhm & Co., Baltimore, Md.; Royaltou Woolen Company, 70 Worth street, New York; Wm. Shapiro, 587 Fifth avenue, Brooklyn, N. Y.; Wendell, Fay & Co., 82 Worth street, New York. E. B. Estes & Sons, 74 Warren street, New York, supply police clubs.

Municipal Central Station Heating for Small City

Can you tell whether municipal heating is an attractive proposition for a city of our size? We have two school buildings about eight blocks from the city water, light and power plants. It has been suggested that we utilize the waste steam from the power plant in heating our two buildings. It has also been suggested that the city furnish heat for the business section of the city which is located between our buildings and the power plant. Any information you can give will be appreciated. S., ———, Ind.

Some very successful small plants have been established and some have been failures. Good engineering in the design and construction and permanent, competent management are essentials.

A brief illustrated article in the February number of MUNICIPAL ENGINEERING will indicate the possibilities and some of the troubles. The question is well worth investigation, for which purpose an expert should be employed who would not be interested in the construction of the plant to such an extent as to bias his view of the subsequent operation. Distance is not so great a factor in computing efficiency as it was formerly, and there is often considerable economy in using the exhaust steam from a light, power or water plant.

Some years since MUNICIPAL ENGINEERING published quite full statistics of the plants then in existence. There are now many more, and the methods of design and construction have been well standardized.

Gifford's "Central Station Heating" ($4) will give much detailed information as to methods and results and some data as to cost of construction and operation and the determination of rates.

Well-Drilling Machinery Makers

This city is contemplating a change in the source of her water supply at the municipal water plant. We are at present pumping from the river, and contemplate changing to some drilled wills.

Could you kindly give me a list of names of people who make machinery or who have patents for this class of work.

We will need an outfit to pump about four and a half million gallons of water per day.

T., ———, Ky.

Prominent makers of such machinery are the American Well Works, Aurora, Ill.; Austin Mfg. Company, 910 South Michigan avenue, Chicago, Ill.; Keystone Driller Company, Beaver Falls, Pa.; Oil Well Supply Company, Pittsburgh, Pa.; Southern Well Works, Chattanooga, Tenn.; St. Louis Well Machine and Tool Company, St. Louis, Mo.

Methods of Street Lighting for Special Occasions

Will you kindly inform us where we may be able to obtain information relative to some of the more recent and more effective methods of special street lighting for specal occasons, such as conventons and celebrations, which may have been employed by some of the larger cities of the country?

For several years we have maintained on Nicollet avenue, our chief retail street, a system of overhead wire arches, bearing incandescents. These have ceased to be a novelty, and we have decided to discard them entirely. A committee of retail merchants of this association has been appointed to develop some more novel and less expensive plan for special illumination. You know that we have one of the best developed systems of ornamental light standards, covering practically our entire business district, to be found anywhere. What we seek now is an auxiliary and circus-sort of scheme for state fair and holiday week.

We shall be deeply grateful if you can refer us to any city which has accomplished anything striking along this line, and we thank you for any attention you may find it possible to give this communication.

E. C. HILLWEG, Assistant Secretary,
Civic and Commerce Association,
Minneapolis, Minn.

The various cities which entertained the Perry celebration with the rebuilt flagship of his little Lake Erie fleet, used methods of illumination which would give some excellent ideas for special lighting for special occasions, notably Cleveland, Buffalo, Erie and Milwaukee. New York City has had some wonderful results from special lighting plans for celebrations. St. Louis has done some fairly good work of this sort. Denver and New Orleans could also give some ideas. The expositions, great and small, are also sources of good suggestions. Possibly the lighting plans of the San Francisco Exposition are sufficiently developed to afford some assistance.

This sort of lighting has become almost a necessity of special occasions and is worthy of the special study of an illuminating engineer of artistic tendencies. The best results will be obtained by the employment of such an expert to work out the plans and their details after the necessary conferences with those interested in the results and in paying the bills.

The secretary of the Illuminating Engineering Society, I. S. Israel, 29 West Thirty-ninth street, New York, may be of assistance in this matter.

Ordinance Governing Electric Current Meter Inspection

I would like to have a copy of a representative ordinance governing the inspection of watt-hour meters if you can furnish the same. If you have not this, can you give me some information regarding the percentage of error that is allowed in such a meter, and can you inform me as to whether or not it is customary to test at three loads (light, medium and heavy), and whether it is customary to require the reading to be correct, within the allowed percentage of error, at each of these loads. Would also like to know what would be considered as light load on a 5-ampere house meter.

S., City Engineer, ———, S. D.

The Massachusetts law on this subject may serve as the basis for a city ordinance. It reads as follows:

"A customer of an electric lighting company or such company may apply to the board of gas and electric light commissioners for an examination and test of any meter in use upon a customer's premises. The board shall forthwith cause to be made by a competent and disinterested person such examination and test of said meter as in the judgment of the board is practicable and reasonable, and shall furnish to the company and to the customer a certificate of the result and expense thereof. If upon such examination it appears that the meter does not register correctly, the board may order the company to correct or remove such meter and to substitute a correct meter therefor. All fees for examination and tests shall in the first instance be paid by the person or company making application therefor; but if the examination or test is made at the request of a customer and the meter is found to be incorrect because too fast the company shall pay such fees to the board, to be repaid by it to the applicant. A meter shall be deemed correct for the purposes of this section if it appears from such examination or test that it does not vary more than 5 per cent. from the standard approved by the board."

In the latest report of the Massachusetts Board of Gas and Electric Light Commissioners are reports of tests of six five-ampere meters. Their percentages of error were as follows:

No. of inspection.	At 1/5 load. % Fast.	At 1/5 load. % Slow.	At ½ load. % Fast.	At ½ load. % Slow.	At full load. % Fast.	At full load. % Slow.
399.......	396	1.8	...	0.5	0.6	...
399.......	2.0	...	1.7	...	2.3	...
401.......	...	1.0	0.7	...	0.5	...
414.......	0.6	...	...	0.1	...	0.1
422.......	3.3	...	1.3	...	3.0	...
428.......	...	1.7	0.3	...	...	0.1

Garbage Disposal for Small City

This city is desirous of securing access to information in relation to garbage disposal plants which may have been published in your magazine within the last two or three years.

This city, as you probably know, has about 20,000 inhabitants and the garbage disposal problem is becoming a pressing need.

If you have in convenient form a list of cities of about this size who are operating plants, we would be appreciative of a copy of the same.

R. K. P., City Attorney, ———, Ore.

Following are the articles which have appeared in MUNICIPAL ENGINEERING regarding garbage disposal within the period mentioned:

In vol. xlii: Garbage Disposal for Small Cities, p. 250; List of Articles on Garbage and Refuse Collection and Disposal, p. 252; Statistics of Proposed Garbage Collection and Disposal, p. 320; Automobile Garbage Trucks in Cleveland, p. 328; Disposal and Collection of City Wastes, p. 385; Street Cleaning, Garbage and Refuse Collection and Disposal, p. 468.

In vol. xliii: Motor Garbage Trucks in Homestead, Pa., p. 53; Ordinance Requiring Weed Cutting and Refuse Removal, p. 254; An Individual Garbage Destructor, p. 257; Chicago Garbage Removal, p. 327; A Book on Garbage Destruction, p. 329; Methods of Garbage Collection, p. 391; The Collection of Refuse, p. 414.

In vol. xliv: Automobile Truck for Refuse and Street Sweepings, p. 119; Statistics of Proposed Garbage Disposal, p. 229; Garbage Disposal in Canton, Ohio, p. 241; Makers of Garbage and Refuse Destructors, p. 330; Information About Garbage Disposal, p. 519; The Question of Garbage Disposal, p. 572; Refuse Destructor at Halifax, N. S., p. 582; Garbage Destructor for Los Angeles, p. 584.

In vol. xlv: Garbage and Waste Disposal, Mixed Method, p. 25; Sewage and Garbage Disposal Methods, p. 43; Motor Trucks for Removal of Garbage, p. 260;

Results of Garbage Reduction at Columbus, Ohio, p. 321; Free Garbage and Refuse Collection in Schenectady, N. Y., p. 366; Facts About Collection of Garbage and Refuse, p. 366; The Destruction of Garbage on the Premises, p. 402; Garbage Disposal in Chicago, p. 441; Refuse Disposal Methods as Adapted to Chicago, p. 528; Recoverable Values of Municipal Refuse, p. 550; Destruction of Garbage on the Premises, p. 562.

In vol. xlvi: The Refuse Destructor at Northampton, Eng., p. 8; Municipal Garbage Reduction and Destruction Plants, p. 35, gives the list desired; Incinerating Plants Producing Power, p. 40; The Refuse Incinerator at Moose Jaw, Can., p. 161.

Specifications for Laying Natural Gas Pipe

I am desirous of obtaining a specification for the laying of natural gas pipe in city streets, especially in reference to provision for temperature contraction.

A company supplying natural gas to the town laid, last summer, 1,000 feet of 3-inch pipe, 18 inches below the surface of ground, with but one expansion joint. When cold weather came the pipe broke from some cause, and the escaping gas entered a dwelling and caused an explosion.

I have looked over back numbers of Municipal Engineering, but think books mentioned refer only to manufactured gas plants. A., ———.

Can any of our readers supply such specifications? The specifications for laying natural gas pipes would ordinarily be less strict than for artificial gas because the trouble from condensation is less and so the provisions for drainage of pipes are not so elaborate. Pressure on distribution pipes are no greater. The supply mains, however, are under greater pressure and must be more carefully laid and with stronger joints. Provision for expansion and contraction is seldom necessary in city streets because the pipes must be laid deep enough to get them beyond dangerous variations in pressure. In a cold climate the pipes should be laid deep, and this is probably the defect in the specifications under which the pipe in question was laid.

In the open country natural gas pipes are often laid uncovered or very slightly covered, but the departures of the pipes from straight lines give opportunity for expansion and to some extent for contraction. Breaks in the pipes are not infrequent, but are seldom dangerous.

In the early days of natural gas there was much fear of such explosions as that named and some city ordinances provided systems of protection, instead of requiring improvement of the specifications. The Indianapolis ordinances provided the following safeguards:

"All pipes, mains and apparatus of every kind and description used by any corporation, individual, firm or company accepting the provisions of this ordinance shall be of the most approved design and quality. All pipes shall be standard weight."

"The mains and service pipes shall also be so laid in the public streets, alleys, avenues, lanes and public grounds of said city as to prevent the escape of gas and in such manner as that the use of the gas will be safe."

"In order to provide against gas that may escape from high or low-pressure mains and pipes from passing into cellars, sewers and buildings, it shall be and is hereby made the duty of all such corporations, companies, firms and individuals laying mains and pipes for carrying gas as aforesaid when deemed necessary by the city civil engineer and said common council and board of aldermen to provide, furnish and supply a system of escape pipes to be approved by the city civil engineer and said common council and board of aldermen sufficient to carry off any and all gas which may leak or escape thru defective joints, service pipe connections or defects in the mains. Gages showing the amount of pressure on all natural gas lines shall be erected at the expense of such corporations, companies, firms or individuals, and shall be open at all times to public inspection, and located at such points as may be directed by the city civil engineer when concurred in by the common council and board of aldermen, and it shall be and is hereby made the duty of said engineer to notify such corporation, company, firm or individual to reduce or cut off the pressure upon such line or lines as the public safety from time to time may require."

"The top of any and all natural gas mains laid under the provisions of this ordinance for the purpose of conveying or supplying natural gas in said city shall be placed at a depth of not less than 3 feet below the surface."

"The maximum pressure allowed on any or all high-pressure mains within the limits of the city of Indianapolis shall be 20 pounds per square inch. The maximum pressure allowed on any and all low-pressure mains within the corporate limits of said city shall be 8 ounces per square inch," with a provision for special permission for higher pressures under special precautions. All mains were tested before use at 80 pounds per square inch for high-pressure lines and 10 pounds for low-pressure lines, service pipes being tested for the same pressures as the mains to which they were attached.

The escape pipes described were put in and were of some use in leading gas leaked from mains to standpipes, where it could be burned if the leakage were constant, but as the supply of gas was reduced and it became more valuable leaks were stopped, and in the later years there was no more trouble than on artificial gas lines, where tight joints were required by reason of high cost of leakage.

The development in recent years of high-pressure distribution of artificial gas has brought about an improvement in specifications for materials and workmanship and in design of the high-pressure lines, which is more elaborate than the ordinary requirements made of natural gas companies where natural gas is abundant and cheap. These specifications should be used for natural gas construction.

Street main joints are illustrated in a paper by W. A. Learned before the New England Association of Gas Engineers in February, 1903.

In replies to questions given by seven prominent gas engineers, provision for expansion where lines cross bridges and are therefore more subject to changes in temperature is made in high-pressure gas distribution mains by two, but not otherwise; three use expansion joints, one occasionally and one every 500 feet; two make no special provision for expansion.

Tests in St. Louis of cement joints and others indicated great difficulty in making tight joints on high-pressure gas mains.

Earth as a Paving Material

We have understood that there was a pavement which is made out of common dirt by mixing it with some sort of material, and we would be pleased to know if you can give us the address of the firm handling this kind of pavement? J., City Attorney,
———, Kan.

Possibly the bitu-mass pavement developed by the American Paving and Manufacturing Company of Indianapolis, Ind., is the one referred to.

In the beginning it was assumed that this pavement could be made out of old macadam or gravel streets by digging up the gravel or stone, running it thru the machine, heating and mixing it with bituminous material and redepositing it on the street and rolling it into place. It was soon found that this would not give a sufficiently solid pavement, so that it was necessary to add what was called grit to the material found on the street. Still later it was found that a uniform pavement could not be produced without using a more uniform material, so that they used new material entirely.

Possibly the petrolithic pavement is the one referred to. This process is reported to work best in sandy soil, but has been applied to all kinds. It consists in compacting the sub-soil as thoroly as possible by means of a special tamping roller and treating the roadway so prepared with oil, alternately, until a comparatively hard bituminized surface is secured, as described in MUNICIPAL ENGINEERING, vol. xlv, p. 246.

Directory of American Cement Industries

We would like to inquire if you have as yet published the 1914 directory of the American cement industries, and if so what is the price of the same?

G. L. SIMONDS & Co.,
Chicago, Ill.

No recent edition of the Directory of American Cement Industries has been published. The *Cement Era*, 1207 Morton building, Chicago, Ill., publishes a Directory of American Cement Manufacturers which gives full information about cement factories, companies, brands and sales agents. The 1914 issue is out and costs $1.

Drill for Inspecting Cement Pavements

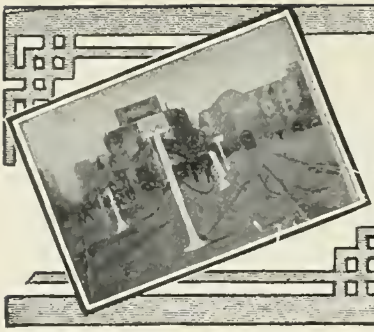
We have an inquiry for a tool which is used to test or rather inspect cement roadways.

We understand this is in the shape of a hollow drill which turns with a handle and takes out a plug the entire thickness of the cement, grinding about ½ inch diameter.

Perhaps you can put us next to such an article and let us have a circular of same.

JONES HARDWARE COMPANY,
Richmond, Ind.

A small core drill is what is described, and it can be obtained of the manufacturers of such drills, among whom are the American Diamond Rock Drill Company, 90 West street, New York; American Drill Works, Aurora, Ill.; Cyclone Drill Company, Orrville, Ohio; Ingersoll-Rand Company, 11 Broadway, New York; Sullivan Machinery Company, People's Gas building, Chicago, Ill.



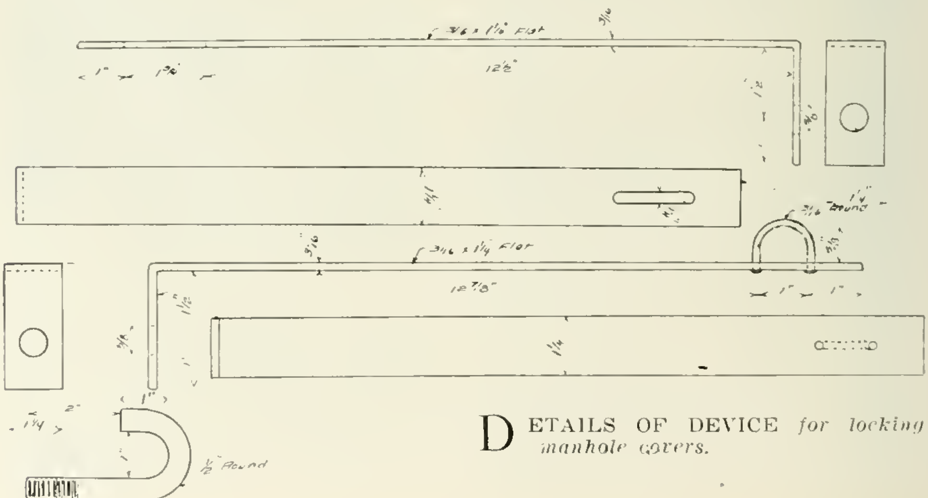
WORKERS IN THE FIELD

Device For Locking Sewer Manhole Covers.

The Editor of Municipal Engineering:

Sir—Some time since the writer described a device which has been used successfully in this city for locking the covers of sewer manholes in place so that boys and others could not remove them and deposit rubbish, etc., into the smaller sanitary sewers and cause them to become clogged. As shown on the accompanying plan it consisted simply in two wrought iron hasps, each held in place at the side of the casting by a one-leg U-bolt, and meeting at the center of the cover where they were fastened by means of an all-brass, or other non-rusting padlock. As stated in the above mentioned article, this scheme worked well on those castings where it was necessary to raise the lid something like two inches vertically before it could be pushed laterally off of the frame. However, a great many of our manholes, especially on the older sewers, are capped with a casting so arranged that it is only necessary to raise the edge of the lid from one-half to three-quarters of an inch to be able to shove it off of the frame. With the class of mechanics one usually gets to do this kind of work, it is practically impossible to get a close enough fit with the hasps but that one edge, at least, of the lid can be lifted a half inch or more, especially if the castings vary slightly in size. So it was deemed expedient to try some other arrangement, and the following method was devised, which does the work and is cheaper than the first device.

Instead of using hasps, three short pieces of open link chain are used. They are fastened to the frame by eye-bolts set in holes drilled in the side of the casting and meet at the center of the lid, where they are fastened with a suitable padlock as in the former case. The eye-bolts are spaced equi-distant around the circumference of the outside of the casting, and are so placed vertically that when the lock is in place the chains are as tight as is possible to get them. That is, the final adjusting is done in spacing the last eye-bolt, for the reason that the lengths of the links in the chain vary considerably. In this way, tho the lid may be lifted vertically enough to clear



DETAILS OF DEVICE *for locking manhole covers.*

the seat on the frame, it is impossible to shift it very far laterally, for the reason that the straight line distance between any two eye-bolts is less than the diameter of the lid. The disadvantage of this scheme over the former is that three holes are required to be drilled in the castings instead of two, but this is more than offset in the amount of blacksmith work necessary to be done.

With the first device used it was found that they could not be put on the manholes at a cost much less than $2.00 each, which included the padlock and everything. A machinist was paid 60 cents per hour for drilling the holes and placing them, and it took about an hour for each one, including time lost moving. With the latter method the work was done by a regular employe of the city, who, by the way, was a first class man for that sort of work. He did all the blacksmith work as well as the drilling, and, including the cost of a good secondhand ratchet drill, these last twelve locks were placed at a cost about 80 per cent that of the former. The following data give the cost of making and putting in place twelve complete fastenings:

Chain	$ 2.20
Material for eye-bolts, scrap	0.00
Padlocks	4.80
One man, blacksmith and machinist, 3½ days at $2.75	9.63
Total cost for 12	$16.63
Each	$1.39

The outside diameter of the castings was about twenty-seven inches, so each piece of chain was about fifteen or sixteen inches in length.

The locks were a regular fifty-cent Corbin lock, all brass except the eye, which was steel. This particular lock was selected because the keys were flat and so arranged that by filing out all notches between the two exterior notches on each side, any one key could be made into a master key that would open all the locks. On the first set of fastenings put on, each lock could be opened only with its particular key. These were numbered and tagged, but upon using them the first time after they had been placed it was found that the tags had come off while being carried in the pocket, and it was necessary to try each key in each lock until the proper one was found. Hereafter all locks will be of one pattern so that one key will open all.

It took two and one-half days to put the fastenings in place on the castings. One reason for taking so much time was that most of the manholes were located on the outfall sewers and were in inconvenient places to get at. Also they were scattered from one side of the city to the other and considerable time was lost in moving from place to place. The castings were generally about one and one-half inches in diameter and the drill bit was long, and for that reason care had to be exercised in working the feed screw to not buckle and break the bit. It was found that with a sharp bit a hole could be drilled in about ten minutes, tho after the bit had become dull, or when a particularly hard casting was encountered, it frequently took as much as fifteen minutes per hole. Had the bit been some larger, say five-eighths or half-inch, and with a short shank, I believe each hole could have been drilled in five or six minutes.

The ratchet was worked on the inside of the manhole, supported by blocking against the opposite side of the casting. In placing the first set of fastenings the drill was worked on the outside of the castings, employing what is known as an "old man" to support the ratchet. This was made from a piece of ½ by 3-inch flat and bent to fit over the top of the casting. It was necessary to use care and not feed the drill too fast, and even then considerable time was lost in taking the "old man" off and straightening its back.

E. W. Robinson, City Engineer,
Webb City, Mo.

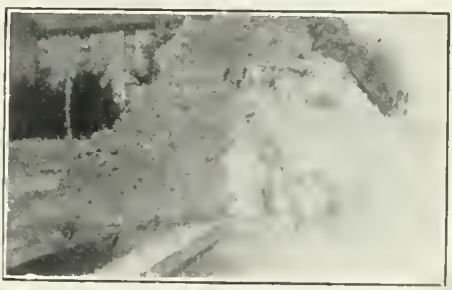
Difficult Cleaning of Sewers

The Editor of Municipal Engineering:

The picture herewith shows gravel which was removed from a section of our Washington street sewer from a 300-foot section of 15-inch pipe.

We later encountered much worse conditions in our Franklin street sewer. In this we found pieces of brick and wood, sand and gravel, besides tin cans and numerous other things. These obstructions were packed so solidly in the sewer that it was only after considerable effort that we were able to dislodge them.

In St. Paul street, a 12-inch sewer was laid several years ago with pipes made



GRAVEL *removed from Wausau sewer.*

ROOTS *removed from St. Paul street sewer, Wausau, Wis.*

from cement and sand; from this were taken the roots shown in the picture. This is the third time within the last eight years that we have been compelled to remove roots from this sewer. Previously we were compelled to dig up the sewer and break the pipes to remove the masses of roots that had formed. This year, however, we were successful in removing the larger portion of the growth with the sewer cleaning machine In fact, after we secured the machine from the Turbine Sewer Machine Renovating Company, of Milwaukee, we succeeded in cleaning most of the sewers with which we had experienced trouble. We have also used the sewer cleaning machine to good advantage in removing tar which had entered one of our sewers from our gas plant. The work of removing tar is somewhat difficult and unpleasant but by applying considerable water pressure to the machine, we were able to force the tar ahead of it and afterward to remove the tar from the manhole where the machine had been at work.

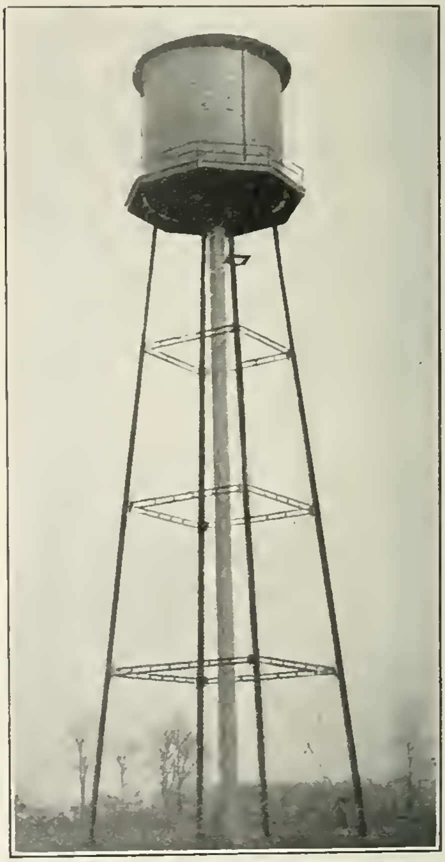
H. E. Marquardt, Comptroller,
Wausau, Wis.

The Water Works of Payne, Ohio

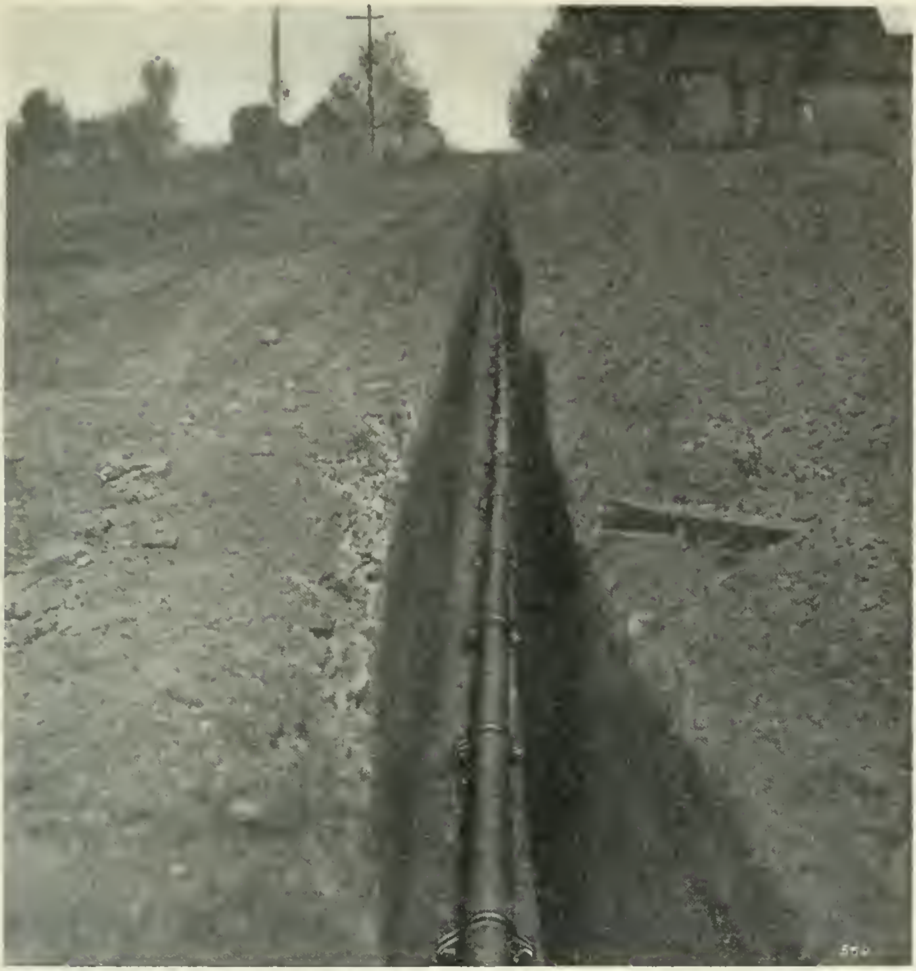
The Editor Municipal Engineering:

Sir—A description of the water works of Payne, Paulding county, Ohio, is herewith given, as it is of interest as to the methods of laying and testing the water mains. Universal pipe was used for the water mains, this pipe having turned male and female joints bolted together and held by two lugs on the side of the pipe. This construction was used thruout except at the hydrants, the hydrants having ordinary lead joints.

The village, which has a population of about 1,200, is supplied thru a distribution system having a total length of 18,000 feet of pipe, 34 fire hydrants and 23 valves. The system comprises 751 feet of 8-inch pipe, 2,177 feet of 6-inch pipe and 15,037 feet of 4-inch pipe. The fire hydrants are distributed in the manner shown on the plan and the town has excellent fire protection. Special attention was given to the placing of fire hydrants in the business district in order to get good fire protection there. At the same time special care was taken that no water mains be laid under brick-paved streets, but they have crossed the paved streets in a number of instances. In other parts of the town the brick streets do not extend the full width and as there was a large space between the sidewalk and the street, the water mains were laid in this space. This resulted in considerable saving in the laying of the mains and a ditching machine was used thruout the work except in some of the alleys. The pipe is laid in a 4½-foot trench, a Buckeye ditching machine being used. After inspection and testing of the pipe the back fill was scraped back with a team and scraper, and after the entire work was completed the top of trench was trimmed in a neat manner for future settlement. A large portion of the work was done during wet



WATER TOWER *and tank at Payne, Ohio.*

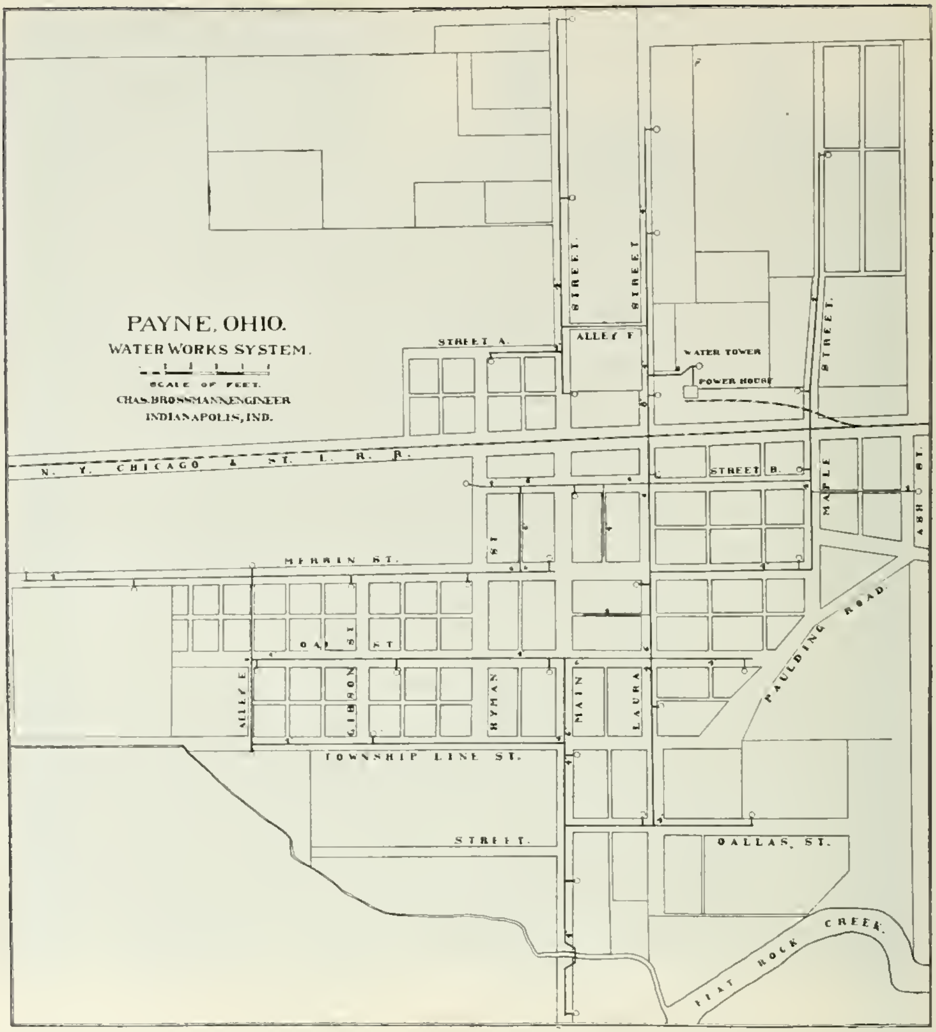


PAYNE WATER WORKS. *Pipe-laying and trenching; pipe ready for test.*

weather and in the winter season. The type of pipe, however, was favorable for laying in this kind of weather and no difficulty was experienced in getting a good installation. The work of laying was started at the water tower, connections being made to the well and pump at the plant. As each section of the main was laid the pipe was tested in open trench for leaks, the pressure being run to 160 pounds per square inch, and all work was tested in this manner except at a few points where it was necessary to back-fill at once. There were a few leaks, from which the amount of water was usually very small, and these were taken up very easily by tightening the joints. These few leaks were usually due to either the pipe not being cleaned or wiped before putting together or to the pipe not being properly lined up. The leaks, however, were easily and quickly taken up in most cases. As much of the trench was left open as possible before back-filling in order to get subsequent tests on the pipe after the first tests, as high as 4,000 feet being left open at a time. After the entire line was installed tests were then put on for a number of hours and as the water tank was completed before the pipe line, the tank was then filled and left standing. In a period of 12 hours no loss in pressure was shown on the gage from the tank. The line has been very satisfactory as to tightness.

The water tower and tank were furnished and built by the Flint & Walling Company and the tower is 100 feet high to the bottom of the tank.

The hydrants and valves are Ludlow, the hydrants being the standard 4-inch two-nozzle type. The threads on the hy-



MAP OF WATER WORKS *distribution system of Payne, Ohio.*

drants were made the same as the threads at Ft. Wayne, which is about 25 miles away, so that in case of a large fire outside assistance could be secured.

At the present time the village is using the water from a well at the electric light plant, the present pump in the plant being used to supply the system with water. This water is taken from a well about 300 feet deep, the limestone being struck at the depth of about 50 feet. The water at present is being used simply for sanitary and sprinkling purposes, as the original plans contemplate the installation of a well and an electrically driven pumping station away from the more thickly populated district of the town. The entire distribution system cost $10,765, which included all pipe, hydrants, valves and laying of same. The engineer's original estimate on the distribution system was $10,818. The water tower and tank cost $3,175. The contemplated cost for all work, including the proposed electrically driven pump, will be in the neighborhood of $17,000 when the entire plant is completed.

The writer, Merchants' Bank building, Indianapolis, Ind., was consulting and designing engineer and the pipe work was installed by the National Company of South Bend, Ind.

CHARLES BROSSMANN,
Consulting Engineer.
Indianapolis, Ind.

WATER

Water Works of Spokane, Wash.

The plan of the Spokane water works is somewhat complicated, due largely to the desirability of dividing the area to be served into one low, two intermediate and one high service district, the extremes of elevation being 1,780 and 2,400 feet above mean sea level.

The main pumping stations are located on the Spokane river east of the city limits, where the water is taken from two wells, each 30 feet in diameter and 39 feet deep, having steel casings perforated with ¾-inch holes in the lower 10 feet and brick walls above. There is plenty of water in the strong flow in the coarse gravel stratum reached by the wells, pumping at 35,000,000 gallons a day from one well only lowering the level 44 inches. There is a variation of level in the water of 14 feet at different seasons of the year.

The old pumping station, built in 1894, with several additions since, contains seven 54-inch and two 60-inch turbines built at several dates from 1889 to 1907, supplied with water power from a dam about a half-mile above the station. These turbines drive two 30-inch Morris centrifugal pumps, which together can lift 57,600,000 gallons a day from one of the supply wells into three concrete suction wells of 8 by 10 feet dimensions, with an average total head of 20 feet, nearly equally divided between suction and discharge; also 12 Holly pumps of 2,500,000 gallons rating and one of 4,500,000 gallons, which pump into the low-service mains under a pressure of 115 pounds, 5 being connected with a 24-inch main and 11 with a 36-inch header, which branches into a 24 and a 30-inch. Four of the pumps are also connected with a 28-inch intermediate-service main, which they supply under a pressure of 170 pounds.

A new pumping station was built in 1910 near the old one, which has also been added to since and now contains four units, each driven by a 900-h.p. induction motor and containing two multi-stage centrifugal pumps direct connected to the shaft, the total pumping capacity of the new station being 50,000,000 gallons a day. The maximum suction lift of these pumps is 16 feet, and they are connected with both the low and the intermediate services; each thru a 30-inch main. The pumps of each unit are so connected that they can be two-staged when pumping into the intermediate service, this reducing their pumping capacity one-half. One of the accompanying photographs shows the interior of this station.

All the mains—two 24-inch, 28-inch and two 30-inch—extend west and southwest about two miles before they reach any material part of the distribution system.

The 30-inch main of the low-service system connects with both bays of the low-service reservoir, shown in one of the photographs. This is located at Ninth avenue and Pine street, in the southern part of the city, is of concrete in two sections, mainly in solid rock excavation and has an area of 2.6 acres and capacity of 15,000,000 gallons. The 24-inch main of the intermediate service (a branch of the 30-inch supply main of this service) is connected with each bay of the reservoir thru 8-inch pressure regulating valves, which discharge when the pressure in that main is 10 pounds above normal. The water surface in the reservoir is at elevation 2,114, about 220 feet above the central part of the city. In the far northwest part of the service district is the Audubon standpipe of concrete with overflow into a near-by sewer.

There are five of these standpipes, each 30 feet in diameter and 70 feet high and of 370,000 gallons capacity. Two of them are connected with the intermediate distribution systems. The Kenwood standpipe of concrete at Cincinnati street and Queen avenue, is in the extreme northern part of the city and is the regulator for the small northern intermediate pressure district. Its water line is at elevation 2,144. The Cook Hill standpipe, of riveted steel, at Grand boulevard and Fourteenth avenue, near the low-service reser-

SPOKANE WATER WORKS. *View of new municipal electric pumping plant. This plant operates alongside an older municipal water power pumping plant and purchases electric current from a company operating a large hydro-electric power plant.*

voir, serves the southern intermediate district. Its water line is at elevation 2,287.

The Twenty-ninth avenue standpipe, of riveted steel, at the corner of Scott street, in the extreme south end of the city, serves the high-pressure district at the water line elevation of 2,441 feet. This high-service district is supplied with water by the high-service pumping staion located at the Cook Hill standpipe. Two 500,000-gallon pumps run by electricity lift water 8 feet from a small concrete well fed by the 14-inch line leading to the standpipe and pump it into the high-service system of distribution at a pressure of 103 pounds.

There is also the old Cannon Hill standpipe built in 1898, which is kept full with water line at elevation 2,217 and is ordinarily shut off from the distribution system.

There are two small pumping stations built in 1900 and 1903 for the purpose of taking water from the low-service distribution system and raising it to the intermediate system. These are now held in reserve and are not in regular use, especially in view of the construction of the new reservoir at Ray street and Twenty-fourth avenue on one of the branches of the new 30-inch supply main for the intermediate system.

The low service supplies most of the city, including the business and manufacturing sections and large residence sections at elevations from 1,780 to 2,050. The intermediate service supplies sparsely settled to moderately well built up sections between elevations 2,000 and 2,250. The high service supplies a small residential section which has elevations as high as 2,384 feet above sea level.

The engineers of the National Board of Fire Underwriters recommend a high-pressure fire-main system in the business section separate from the low-pressure distribution system, but connected with a supply main of the intermediate service so that it will have the pressure due to the higher elevation of its regulating reservoir and standpipes.

The city is improving the distribution by the addition of some cross lines of larger sizes than the ordinary street distribution mains so that pressures and deliveries at times of draft for fires will be equalized and improved and the underwriters have less than the usual number of recommendations of improvements of this sort.

Power Generation and Transmission at San Francisco Exposition

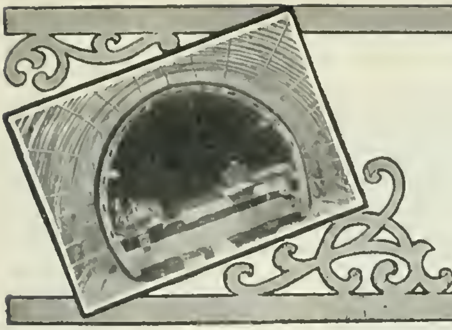
More than a dozen large firms have contracted for space in the Panama-Pacific International Exposition at San Francisco in 1915 in which to install engines built on the Diesel principle. These exhibits will occupy a central space in the great Palace of Machinery, and will be under operation thru connection with electric generators or other machinery for the purpose of showing the efficiency and economy of working. This ingenious motor is adapted now to railway traction. The engine, which uses crude petroleum as a fuel, has shown marked superiority in economy of operation over any form of steam-driven engine on board ships, particularly those running on routes where a supply of petroleum is available.

A large amount of exhibit space in the Palace of Machinery has also been spoken for by the manufacturers of steam turbines and unit type plants, the latter consisting of compact boiler, superheaters and engines. In the electrical department will be demonstrated the latest apparatus for the transmission and control of electric currents amounting to 1,000,000 volts or more.

Ornamental Lighting for Alhambra, Cal.

The city of Alhambra, Cal., installed about six miles of ornamental lighting last year. The post used was designed by R. H. Blacklidge, city engineer, and is shown in the accompanying photograph.

SPOKANE WATER WORKS. *The low-service reservoir supplying the lower sections of the city, including the main business and residence sections. Of concrete, with two bays and supplied by pumps at the river above the city.*



SANITATION

Pollution of Scioto River at Columbus, O.

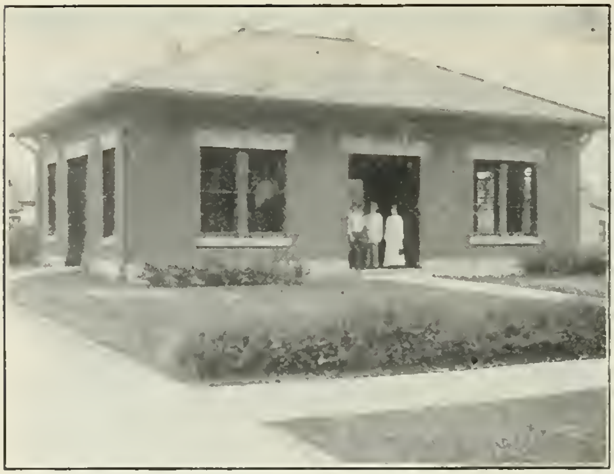
The report of C. B. Hoover, the chemist in charge of the division of sewage disposal at Columbus, O., for 1913, makes it evident that the sewage disposal plant now in operation treats only part of the polluting matter tributary to the stream, so that while the average discharge from the filters "probably would have been sufficient to prevent offensive conditions in an unpolluted stream" with the large flow of sewage in August, 20,990,000 gallons a day maximum and 18,400,000 gallans mean, and the low average flow in the river, probably less than 50,000,000 gallons a day, the condition of the stream was far from satisfactory.

The year was a very troublesome one. Heavy rainfall in the first four months was followed by low water for six months and heavy rainfall in November resulting in stages above normal in the river for the last two months. March was memorable for the heaviest rainfall and greatest flood the Scioto river has ever known, but the sewage purification plant was so well protected by levees that the damage to it amounted to a very few hundred dollars. The plant was not in operation so that there was no inconvenience on that score. The plant was shut down in October, 1912, and was not again put in operation until the middle of May, 1913. One of the accompanying photographs shows a flood which occurred during the construction of the plant and before it was wholly surrounded by levees. The 1913 flood reached nearly to the top of the levees shown.

Lack of funds and the greater dilution and less nuisance with discharge of raw sewage into the river during the winter months are assumed by the municipal authorities to be sufficient reasons for stopping the operation of the plant in cold weather.

The east side pumping station lifts the sewage from the eastern district over a divide into a branch of the main system. It was in operation in January and February not at all, but one day in March, 3½ days in April, all but one to 4 or 5 days in

FLOOD IN SCIOTO RIVER *before completion of works and protecting levee. Latest flood approached top of finished levee in background.*



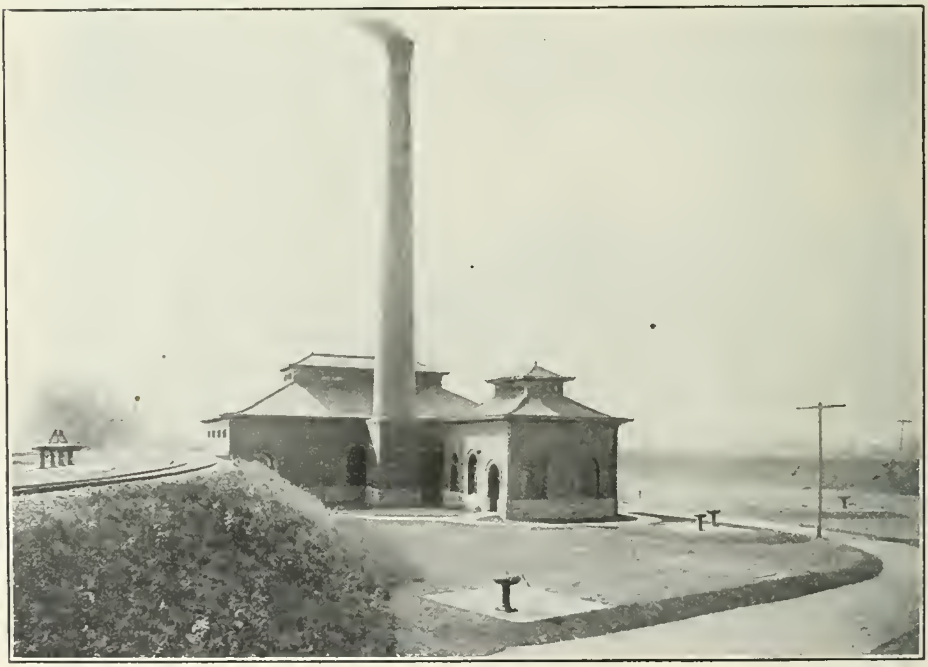
EAST SIDE PUMPING STATION *of Columbus sewage disposal. Electric power pumps.*

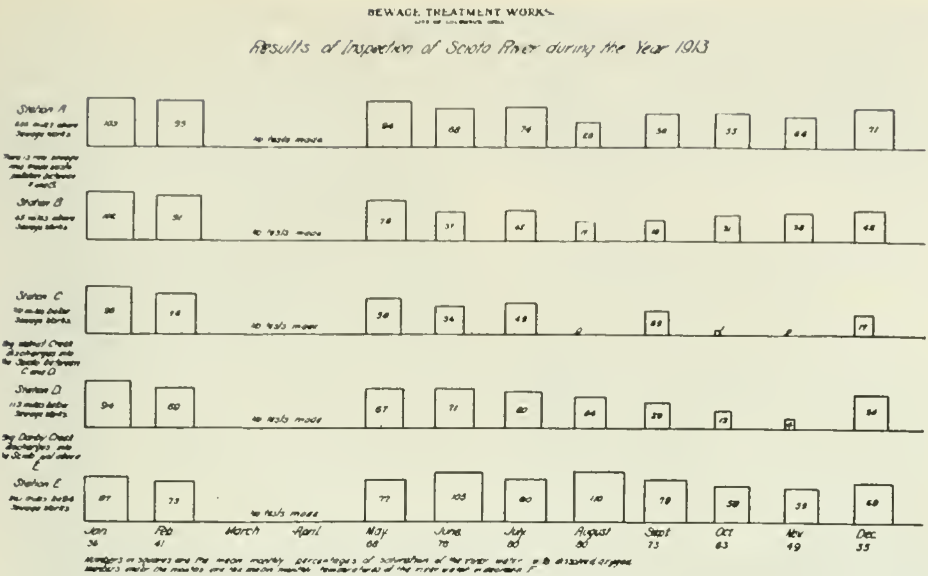
each month from May to October; 16 days in November and 14½ days in December. The rest of the time the sewage ran into the river directly at a point opposite the main pumping station. On account of insufficient pumping equipment at the east side station more or less sewage discharged into the river thru this relief outlet practically every day in the year, causing material pollution of the river by this raw and concentrated sewage.

The waste liquors from a large meat packing establishment are discharged into the river a short distance away and are probably much more responsible for the offensive conditions in the river than the effluent from the sewage treatment plant.

There are some 25 points at which the storm sewers overflow into the river, the sewage at ordinary times running into the intercepter and finding its way, with the above leakages, into the sewage tanks. When the storm water is above a certain volume the sewage overflows with the storm water, but diluted by it, directly into the river. When the connection of the sewer with the intercepter is clogged the sewage overflows directly into the river. This occurred in August in a sewer lo-

MAIN PUMPING STATION *of Columbus sewage disposal. A steam pumping plant.*





cated about 600 feet above sampling station A of the accompanying diagram, continuing for about 3 weeks until the obstruction could be all removed. This accounts for the high pollution shown in the diagram for August as compared with other months.

The main pumping station has the duty of raising all the sewage of the city some 18 feet into the outlet sewer connecting with the sewage disposal plant below the city, and of pumping out drainage water from the low west side when the water in the river is high enough to interfere with its drainage. It was in operation in January pumping west side drainage whenever the river was high, in February one day, March four days and April every day, pumping west side drainage; in May 15 days pumping west side drainage and 15 days pumping the city sewage into the outlet sewer; in June all the month taking west side sewage and as much from the east side as the pumps could take; in July all the month except 2½ days for repairs to steam lines and 2½ days in July and 2 in August because the apparatus for lifting sand out of the sand catcher was broken and there was no by-pass; in August all the month except as above; in September, October and November continuously but with reduced pumpage frequently because of numerous excessive storm flows in the sewer; in December continuously but with reduced pumpage because of shortage in operating funds. When the station is not in operation the raw sewage flows directly into the river.

After the first of May there was no day when a scouring velocity prevailed in the river and for much of the time there was nearly minimum flow. As a consequence the deposits in the river increased rather than diminished and the stream was seriously polluted thruout the year. Foul odors, gasification and floating sludge were present at times in the river from the relief outlet of the east side sewer to a distance of about 15 miles below the outlet of the sewage disposal plant. Wherever gasification was noted sludge deposits were found. No odors were detected where there was any residual dissolved oxygen, but absence of oxygen was not always accompanied by odors.

The zone of objectionable pollution is determined by the dilution, the oxygen requirements of the liquor discharged into the stream and the temperature. The percentage of saturation of the river water with dissolved oxygen was determined once each week during May to the middle of October and once each other month except March and April, following the great flood, at five points. The average results for each month are shown graphically in the accompanying chart, the figures in the squares noting the average percentages of saturation of the samples taken during each month as stated.

Mr. Hoover states in his report that if sufficient funds are supplied, the pollution from raw sewage can be very materially reduced and that the first and most pressing duty of the city is the prevention of the pollution from trade wastes and raw sewage above the disposal plant. He suggests again the desirability of installing improved treatment facilities at the sewage disposal works, on which he promises a special report.

Columbus is a growing city and it has

been obliged to spend vast sums of money in public improvements, and has still larger expenditures in view for flood protection and flood prevention, but it can hardly afford to skimp its sewage purification funds and must apparently increase, rather than decrease, its expenditures on this account if it is to keep its sanitary facilities equal to its material growth.

A German Garbage Collection and Incineration Plant

Furth, a Bavarian city of 70,000 population, a suburb of the city of Nuremberg, has had in operation for more than two years a municipal garbage incineration plant that is regarded as a model of its kind and which, in connection with a modern system of garbage collection, makes the disposal of garbage of that city not only the least offensive and most sanitary possible, but also a matter of actual, although small, profit to the municipality, according to the report of the U. S. Consut at Nuremberg. Other German cities have excellent garbage incineration plants and still more almost ideal systems of collecting the garbage, but Furth is unique in that it combines the two and that both are models of their kind.

The garbage incineration plant occupies an oblong building 50 by 20 meters (164 by 65.3 ft.) ground plan and is located on the outskirts of the city, on the same premises with the municipal gas works. The building contains the boiler plant of the gas works as well as the incineration furnace.

Prior to February, 1911, Furth disposed of its garbage by depositing in receptacles of all descriptions, mostly uncovered, placed in front of the houses for the collection wagons, which were simple carts with lids, not preventing the dissemination of dust and stench in loading and unloading or even in transportation to the dumping ground, which lay in the vicinity of dwellings, into which dust and stenches were continually blown, and was, in spite of police prohibition, visited by small children and that class of people who always search garbage heaps for scraps.

The city magistrates on November 24, 1910, passed an ordinance requiring all persons living within the garbage-removal district to put household and kitchen waste, sweepings, ashes, and similar malterials (excepting tin, wire and metal scraps, glass, porcelain and clay vessels) in cans to be provided by the municipal incineration plant. The single-can system was adopted—one can for each house—and a can of such limited dimensions that the public would not be tempted to throw old shoes, dilapidated hats and broken pots in same vessel with garbage proper.

Each household must use the can furnished by the city. It is made of sheet iron with a heavy coating of zinc and has a capacity of 33 liters (8.7 gallons). The cans are solidly made, have a flat sliding lid fastened with a bolt and can be conveniently piled on top of each other. The cans are known as the "Ochsner system."

The wagons consist of a long truck on which rest 4 box segments divided into 2 compartments and opened at the top by sliding lids. There are 8 such lids on each side of the wagon. The garbage can is placed top downward on one of these lids in such a way that a device in the can lid catches on a rod extending along the edge of the segment box. This movement pushes back the lid of the wagon and opens the can, for the can lid remains attached to the rod. The garbage falls unseen, without dissemination of odor or dust, into the wagon. Each segment box has a capacity of 1.7 cubic meters (2.2 cu. yd.), consequently that of the wagon is 6.8 cubic meters (8.9 cu. yd.). The average weight of the garbage in each wagon is 2,550 kilos (5,621.8 lbs.), The sliding lids on the boxes are 1.45 meters (4¾ ft.) above the ground, permitting the collector to stand conveniently on the pavement and empty the cans. These boxes are removed from the wagon truck one at a time by an electric crane and placed on top of the furnace, into which the the contents go upon opening a spring valve in the bottom.

¶ GARBAGE WAGONS *are more than usually sanitary and odorless during collection.*

The garbage wagons are so constructed that they may be driven by horses or mechanical power. Experience has proven the latter to be 36 per cent. cheaper than the former. The wagons, therefore, are ordinarily coupled to an electric automobile having two large driving wheels in front and two smaller wheels in the rear, which are hoisted about a foot above the ground when the automobile is attached to the wagon and lowered only when it is detached. The axle motors (Braun syssystem) have an efficiency of 5.15 horsepower and are operated by storage batteries charged at the power house of the municipal electric works. They are divided into 42 cells and have a capacity of 390 ampere hours. The automobiles, when attached to the garbage wagons, attain a speed of 2 to 14 kilometers (1¼ to 8.7 miles) per hour, and when attached to the city supply wagons can reach 24 kilometers (14.9 miles) per hour. The trucks of the garbage wagons rest on 2 pairs of wheels, making 3 pairs in all when the automobile is attached, and are so adjusted that both can be turned in a surprisingly small space.

After the city decided to burn its garbage it made a careful investigation, finally deciding on the Humboldt system used at Barmen. The one at Furth is about 16 feet in each dimension, and is divided into two chambers. Into these the two compartments of the garbage box are successively emptied after the latter has been hoisted from the truck by a crane and placed on top of the furnace. This is accomplished invisibly and there is no exhalation of any kind, because a system of mechanical draft creates a powerful suction.

The garbage thrown into the furnace comes in contact with the hot walls and the glowing slack and ignites in a few minutes. The furnace grates are divided into two parts—a principal grate and a front grate. Air is introduced thru numerous holes in the grates by a turbine draft. The garbage is first dumped onto the principal grate, where it burns at an average rate of 1 cubic meter (1.3 cu. yd.) in 15 to 30 minutes, the time depending on the amount of moisture in the garbage, and being longer in summer on account of the larger masses of vegetable waste. After the garbage is burned to a slack it is pulled with long hooks, operated by hand, onto the front grate, where it remains until the next wagon load is dumped into the furnace. It keeps the furnace warm and helps destroy the gases from the garbage being burned on the principal grate.

The gases are withdrawn into a separate chamber, where a temperature of 1,200 to 1,400 degrees C. destroys all organic and unwholesome materials, and where the floating ashes are segregated. They then pass to a boiler with a heating surface of 220 square meters (2,368 sq. ft.), which they touch on the front wall and then on the back wall, after passing beneath, thru pipes. The floating dust and ashes that still remain in the gases are precipitated under the boiler. The gases so purified now escape from chimneys 50 meters (164 ft.) high. The ashes that accumulate in the pipes and under the boiler are pumped out automatically by rotating pumps. The steam generated in the boiler is used primarily in the gas plant and what then remains is converted into electricity and used in the electrical plant.

The garbage is burned into a mass of slack, which is removed from the front grate into iron carts with long hooks operated by hand. The slack is cooled in water and then removed to a crusher, where it is pulverized. Hard substances, like pieces of metal, which were not decomposed in the heat of the furnace, are here separated. The ground slack is sifted into two piles, the one fine as gravel and the other about as coarse as chestnut coal. The ground slack has been pronounced by eminent authorities an excellent substitute for the gravel ordinarily used in mixing concrete.

The distribution of the municipal garbage cans began in January and by the end of February, 1911, about 1,500 cans had been distributed. At the end of the year this number had increased to 16,017. About 85 per cent. of these were sold for cash at 3.75 marks (about 90 cents) per can, and the rest were paid for in 24

THE TYPE OF GARBAGE WAGON USED, *but somewhat smaller than those described in the text.*

monthly instalments of 20 pfennigs (4¾ cts.) each. The old receptacles were used until the distribution of the new cans was effected.

¶ THE PLANT, *its equipment and results are shown in detail.*

The city began to remove its garbage in the new manner in the latter part of February, 1911, after the incineration plant went into operation. It had at its disposal 3 electric automobiles, 3 wagons, 1 supply wagon and 44 detachable garbage boxes. The total cost of installing this garbage-removal system was $10,888. Each wagon is accompanied by four to five men, who fill it in less than an hour. The electric automobile that hauls it to the incineration plant is immediately attached to a wagon that has been emptied in the meanwhile and returns to the place of collection. During the 11 months of operation in 1911, 1,873 collection trips were made, totaling 2,253 hours, i. e., each wagon was employed in collecting on an average of 1.2 hours per trip. During the same year a total of 10,517,000 pounds of garbage was collected. The total distance traveled by all the wagons was 8,456 miles. At the same time a smaller quantity was collected and transported in wagons drawn by horses, the average time taken by each wagon in this case being 1.46 hours. The amount of garbage brought to the plant in this latter manner amounted to 427,344 pounds, making a grand total of all garbage collected by means of horses and automobiles of 10,944,344 pounds.

On one day in the week in summer and on two days in the week in winter garbage is collected by horsepower, but only two segment boxes are used in this case, instead of the four used when the delivery is made by automobiles. The garbage collected in 1911 came from 2,255 properties, with a population of about 63,400. The whole business of collecting requires only 10 persons, namely, a foreman, a preparer, 4 collectors, 2 automobile drivers and 2 assistants. In winter an extra collector is employed.

The cost of collecting the garbage in 1911 was covered almost exclusively by fees taken from the property owners in the collection district. The amount of the fee is based on the rental value of the rooms from which the garbage is collected as ascertained in the tax valuation. As a rule the rental value of all the rooms is taken into account, but certain exceptions aer made, as, for instance, when continuously for more than six months no garbage has been collected from certain parts of the building. The total sum derived from fees in 1911 was $9,044. The cost of administration during the same year amounted to about $595, and the cost of operating to nearly $5,236.

Before the furnace was installed it was calculated that the annual quantity of garbage to be collected in Furth would amount to 12,000 tons. This computation rested on statistics from other German cities, where the daily output of garbage is 1.1 pounds per capita. It was found, however, that the total amount actually collected at the end of the year was less than 5,000 tons. The average time spent daily in consuming the garbage was 11.7 hours, so that the furnace cooled in the meanwhile, causing considerable waste of time each morning to bring it to the normal temperature.

The furnace, as stated, is divided into two chambers and there is a supplementary chamber for burning coke. This was designed to supply steam for the gas works during the night, when the garbage furnace was not in operation, but it was soon found to be inefficient for the purpose, and will probably be converted into a garbage furnace. Each chamber in 1911 received 7,544 dumpings, each representing the contents of a segment box holding 1,400 to 1,500 pounds of garbage. The average time spent in burning each load was 24.6 minutes.

¶ THE STEAM *generated by the plant and the clinker produced are sources of revenue.*

The steam generated in the boiler is used mainly in the gas works and the remainder is converted into electricity. In 1911 nearly 6,540 cubic yards of water were turned into steam. It is the most important item in making the incineration plant a profitable undertaking. For 1911 the value of the steam generated was estimated at about $5,700 and the price received for the slag was only $714. The expenses of operation for the same year were: Salaries and wages, $2,451; use of water, $714; maintenance, $536; interest on loan, $762; depreciation, $1,785. The income from the value of steam and the sale of slag was $6,414, leaving a slight profit of $166.

The slag from the furnace presents slight commercial possibilities. It was first used to cover the old dumping ground and then employed in concrete structures on the premises. Several authorities have carefully tested it and pronounced it an excellent substitute for the gravel ordinarily employed in mixing concrete. In some of the strength tests of the former, concrete cubes made of slag showed a resistance of 175 kilos per square centimeter (2,489 lbs. per sq.). In the freezing tests, which lasted 21 days, the cubes were submitted to 25 alternate freezings and heatings, but at the end of this period their condition was unchanged. Other tests made were even more favorable, showing a resistance as high as 302 kilos per square centimeter. Inasmuch as the minimum resistance required of concrete pillars and foundations is only 80 to 100 kilos, the value of the slag is apparent.

Up to the present the city has sold the coarser grade of sifted slag for 4.50 marks per cubic meter ($0.824 per cu. yd.), but has used all the finer sort on the premises. It hopes in time to derive considerable profit from the sale of slag.

As already noted, the small garbage cans are not destined for the reception of scrap tin, old shoes, etc. These however, are also carted away in separate wagons free of charge, are sorted at the garbage plant and the scraps are sold, producing enough to pay for their removal.

Sewage Disposal in England

In Birmingham the household wastes and street washings flow thru the same sewers. More than half the houses of the city are connected with sewers. The sewage is first run into settling tanks and then treated on biological filters. The sludge is treated biologically, rendered inodorous, and afterwards dried on drying beds. The first attempt to eliminate impurities from the sewage was made in 1859, when two precipitation tanks were built and several acres of land acquired for irrigation. The purification effected was not satisfactory. Several methods of chemical precipitation were subsequently tried, but in 1871 a committee reported adversely on these methods. Since then the tank capacity has been greatly increased and a much larger area acquired for irrigation. Street sweepings, garbage, and ashes are burned in incinerators.

In Wolverhampton, a city with a population of over 95,000, sinks and water-closets are connected with sewers. There are some 10,000 pan closets, which are emptied weekly and the contents, mixed with ashes, sold to farmers. Separate sewers are provided for street washings in about two-thirds of the borough. The sewage is subjected to precipitation with lime, followed by land filtration. The sludge is pressed and sold to farmers in winter and air-dried on land in summer. Septic treatment of sewage was tried, but was considered unsatisfactory.

In Worcester, population about 48,000, sinks and water closets are connected to the same sewers that carry off the street washings. Sewage is filtered thru gravel beds and then thru sand beds; sludge is used for raising lowland. Street sweepings are sold; house refuse deposited on vacant land.

In Walsall, population 92,000, household wastes and street washings flow into the same sewers. The sewage is treated biologically and the sludge is used for fertilizing. Street sweepings, etc., are tipped on vacant land.

In Dudley, population 52,000, separate sewers are provided for street washings. Sewage is disposed of in two ways: The larger portion is conveyed to a large estate six miles from the town and turned onto the land there; the remainder, which cannot be disposed of in this way, owing to difficulties of level, is taken by the Stour Valley Drainage Board to their farms and is paid for by the corporation.

In Coventry, population 115,000, sinks and water closets are connected with the city sewers. The newer parts of the city are sewered on the duplicate system. Sewage is treated in tanks and irrigation fields. Percolating filter beds will be constructed soon with a capacity of half the dry weather flow. The sludge is deposited in beds on the farm and used on the land; it is also given away to farmers. Sweepings, garbage, etc., are burned. At one time Coventry sewage was purified by chemical precipitation.

In the city of Bradford, population 288,000, household wastes and street washings are run into the same sewers. The sewage is purified by chemical precipitation. The sludge is filter pressed for the extraction of wool grease, the yearly value of grease recovered being about $250,000; part of the press cake is sold as manure at 74 cents a long ton, and part is used as fuel. The first method of sewage purification tried in Bradford was filtration thru peat. Later, lime precipitation followed by filtration thru coke was tried, but this method also failed. The street sweepings are tipped onto vacant land, and house garbage and ashes are part tipped and part burned.

In Halifax, population over 100,000, household wastes and street washings flow into the same sewer. The sewage is treated in precipitation tanks and bacterial filters (double contact beds and percolating filters). The sludge is pressed and carted away by farmers. Street sweepings, garbage and ashes are tipped onto vacant land.

The city of Leeds has a population of 445,000 and maintains five sewage works. Household wastes and street washings flow into the same sewers. The sewage is subjected to bacteriological treatment after chemical precipitation, and the sludge is pressed into cakes and disposed of as fertilizer. Sixty per cent. of the house garbage and ashes collected in the city is disposed of in destructors; the remaining 40 per cent is deposited on land as manure or is used to fill quarries. The street sweepings are sold at 18 cents a ton to farmers and market gardeners. For ten years the city has experimented with practically all the known methods of treating sewage.

In Wakefield, a town of 51,000 inhabitants, located nine miles from Leeds, the household wastes and street washings are run into the same sewers, altho there are a number of special storm sewers to take away surface waters from the streets. The sewage is subjected to chemical precipitation, percolation thru bacteria beds, and settlement in humus tanks. The sludge is trenched into land formerly used for filtration purposes. At one time land filtration after chemical precipitation was tried, but the land proved unsuitable.

Nine-tenths of the sewage of Liverpool is discharged into the Mersey without treatment of any kind. The remaining one-tenth comprises the sewage of districts known as West Derby and Walton and is treated on the West Derby and Walton sewage farms, the system adopted being broad irrigation without chemical treatment, but assisted by bacterial and storm water beds. The West Derby farm has an area of 207 acres and receives the sewage of about 56,000 inhabitants. The Walton farm has an area of 183 acres and receives the sewage of about 61,800 inhabitants. The crops on both farms consist chiefly of rye grass, cabbages, potatoes, mangel-wurzels and beets.

In Salford, a town of 231,000. lying opposite Manchester, one system of sewers is used for both household wastes and street washings. The sewage is subjected to chemical precipitation, in which lime and salts of iron are used, and the tank effluent is then passed thru roughing filters and finally bacterial filters. The sludge is sent to sea in a 600-ton sludge steamer. Street sweepings are sold as manure, and the house garbage, ashes, etc., are burned in destructors. Many methods of sewage purification, probably twenty to thirty, have been tried in the last twenty-five to thirty years.

In Oldham, a town of more than 147,000 population all household wastes and street washings are carried off in the same sewers. The sewage is treated by precipitation, settlement and contact and sprinkling beds. The sludge is given to farmers. Street sweepings are used as manure, and garbage and ashes are burned in destructors.

Accrington, with a population of 50,000, has the single sewer system. The sewage is purified in septic tanks and by continuous filtration in percolating bacteria beds. The sludge is sent to the farming districts by canal. Street sweepings are sold as manure and the garbage and ashes are destroyed in destructors.

The single sewer system is also used in Stockport, population over 100,000. The sewage is subjected to chemical precipitation, land filtration and oxidation on bacteria beds. The sludge is pressed and disposed of to farmers. Street sweepings and ashes are at present tipped, but a destructor is in course of construction.

Leigh and Atherton, two towns with a combined population of over 66,000, have a single sewer system in common. The sewage is treated by means of chemical precipitation tanks, land and filters. The sludge is pressed and sold to farmers. Sweepings, garbage and ashes are burned in destructors or buried in tips.

In Rochdale, population over 91,000, household wastes and street washings are carried off in the same sewers. The sewage is subjected to sedimentation and bacterial treatment and the sludge is disposed of to local farmers. Street sweepings are sold to farmers and garbage and ashes are burned.

Until 1886 the sewage of Sheffield flowed in an untreated condition into the rivers and water courses. In that year a main sewage scheme was completed at a cost of $750,000, and sewage disposal works were constructed at a further cost of $220,000, the process adopted being that of lime precipitation. The works were designed to treat a flow of 10,000,000 gallons of sewage per day, but for several years a flow of 17,000,000 gallons has been dealt with, and since 1886 the population has increased from 304,720 to 470,000, and the introduction of the water carriage system, the extension of the drainage area and the increased requirements have necessitated improved methods of treatment in addition to increased capacity. It was finally decided after exhaustive experiments to adopt a scheme consisting of continuous flow settling tanks and contact beds. The local government has approved of the scheme which is now partly in operation, and the remainder is approaching completion.

The estimated cost of the extensions was $1,350,000, but it appears probable that the work will be completed for $35,000 less than that amount. In addition to this the city has bought lands for the present works and future extensions at a cost of $430,000.

The principal features of the scheme include a new main valve chamber, into which a 5-foot barrel sewer discharges, and also a 7-foot duplicate sewer. A storm water overflow arranged to discharge the excess flow above 64,500,000 gallons per day to a storm water conduit is fixed in the chamber.

A large penstock, with opening 5x12 feet, admits the sewage to a conduit 12 feet wide, which conveys it to the catch pits. Two pairs of catch pits, 42 feet long, 29 feet wide and 13 feet deep, have been constructed; they are fitted with new screens, which extend the whole length of the pits and which are cleaned by hand rakes. The catch pits are in the form of a double hopper and retain the heavier grit, garbage and larger objects. Each pair is fitted with endless chain bucket elevators for cleansing purposes. Two additional catch pits have been added, approximately twice the size of the older ones, and fitted with mechanical screens and an electrically driven traveling bucket dredger. The sewage passes from the catch pits thru branch and main conduits 12 feet, 16 feet and 20 feet wide, built in brick and covered with girders and concrete to the settling tanks. The complete scheme includes seventeen continuous flow settling tanks, each holding approximately 1,000,000 gallons, which are now in operation.

Sixty contact beds, each half an acre in area and sixteen storm beds of similar design but twice the size are in course of construction. The works will provide for the treatment of a maximum quantity of 64,500,000 gallons of sewage a day, and will be one of the largest of its kind.

Sheffield has two extensive garbage destructors, the refuse destroyed in 1912 and 1913 amounting to 42,898 and 33,805 tons, respectively, at a cost of $28,760 and $21,450. For dumping 35,663 tons of garbage requiring railway transportation there was expended, in addition to these amounts, $20,435.

A plant for converting fish refuse into fertilizer recovered 82½ tons during 1913; it was sold at a profit to the municipality of $600. There is also a can bundling plant that handles 300 to 400 tons of used cans a year.

Sewer Construction at Watertown, New York

Wm. J. Semper, contractor, recently completed the construction of 9,500 lineal feet of sewer at Watertown, N. Y. Reinforced concrete pipe was used in different sizes from 27 inches to 36 inches in diameter. The soil consisted of sand at and near the surface, gradually changing to coarser sand mixed with a little gravel saturated with water at a depth of about 8 feet from the surface. The average depth of excavation was about 12 feet, the first 4 feet being excavated and left standing without shoring, this being possible on account of the compact character of the sand.

Wemlinger Corrugated Steel Sheet-Piling type 3-A, ⅛-inch thick, 10 feet long was used. The contractor purchased 400 sheets, which, owing to the fact that each sheet has an effective width of 12 inches including the overlap, allowed the shoring of 200 lineal feet of trench.

The sheets were driven 5 feet at a time. In other words, the hammer was operated over a section of trench forward until all the sheets in that section had been driven 5 feet. Then part of the trench was excavated further and the timberling lowered, after which the sheet-piling was driven another 5 feet, so that when the excavation was made to grade there remained a toe of 2 feet below the bottom of the excavation, which avoided the necessity of bracing the sheet-piling at the bottom.

After a sheet had been driven, the hammer was raised by means of a 1-ton triplex block mounted on a double-A frame spanning the trench. As soon as the hammer was in position on top of the next sheet to be driven, the block was unhooked and the hammer steadied by hand as shown in Fig. 1. This was found necessary because the sheets went down too fast for the block chain to follow. It was found that the time of driving the sheets 15 feet was from 33 to 40 seconds with the bottom of the sheet-piling 10 feet below the surface. In other words, the actual driving time for each full 10 feet was 1 to 1½ minutes. More time was consumed to shift the hammer than in the actual driving. It was found that it required an average of 2½ minutes to raise the hammer and place it in position for each 5 feet driven. Including the time of moving the driving rig comprising hammer and a frame for driving, it was found that 7 feet of ditch could be sheeted per hour for each 5 feet driven.

As stated before, there was enough sheeting on hand to shore 200 feet of trench. Inasmuch as some of the sheeting was being pulled and carried forward, it required three men to carry all the sheets a distance of about 175 feet. It required about 1½ hours for these men to carry 32 pieces and set up the same on each side of the trench thereby completing a 16-foot section.

No attempt was made to pull the sheet-piling until the sheeted trench had been back-filled to the top, which still left a depth of about 4 feet of bank unprotected, which, as previously explained, stood up without being shored.

With one man at the head of the sheets, whose duty it was to attach the clevises thereto, and two men operating the triplex blocks, seventy sheets 10 feet long were pulled per hour. In other words, for every hour that the three men worked on the pulling, they were able to withdraw all the sheet-piling required for 35 feet of trench. The wages of the men were $1.50 per 10-hour day each, and therefore the cost of pulling was less than 0.1 cent per square foot.

ROADS AND PAVEMENTS

The Importance of Highway Maintenance

By Leonard S. Smith, M. Am. Soc. C. E., In Charge of Highway Engineering, University of Wisconsin, Madison, Wis.

WE, in America, fail to understand that the main reason why our roads are so inferior to those of Europe is the general lack of an adequate system of maintenance. A century of experience has taught the European engineers and taxpayers that the time to begin the repair of a road is the day after its construction is finished. The European engineers when constructing a macadam road provide an extra supply of the same material regularly deposited at the side of the road at intervals of 50 to 100 meters. In America, however, we put off the repair of our roads until the day after they are worn out. As a result, while the European road surfaces are well maintained and long lived, the American roads are too often rough and short lived. This criticism, while generally true of country highways, is also, to a considerable extent, true of the city pavements. We know how to construct as good roads and pavements but we have yet to learn the need of their maintenance. This misconception of the significance of road maintenance is well illustrated in a current engineering magazine in which a road commissioner, after describing how well he has constructed an asphalt concrete road, "subject to the heaviest travel," says: "We feel that we will not be required to do anything in the way of repairs for eight or ten years." If such confidence were only justified.

It is the writer's experience that such a pavement is certain to show some weak spots after the first winter, if not, indeed, the same season. These defects, tho insignificant and easily and cheaply corrected at first, are soon enlarged by a heavy traffic to such an extent as to greatly impair the life of the pavement.

In no other construction does the old adage, "A stitch in time saves nine," apply more aptly than in road repair. This principle has been proved so many times in the history of road construction that the Europeans consider us very stupid indeed not to accept and act on it. This failure on our part to appreciate the function of maintenance as an important element in the economics of highway construction is unfortunately not confined to our humble country path masters but is shown by officials high in authority. This misunderstandng was well illustrated recently when the writer was urging upon a high official the importance of maintenance, but elicited only the reply, "Let us build the roads first." If the maintenance of roads must be delayed until our system is completed the greater part of such roads will be past all hope of repair.

It is well understood abroad that both the construction and maintenance of roads have a single object and that both are necessary to attain that object. It may well be that a better service will be afforded by a poorly constructed road, well maintained, than by a well constructed road without maintenance. At the present time taxpayers are showing much enthusiasm for the construction of hard surfaced highways, and it is important that this enthusiasm and interest in road building shall be fostered and encouraged. Can anyone doubt if the first pavements prove a disappointment, because of their short life, that the effect of such failure will tend to discourage further road building?

Where states or communities build roads or pavements out of the proceeds of the sale of bonds, there exists an additional reason for systematic and thoro maintenance of such roads. For even with good maintenance, there will usually be some difficulty in preserving the road for a term equal to the life of the bonds, and, lacking such maintenance, most highway construction will have worn out long before the bonds are paid. This has actually happened in some of our American states and municipalities.

There are many miles of expensive macadam roads in New York state, the life of which will be less than twenty years, all built out of the proceeds of bonds running fifty years. Such a system of financing good roads is both shortsighted and selfish, because we thereby transfer to the backs of our children the burdens which we of today should bear. It should be a matter of much pride to citizens of Wisconsin, that all state aid for road building is derived from current taxes alone. It does not require a prophet to see that tho the present road problems are indeed serious, those of the future are quite certain to be much more so. Again the failure to maintain the New York roads during the first few years succeeding their construction has resulted in an excessive cost of maintenance during the past three years of over $1,000 per mile per year. But New York state has learned from experience the lesson of continuous maintenance, and other cities may well profit by her example. During the year of 1912 the maintenance department on New York state highways employed 735 patrolmen, who cared for approximately 3,151 miles of completed highway. Each patrolman furnished a horse and cart, together with the necessary small tools. The work of maintenance under this patrol system consisted "in keeping the surface of the paved roadway in as nearly perfect condition as possible, keeping the dirt shoulders smooth and safe for travel; culverts and drainage system free from obstruction; woods, grass and brush cut within the limits of the highway and in making small repairs to structures and guard rail. In addition to these duties, the patrolmen filled the ruts and repaired small defects which appeared in the road as a result of heavy travel." The total amount of money spent by New York state in 1912 on maintenance and repair work amounted to nearly $3,000,000. Contrary to the common belief, paved roads there are not permanent structures.

¶ CHANGES IN TRAFFIC *conditions are very rapid on newly improved roads and must be allowed for in making the plans.*

One reason for the general indifference in the United States toward this question of maintenance is found in the failure to visualize the future traffic. For example, the officials of one state highway commission took a traffic census several years ago on country highways and found only a light traffic; they therefore concluded that a construction suitable for such traffic was all that should be provided. As a matter of fact the building of a hard surfaced road at once disturbs the old equilibrium of traffic by attracting to the new road new traffic which formerly sought other routes.

This can best be illustrated by giving some statistics from a paper by Col. Sohier, chairman of the Massachusetts State Highway Commission, and presented by him at the convention of the American Road Builders' Association at Cincinnati. Briefly stated, he found the average daily traffic on one road, which in 1909 was 185 vehicles, had increased in 1912 to a daily average of 586 vehicles, an increase of 217 per cent. in three years. The increase of motor-driven vehicles was 200 per cent. and of heavy teams 288 per cent. On another road the average daily traffic increased from 81 vehicles in 1909 to 333 in 1912, or 300 per cent. In this case motor-driven vehicles comprised 42 per cent. of the traffic in 1909 and 75 in 1912. These examples are probably indicative, in general, of traffic changes in other states, tho, of course, not always with the same percentages. The point which here needs emphasis is, that if a dirt road requires little or no maintenance before its improvement, after such improvement the increase in traffic which it is certain to attract, will render some maintenance imperative. This has been repeatedly shown to be true in every eastern state, and it is high time that the western states profited by such experiences. The situation would only seem to require that the full facts relating to this experience should become widely known to our citizens.

To a student of highway economics, the alarming rate at which maintenance expenses increase, when any considerable amount of the state highways have been improved, is certain to cause apprehension, and should be of vital interest to the taxpayer.

Turning again to New York state, we take the following figures from the published report of the State Highway Department:

Cost of Maintenance.

Year	Mileage.	Maintenance.	Cost per Mile.
1907........	667	$ 206,100	$ 309
1908.........	978	360,660	379
1909........	1,987	1,369,100	679
1910........	2,133	1,800,000	1,001
1911........	2,622	2,135,133	387
1912........	3,100	3,127,900	1,009
1913........	3,813	5,000,000	1,311
Average			$ 983

Heavy traction engines, fast moving automobiles, and heavily laden narrow steel-tired wagons are responsible for a very large part of this excessive cost of road maintenance. In all justice to the taxpayer this class of vehicles should be made to contribute to the maintenance fund, their just share of such damage. This principle has long been recognized and acted on in Europe, and, to a lesser extent, also in some of our states. Most states exact an automobile license fee, but often not more than five dollars per year, an insignificant sum if intended to compensate for the wear of the roads. Instead of a flat sum it seems more fitting that the license fee should be made proportional to the weight and horsepower of the vehicle. In England a 45-h.p. touring car would be required to pay a license fee of about $100 per year. Such a tax has been justified, not only as a partial return for damage done to the road thru the use of the motor car, but also as coming from a class to whom such a tax would be far from a burden.

The following table showing the annual cost of road maintenance in Massachusetts is perhaps a safer guide because this work has been under a more continuous and expert management than in New York:

The Cost of Maintenance of State Highways in Massachusetts.

Year.	Total Mileage.	Cost of Maintenance per mile of road.
1905	548	$105
1906	610	112
1907	655	162
1908	702	327
1909	740	543
1910	784.6	652
1911	828.6	647
1912	879.5	676

Another method of securing the funds for maintenance and one largely used in Europe, is the taxing of all gasoline used in motor cars. It has been estimated that a tax of six cents per gallon (the tax in England) would have produced a fund of $1,600,000 in New York state in 1912. Such a tax would have the advantage, also, of being proportional to the use of the roads. This method of taxation will be recommended to the next New York legislature by the state superintendent of highways, and would seem to deserve a wide adoption.

¶ TRAFFIC REGULATION *is resorted to for the purpose of preventing excessive wear or extravagant cost of construction.*

But better still than paying for excessive wear to our roads is a system of state legislation designed to prevent such wear. Several eastern states have already enacted such legislation. Some of the provisions of the New York law include the following: (a) Traction engines are prohibited from traveling over improved highways for threshing purposes after January 1 1914, and, in the meantime, such engineer must pay for any damages. (b) The tires of each wheel of any steam roller, automobile truck motor, or other vehicle shall be smooth, and the weight of such vehicle, including load, shall not exceed 800 pounds upon any inch in width of the tire, wheel or roller. (c) No motor or other power vehicle shall have a greater width than 90 inches except traction engines 100 inches. (d) No traction engine, steam roller, automobile truck or motor carrying a weight in excess of 4 tons, including the vehicle, shall be operated at a speed of greater than 15 miles per hour and no vehicle carrying a weight in excess of 6 tons including the vehicle, shall be operated upon any state highway at a speed greater than 6 miles per hour, when equipped with iron or steel tires nor greater than 12 miles if equipped with tires of hard rubber.

With a force of over 700 patrolmen evenly distributed over the state highways, and assisted by the other regularly constituted peace officers of the state, it would seem entirely feasible to enforce the above laws and regulations. There can be no doubt that such enforcement will go very far toward preventing the present excessive wear on improved roads. Neither European nor American roads have been built to withstand the present traffic demands, especially the fast moving auto and heavy motor truck. Even the expenditure of $45,000,000 per year on the widely heralded French highways has not prevented these water-bound roads from wearing rough where subjected to excessive motor traffic. The general substitution of the motor vehicle for the horse-drawn vehicle, while greatly reducing the maintenance cost of city pavements built of wood, stone, brick or asphalt, has had exactly the opposite effect upon country highways built generally of some form of broken stone or gravel.

In the judgment of our most experienced engineers, the road of the future, designed for heavy fast moving traffic, will make use of our immensely valuable broken stone and gravel resources in a permanent concrete foundation, provided with some comparatively thin and easily replaced wearing surface. If such wearing surface be made of some kind of bituminous material which could be remelted and laid again, the maintenance costs involved would seem to be a minimum. In a large part of the Mississippi valley the use of vitrified brick on a concrete base is becoming deservedly popular because of its long life and resulting uniformly low costs of maintenance. At the present time numerous American road officials are experimenting with various mixtures of concrete for both foundation and wearing surface. The reports on these experimental pavements are very conflicting except on one point, viz: That concrete roads have not been able to withstand the abrasive action of heavy steel tired vehicles, tho well suited for motor traffic.

The writer disclaims any partiality toward foreign practice of road making. In fact, except for their superior system of road maintenance, his investigations fail to show any superior knowledge on road administration over that possessed by American engineers. Indeed, so far as the theory and practice of asphaltic materials for road purposes is concerned, European engineers frankly confessed that they looked to America for the correct solution of present problems.

Again, in making any comparisons of highway conditions in America and abroad, due allowance should be made for the fact that European road systems have taken a century for their construction; in fact, many of their main roads were first built by the Romans over 1,500 years ago. Moreover, this great work was first initiated, and in very large part supported by an ever-present military necessity.

In America, the good road movement is scarcely fifteen years old. In this brief experience we have learned how to make our standard roads as well suited to our comparatively thinly settled country and the attendant traffic conditions as the French roads are suited for French conditions. One might go further and say that no county in England has a system of roads so permanently constructed as the 1,700 miles of brick pavements in Cuyahoga county, Ohio. It is not the construction, but in the maintenance of our roads that we need to copy from Europe. When will we learn that pavements are not permanent structures, but instead require constant repair and maintenance? We will be very stupid, indeed, if we do not accept and take advantage of the experience of Europe and our own eastern states. The highest efficiency and continuity of management will be promoted by placing the maintenance of all state or main trunk roads in the hands of the state highway departments, out of the influence of petty county politicians.

Most significant to highway engineers and most encouraging to the taxpayer is the present well founded confidence in and reliance on scientific methods, both in the selection of road materials and in their incorporation into the completed road. But only after our people are equally well converted to scientific maintenance can we realize our ambition for good roads.

Brick Pavements in Baltimore, Md.

In its new work the paving commission of Baltimore has made quite an important place for brick paving, recommending it particularly for medium traffic business streets and for streets and alleys less than 30 feet wide.

The average cost of vitrified block paving with cement filler on 4-inch concrete base is about $1.92, and on 6-inch concrete is $2.14.

The specifications used are practically those of the American Society of Municipal Improvements and are restricted to cement filler. Wire-cut-lug blocks are popular, having been introduced but a few months since.

At the begining of last year the city had 30.69 miles of vitrified block pavements in streets and 3.96 miles in alleys, a total of 34.65 miles, or 654,828 square yards. In mileage brick is exceeded only by granite block, and the cobblestone which is being so rapidly replaced, and amounted at that time to 334 miles. In yardage brick is exceeded only by sheet asphalt and granite block. In 1912 about 20,000 square yards of brick pavement was constructed.

Method of Constructing Concrete Pavement

By Paul E. Kressly, C. E., City Engineer, Inglewood, Cal.

WHILE hydraulic concrete pavement is to be recommended only for country roads and for city streets of moderate travel, it may, however, be interesting to engineers engaged in the construction of highways to bring to their attention the durability and serviceability of this type of pavement which the author of this article designed and constructed for the city of Nazareth, Pa., during the summer of 1908.

While our experience with this kind of pavement is yet limited, there is reason to believe from the nature of the material that it will not prove to be a satisfactory or economical pavement for streets of heavy travel, unless the surface is protected by a bituminous macadam wearing surface of such a character as will protect the concrete and resist the abrasive stress of travel. Such a pavement undoubtedly would satisfy the following conditions:

1. Low in first cost.
2. It would be durable, i. e., the cost of perpetually maintaining its surface in good condition would be comparatively small.
3. It would have a smooth surface; however it would possess only a medium hard surface, and therefore the tractive

resistance would be slightly greater than that of some other types of pavement surfaces.

4. It would offer a good foothold to enable horses to draw heavy loads, and prevent them from slipping or falling.

5. It would be comparatively noiseless.

6. It would be easily cleaned.

7. It would be practically impervious, and can therefore be kept in good sanitary condition.

8. It would yield neither mud nor dust.

9. It would be comfortable to those who ride over it.

10. It would absorb more heat than some other types of pavement; however, this would not be excessive, as to make it very objectionable.

Taking into consideration all the conditions that a hydraulic concrete base with a bituminous macadam wearing surface fulfills, it is safe to state that this kind of pavement approximates the perfect ideal for country highways or city streets with light traffic where a permanent pavement is wanted and warranted. For these it is believed that a properly constructed pavement of this type will prove very satisfactory and durable, and the low cost at which it can be constructed should make it very attractive to city officials or those interested in the construction of state and county highways. Like other composite pavements, its utility and durability will depend largely upon the good quality of the materials used and the skill and thoroness with which the work is done.

Getting back to the hydraulic concrete pavement constructed at Nazareth, Pa. I want to describe the methods of designing and construction employed, the cost, wearing qualities and other important data relating to this type of pavement. As stated before, this pavement was constructed under the supervision of the author in the summer of 1908. As to the results of the wearing qualities, I am indebted to Mr. Frank P. Stirk, C. E., who was the engineer in charge of the construction work, and who has made frequent observations of this particular pavement described, and reported to me in November, 1913, that the same has given very satisfactory results up to that date. The pavement has therefore been in use for a little more than five years, and has fully demonstrated its usefulness. The life of the pavement is problematical, but it is safe to state that if the concrete were protected by a bituminous macadam wearing surface its life and usefulness would be inestimable.

The design, specifications, methods of construction, etc., will be described in the following order:

Hydraulic Concrete Pavement Surface—13,625 square yards.

Grades—The length of the street paved was six blocks, approximately 3,600 feet in length and 35 feet in width between curbs; the grade for five blocks was 0.4 per cent., and one block a grade of 3.9 per cent.

Cross-Section of Roadway—A parabolic crown was used, in which the amount of crown was equal to 1/120 of the width of the roadway, or approximately 3½ inches. This coefficient of roadway crown was used to reduce the lateral slope of the roadway, thereby reducing the probability of horses slipping and which would at the same time effectively drain the roadway surface.

Subgrade—The character of the soil was clay loam, underlying which at an average depth of three feet was a stratum of limestone rock. The excavation to the surface of the subgrade had an average depth of eight inches, which was loosened with a plow and loaded on wagons by hand shoveling. The surface was dressed with pick and shovel, after which it was sprinkled and thoroly rolled with a twelve-ton steam roller, which was passed over the surface successively, until the subgrade was consolidated and uniformly hard and firm. The subgrade was eight inches below the finished surface of the pavement, and parallel thereto.

Concrete Base—Thickness, 5½ inches; proportions of concrete, 1:3:6.

Cement—Portland. Three kinds were used; namely, Phoenix, Dexter and Nazareth; each kind being manufactured by different firms within the city limits of Narazeth. Two blocks were constructed with each brand. The cement was required to meet the tests recommended by the Committee on Uniform Tests of Cement of the American Society of Civil Engineers.

Sand—To be composed of grains not softer than hard limestone. It shall be moderately coarse and preferably made up of grains of varying size producing a mass with low percentage of voids. It shall not contain, in all, more than 5 per cent. by volume of clay, loam, mica scales, silt or other objectionable inorganic matter, nor more than 1 per cent of organic matter.

Broken Stone—It shall be of hard and sound limestone, broken to a roughly cubical form. It shall be screened thru efficient revolving screens, and only such fragments as have passed thru circular screen opening 2½ inches in diameter shall be used. If the crushed dust and fine fragments be not screened out, the stone must be so handled that the fine material will be evenly distributed thru the mass when it reaches the mixer.

Water—Water used for concrete shall be fresh and reasonably clean.

Care and Handling of Concrete Materials—Cement was placed on a platform which was at least six inches from the ground. It was never allowed to become wet or damp. Sand and stone delivered on the work was stored on lumber floors, as this avoided taking up earth and mud with materials, particularly when the street was wet or muddy, so that there was no fear of injuring the concrete. The stone was thoroly wet a sufficient time before being placed in the concrete, to allow any surplus water to drain away; however, remaining moist when it reached the mixer.

Mixing Concrete—A machine batch mixer was used on the work, and the time allowed for mixing was never less than about two minutes, averaging three minutes, so that the mortar was evenly distributed thru the mass and every fragment of stone was well coated with mortar, sufficient additional water being added as the mixing progressed to produce a rather wet, but not sloppy, concrete.

Placing the Concrete—It was delivered from the machine directly into barrows, and in such a manner as to prevent, as far as possible, the separation of the mortar from the stone. It was evenly distributed in a single horizontal layer of such depth that, after ramming, it was 5½ inches in thickness.

Wearing Surface Course—Thickness, 2½ inches; proportion, 1:1½:3½.

Cement—Requirements same as in base.

Sand—The sand as specified in sand for base, except that it shall be especially clean, and the grains of such size that at least 75 per cent. of the mass will fail to pass a screen having thirty meshes to the linear inch, and shall be of a superior quality.

Crushed Rock—The rock similar in quality to that used in the base, with the exception that it shall be crushed to such sizes that all will pass thru a screen having meshes 1¼ inch square and that none will pass thru a screen having meshes ½ inch square, and it shall be free from clay, refuse or other foreign substances.

Mixing Concrete—Same methods employed as the base mixing, with the exception that the cement and sand were thoroly mixed together dry, enough clean water was then added to make a rather wet mortar and the mixing continued until the materials were thoroly incorporated into a homogeneous mass. The crushed rock was then added and the mixing continued until every fragment of stone was completely covered with mortar. Care was taken in handling and adding the stone to the mortar to prevent the stone segregating into masses of different sizes. Sufficient water was then added during the mixing, whenever necessary to make what is termed a "wet" concrete.

Placing the Concrete—The concrete thus prepared was placed upon the base course before the latter had begun to set. This requirement was strictly enforced. Otherwise, there would have been danger of the two courses not properly adhering to each other. The concrete thus placed was well rammed and carefully graded by means of a templet, the surface of which conformed to the finished surface of the pavement.

Rolling—The surface was then rolled with a five-ton power roller of the asphalt type. All these operations were completed before any of the concrete in either course had begun to set. The purpose of this rolling was mainly to evenly compress the mass and thus secure its uniform density. It also produces a truer surface than can usually be secured by any other method. At the termination of the day's work the concrete was always continued to an expansion joint.

Protection of Concrete—For a period of ten days, and frequently longer, if conditions made a longer time necessary, the concrete was kept in a moist condition thruout by sprinkling. No travel was allowed on the street for a period of fourteen days.

Expansion Joints—These were placed along the curbing on each side of the roadway, and on account of there being an electric railway track in the center of the street, an expansion joint was placed approximately 2 feet 3 inches outside of each rail, and running parallel thereto. Longitudinally they were placed 25 feet apart. The roadway, as stated before, being 35 feet in width between curbs, this arrangement of the expansion joints made the size of the blocks approximately 13 feet by 25 feet, and 8 inches in thickness. The joints were made ¼ inch in thickness, cutting entirely thru both courses of concrete along a straight line. They were made by the use of a ¼-inch-thick steel plate, the shape conforming to the crown of the street, and were placed in position before the concrete was deposited and removed just before the same had begun to set; after which the joint was smoothed with a T-shaped smoother, and of the same thickness as the steel plate. The smoother was worked back and forth in the joint until the edge of the concrete adjoining the joint was thoroly and smoothly compacted, having a radius of about ¼ inch.

Filling the Expansion Joints—The filling of the joints was made with bituminous cement composed of coal tar pitch, to which was added 20 per cent. of refined Trinidad asphalt and 20 per cent. of hydraulic cement, all by weight. The pitch was first melted, and also the asphalt, which was added to the pitch and thoroly incorporated by agitation. The hydraulic cement was then added and the whole agitated until a complete and uniform mixture was obtained. The cement was poured into the joints while still hot, until they appeared to be nearly or quite full. After allowing time for the filling to subside, the joints were gone over a second time and completely filled.

Among engineers there is quite a wide difference of opinion as to the necessity for expansion joints and also as to the proper spacing. Some suggest that it would be better to omit them entirely, allowing the pavement to form its own expansion joints by cracking along lines where the natural forces dictate. Such cracks by their irregularity give a bad appearance to the surface, and it appears to me that it is not a very good practice to follow.

Cost of Work and Organization—This work was constructed by day labor under my supervision, the construction work being in direct charge of one of my assistant engineers. The organization consisted of:

Construction engineer, per day	$6.00
Two foremen, each per day	4.00
Two experienced concrete men, each per day	3.50
Machineman, per day	3.00
Rollerman, per day	3.00
An average of 28 laborers (Italian), each per day	1.50

Ten hours constituted a day's work.

Summary of cost of pavement per square yard:

	Per Sq. Yd.
Excavation	$0.086
Preparing subgrade	.023
Concrete base, 5½ in. thick, 1:3:6, material	.490
Wearing surface, 2½ in. thick, 1:1½:3½, material	.250
Mixing, placing, ramming, etc., including foreman	.186
Rolling wearing surface and keeping concrete moist for ten days	.012
Expansion joints, averaged per square yard	.034
Incidental expenses	.015
Engineering	.071
Total cost per square yard	$1.167

Cost of cement delivered on the work, per barrel	$1.30
Sand delivered on the work, per cubic yard	1.05
Crushed rock delivered on the work, per cubic yard	1.20

All the material required was close at hand.

Efficiency and Serviceability of Pavement—As stated before, I have not personally seen this pavement for over three years; however, according to the report furnished me, the surface is in excellent condition. There are a few transverse hair-line cracks in several blocks. Between the rails of the track, also between the rails and expansion joints, there are a few cracks, but they are not very prominent. The opening of the cracks does not exceed 3/16 of an inch. The cracking, no doubt, is attributed to the continual jarring of the heavy interurban cars. No repairs were required to date on any part of the work. The maintenance costs thus far were confined to cleaning only. The amount of wear, as close as could be ascertained, amounts to ⅜ of an inch, or slightly in excess of 1/16 of an inch per year.

In addition, I may state that the pavement is subjected to a heavy teaming traffic; the amount at this time I am unable to give, but after the street was completed I feared for the safety of horses on the 3.9 per cent. grade; and the three cement companies, previously mentioned, being interested in the success of this type of pavement, suggested to place a man on duty for a period of ten days, from 6 a. m. to 7 p. m., and take a census of the traffic, and also observe the number of horses slipping or falling on this grade. The results were very gratifying, as follows:

Number of vehicles passed in one day, including pleasure vehicles, automobiles, delivery wagons, heavy teams, etc., average per day for the ten days, 461, of which number 63 per cent. were heavy teams.

Horses slipped, seven in ten days.

Horses fell on knees (slipped on rail), one in ten days; fall on haunches, none; complete fall, none.

Accidents of any kind, none.

It may be interesting to note that, while these observations of traffic were taken, there were two rainy days, and the horses that slipped and the one that fell on the knees did so on the days that it was raining.

Hudson, Wis., Bridge

Traffic from Hudson, Wis., has had to cross the St. Croix river at Stillwater several miles north in order to reach St. Paul, and for many years the need of a permanent bridge at Hudson has been recognized. The St. Croix river at this point is about ⅜ of a mile wide and the channel, located on the Minnesota side, is narrow and deep. A bluff rises directly from the river. On the Wisconsin side there is shallow water for a distance of 2,000 feet.

Designs were prepared by C. A. P. Turner, of Minneapolis, for a crossing consisting of 2,300 feet of fill on the Wisconsin side and steel construction for the balance, 830 feet long, supported for the most part on reinforced concrete piers.

The center span over the channel has a height of 53 feet above high water.

The reinforced concrete piers are of considerable interest. They consist of columns of the mushroom type and reinforced girders. The columns are 4 and 5 feet high which are in turn supported by piles driven into the bed of the river. Most of the concrete construction was done in winter working thru the ice.

The bridge was built by the Central States Bridge Co., of Indianapolis, for the St. Croix Bridge Co., a private corporation with whom the City of Hudson shared the expense.

Tarred Concrete in Portland, Me.

By Edwin D. Lynch, Asst. Engr. Dept. Public Works.

The first section of state highway in Portland, Me., was built of penetration macadam in 1908. Following that were two sections of bituminous concrete (hand-mixed macadam) and two sections of tarred concrete. It was found that the bituminous forms of construction were not economical; almost constant maintenance being necessary during the summer season. In 1911 a section of tarred concrete was laid and while not entirely satisfactory, was so much more so than the bituminous work that the same kind of pavement was laid on the fifth section of state highway in 1912.

This section lies on Washington avenue, between Gould and Galvin streets. The roadway is occupied by a double track in the center, leaving a paved section on each side that varies from 9 to 15 feet in width, according to location. This section is 3016 feet long and its area 7646 sq. yds.

. In connection with the work was laid 826 lin. ft. of 8-in. vitrified pipe underdrain at a cost of 60 cents per ft. Total cost $495.60. The contract price per sq. yd. for concrete snrfaced with bitumen and inclnding grading was $1.30. Total cost $10,367.07.

A general description of the work follows:

The street was excavated to a depth of five inches below grade and thoroly compacted with a tandem roller. On the bed thus prepared was laid 5 inches of 1:2½:5 concrete mixed in a Foote 5A mixer. After being mixed, the concrete, which was of a rather thick, creamy consistency, flowed down an iron chute (attached to the mixer) to the bed. In this manner the concrete was placed with practically no separation of its ingredients.

The concrete was then tamped and floated with wooden floats, as shown in the illustrations. By this floating method a general even surface was obtained with the stone as near the surface as is possible to get it. After one day's setting, the concrete was covered with sand, kept wet, and allowed to set for seven days. It was then opened to travel.

After a considerable delay (the contractors' apparatus not having arrived) the concrete was carefully broomed and a bituminous top called Hassamite was applied with a pressure machine. As the bitumen was applied, it was covered with clean, coarse sand and rolled with a tandem roller.

PLACING *concrete on Washington Ave., Portland, Me.*

The bituminous surface, after rolling, averaged ⅜ inch in thickness.

The work was done by the Hassam Paving Co. of Worcester, Mass. The total cost per sq. yd. of completed pavement was $1.36.

The following calculations show the detailed labor costs of mixing in Job "A":—

JOB "A"—3,100 SQ. YDS.

Base—5 in., 1:3:5.

Average output—530 sq. yds. Time, 5.7 hrs.

	Total.	*Per Sq. Yd.*
9 men on rock at 22½ cents	$11.55	$0.0218
3 men on sand at 22½ cents	3.85	0.0073
1 man at skip at 22½ cents	1.28	0.0024
1 man wheeling cement at 22½ cents	1.28	0.0024
1 man leveling concrete at 25 cents	1.43	0.0027
1 helper leveling concrete at 22½ cents	1.28	0.0024
1 tamper at 22½ cents	1.28	0.0024
1 engineer at 25 cents	1.43	0.0027

FLOATING *concrete on Washington Ave., Portland, Me.*

1 fireman at 25 cents...	1.43	0.0027
1 brick operator at 15 cents	0.86	0.0016
1 water boy at 5 cents..	0.28	0.0005
1 sack boy at 5 cents...	0.28	0.0005
1 foreman at 45 cents..	2.57	0.0048
Total	$28.80	$0.0543

Wearing surface—1½ in., 1:1:1.

Average output, 530 sq. yds. Time, 2.8 hrs.

4 men on granite chips at 22½ cents........	$ 2.52	$0.0048
4 men on sand at 22½ cents	2.52	0.0048
2 men at skip at 22½ cents	1.26	0.0024
2 men wheeling cement at 22½ cents........	1.26	0.0024
2 rough spreaders at 22½ cents	1.26	0.0024
1 fine spreader at 25 cents (also tamps top)	0.70	0.0013
1 fireman at 25 cents...	0.70	0.0013
1 bucket operator at 15 cents	0.42	0.0008
1 water boy at 5 cents..	0.14	0.0002
1 sack boy at 5 cents...	0.14	0.0002
1 foreman at 45 cents..	1.26	0.0024
Total	$12.88	$0.0245

Finishing (530 sq. yds.)

1 finisher, 13 hrs., at 25 cents	$ 3.25	$0.0061
1 helper, 13 hrs., at 22½ cents	2.93	0.0055
Total	$ 6.18	$0.0116

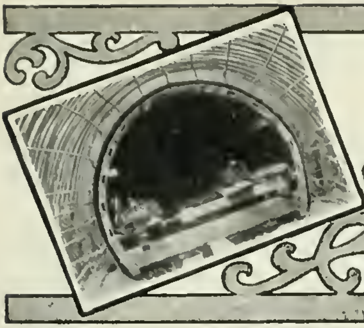
Form Setter.

1 man, 10 hrs., at 22½ cents	$ 2.25	$0.0042

Miscellaneous.

1 man trimming grade, 10 hrs.	$ 2.25	$0.0042
2 men cleaning up stone and sand, etc., while top is being placed, 4.3 hrs. each	1.49	0.0036
Total	$ 4.19	$0.0079

FINISHED *concrete surface on Washington Ave., Portland, Me.*



CONCRETE

The McCallie Avenue Viaduct at Chattanooga, Tenn.

The beginning of the end for railroad crossings at grade in Chattanooga, Tenn., was celebrated recently when the new McCallie avenue viaduct was opened for traffic. This is not to say that the McCallie avenue viaduct is the first in Chattanooga, but it is the largest and best yet erected, and almost simultaneously with its completion the Supreme Court of Tennessee handed down a verdict that he railroads themselves should build viaducts where needed. In the instance of the viaduct just completed the city agreed, in order to hasten the work, to paying $20,000 toward the expense. As a result of the decision referred to it now seems that other badly needed viaducts will be erected reasonably soon. Friendly negotiations have been concluded for a viaduct over the tracks of the same companies affected by the McCallie avenue viaduct, namely, the Cincinnati, New Orleans & Texas Pacific and the Nashville, Chattanooga & St. Louis, at East End avenue, not far from McCallie avenue. The Southern Railway has for years maintained several small viaducts in Chattanooga, two of which within a few years have been rebuilt of reinforced concrete. These, however, are small compared to the one just completed and the other which will be built this year.

A frame and uncovered steel viaduct preceded the new one at McCallie avenue. Fumes from passing engines proved the undoing of this old structure, which also proved entirely inadequate to the demands upon it, there being a double track street car line besides facilities for vehicle traffic and foot passengers. The new structure is thoroly modern. Its cost is roundly $100,000, met by the two railroads with the exception of $20,000 by the city, as explained, which is not affected by the court decision, and some $8,000 by the street railway company.

Work on the McCallie avenue viaduct began April 18 last, when a force commenced razing the old structure. The constructing company, Chickamauga Quarry and Construction Company, began operations a week later, the contract having been let by the railroads after plans and specifications were passed on by their engineers and the city engineer jointly. By December 10 the work was practically completed, including paving of one side of the roadway by the city, and operation of the cars was begun on the permanent tracks to permit completion of a small section of the viaduct at the western extremity and one section of the handrail at the eastern extremity, which were necessarily left to the last because the temporary trestle for cars swung in so close to the lines of the viaduct. No serious delays or accidents were experienced, and it is considered that the contractor made splendid time.

Approximately 10,000 tons of concrete went into the viaduct, which is 735.5 feet long, made up of 21 spans. In width it is 60 feet, divided into roadway 40 feet and sidewalks 10 feet each. This is 12 feet of clear vehicle roadway between the outer car rail and curb on each side. The entire roadway is paved with brick. Ornamental posts, carrying trolley wire and lights, are placed on each side of the structure, being fastened in openings provided in the extended ends of spans. These posts are of the standard type used by railway companies. Each is made up of three sections, one 7 inches in diameter, another 6 inches and the third 5 inches. Each post terminates in a spiral, from which is suspended one 108-watt Mazda lamp. As there are fourteen of these posts, seven on each side, it can be easily appreciated that the structure at night is brilliantly lighted. This same style of light, it might be said parenthetically, was recently substituted for the old type arcs on the bridge across the Tennessee river, and the result was amazing as well as exceedingly pleasing to the public. The viaduct posts were furnished to the railway company by the National Tube Company of Pittsburgh.

The viaduct is all flat span work. The working force averaged 80 men and the pay-roll was about $1,000 a week. The contracting firm is the first in this section to use chutes for depositing concrete in place, and this method explains the quick time in which the viaduct was completed with a comparatively small force. The pilasters and hand rails were set in place. Two towers, made by the Insley Manufacturing Company, Indianapolis, were used in depositing concrete for the main work, one being placed on either side of the tracks. Material for the pilasters and hand rail was mixed and placed by hand.

Steel in the beams is two inches off the bottom, this being a slight variation from usual practice so as to render most remote the wearing away of concrete to such an extent that smoke fumes could get at the steel and disintegrate it. In the floor slabs the steel is 1½ inches off bottom. The 500 tons of twisted steel used for reinforcement, varying from ¼ inch to 1½ inches, was furnished by the Corrugated Bar Company, Buffalo, N. Y.

The longest span in the viaduct is 30 feet, and the piers are from 12 to 30 feet high, including footings. The standard factor of safety, four, was used in determining dimensions. The piers are set about six feet below the top of natural earth, the footings spread out to 10 by 8 feet, as there is no rock within reasonable reach in the formation of the vicinity. The piers themselves are 5 by 18 feet. In the footings railroad iron laid in courses was introduced.

Ten thousand barrels of Royal Portland cement, made by the Dixie Portland Cement Company, went into the viaduct. The contracting company makes a specialty of crushed stone and furnished this material for the viaduct.

The grade of the viaduct is 5.3 per cent. on the eastern approach and 5.5 per cent. on the western approach.

THE McCALLIE AVENUE VIADUCT *at Chattanooga, Tenn., is a handsome reinforced concrete structure abolishing a dangerous grade crossing.*

As twelve railroad tracks pass under the viaduct at an angle of about 70 degrees to the line of the street, it was necessary to set eight piers askew in order to overcome the difference without too greatly disturbing the tracks or killing too much room that might be used in future for more tracks.

Maximum distance of the structure above ground is about 26 feet, this being over the tracks themselves, the tracks being on a fill. The viaduct is about 18 feet above natural level of the ground at either end.

On account of the street car service entering into the problem ten longitudinal beams were provided, whereas without the car traffic probably six would have sufficed.

The construction company used in form work some 150,000 feet of small lumber, besides 66 steel I-beams, 12 inches by 26 feet, and 200 8-inch poles for posts.

On the north side of the viaduct, about midway, the operating department of the C., N. O. & T. P. had the contractor build a stairway leading to the railroad yards below for benefit of the yard force. This was handled as an expense aside from the general contract, as it affected only the railroad named.

Specifications for Concrete Curb and Gutter of the American Concrete Institute

CURB AND GUTTER.

Materials.

1. Cement—The cement shall meet the requirements of the standard specifications for Portland cement of the American Society for Testing Materials and adopted by this association. (Standard No. 1.)

2. Fine Aggregate—Fine aggregate shall consist of sand, crushed stone or gravel screenings, graded from fine to coarse and passing, when dry, a screen having ¼-inch diameter holes; shall be preferably of silicious material, clean, coarse, free from dust, soft particles, loam, vegetable or other deleterious matter, and not more than 3 per cent. shall pass a sieve having 100 meshes per linear inch. Fine aggregate shall be of such quality that mortar composed of 1 part Portland cement and 3 parts fine aggregate by weight when made into briquettes will show a tensile strength at least equal to the strength of 1:3 mortar of the same consistency made with the same cement and standard Ottawa sand. In no case shall fine aggregate containing frost or lumps of frozen material be used.

3. Coarse Aggregate—Coarse aggregate shall consist of inert materials such as crushed stone or gravel graded in size, retained on a screen having ¾-inch diameter holes; shall be clean, hard and durable, free from dust, vegetable or other deleterious matter, and shall contain no soft, flat or elongated particles. In no case shall coarse aggregate containing frost or lumps of frozen material be used. The maximum size of coarse aggregate shall be such as to pass a 1¼-inch ring.

4. Natural Mixed Aggregates—Natural mixed aggregates shall not be used as they come from the deposit, but shall be screened and remixed to agree with the proportions specified.

5. Sub-Base—Only clean, hard, suitable materials, not exceeding 4 inches in the largest dimension, shall be used.

6. Water—Water shall be clean, free from oil, acid, alkali or vegetable matter.

7. Coloring—If artificial coloring material is required, only mineral colors shall be used.

Sub-Grade.

8. Depth Below Grade. (a) Concrete Curb—When a sub-base is required, the sub-grade shall not be less than 30 inches below the established grade of the curb.

(b) Concrete Curb and Gutter—When a sub-base is required, the sub-grade shall not be less than 11 inches below the established grade of the gutter.

9. Preparation—All soft and spongy places shall be removed and all depressions filled with suitable material, which shall be thoroly compacted in layers not exceeding 6 inches in thickness.

10. Deep Fills—When a fill exceeding 1 foot in thickness is required to bring the work to grade, it shall be made in a manner satisfactory to the engineer.

11. Drainage—When required, a suitable drainage system shall be installed and connected with sewers or other drains indicated by the engineer.

Sub-Base.

12. Thickness. (a) Concrete Curb—On the sub-grade shall be spread a material as hereinbefore specified, which shall be thoroly rolled or tamped to a surface at least 24 inches below the established grade of the curb.

(b) Concrete Curb and Gutter—On the sub-grade shall be spread a material as hereinbefore specified, which shall be thoroly rolled or tamped to a surface at least 6 inches below the established grade of the gutter.

13. Wetting—While compacting the sub-base, the material shall be kept thoroly wet and shall be in that condition when the concrete is deposited.

Forms.

14. Materials—Forms shall be free from warp and of sufficient strength to resist springing out of shape.

15. Setting—The forms shall be well staked or otherwise held to the established lines and grades, and their upper edges shall conform to the established grade of the curb or curb and gutter.

16. Treatment—All wood forms shall be thoroly wetted and metal forms oiled before depositing any material against them. All mortar and dirt shall be removed from forms that have been previously used.

Construction.

17. Dimension of Curb—The section of the curb shall conform with that shown in plans. The thickness at the base shall not be less than 12 inches, and at the top not more than 6 inches, with a batter on the street side of 1 to 4.

18. Dimensions of Curb and Gutter—The sections of the combination curb and gutter shall conform with that shown in plans. The depth of the back of the curb shall not be less than 6 inches. The breadth of the gutter shall not be less than 16 inches nor more than 24 inches.

19. Size of Sections—The curb and gutter shall be divided into sections not less than 5 nor more than 8 feet long by some method which will insure the complete separation of the sections.

20. Section at Street Corners—The construction of the combination curb and gutter at street corners shall conform with that shown in plans. The radius of the curb shall not be less than 6 feet.

21. Width and Location of Joints—A ½-inch expansion joint shall be provided at least once in every 150 feet.

22. Joint Filler—The expansion joint filler shall be a suitable, elastic, waterproof compound that will not become soft and run out in hot weather, nor hard and brittle and chip out in cold weather.

23. Protection of Edges—Unless protected by metal, the upper edges of the concrete shall be rounded to a radius of ½-inch.

Measuring and Mixing.

24. Measuring—The method of measuring the materials for the concrete, including water, shall be one which will insure separate uniform proportions at all times. A sack of Portland cement (94 pounds net) shall be considered 1 cubic foot.

25. Machine Mixing—When the conditions will permit, a machine mixer of a type which insures the uniform proportioning of the materials thruout the mass shall be used. The ingredients of the concrete or mortar shall be mixed to the desired consistency and the mixing shall continue until the cement is uniformly distributed and the mass is uniform in color and homogeneous.

26. Hand Mixing—When it is necessary to mix by hand, the materials shall be mixed dry on a water-tight platform until the mixture is of uniform color and the required amount of water added, and the mixing continued until the mass is uniform in color and homogeneous.

27. Retempering, that is, remixing mortar or concrete that has partially hardened, with additional water, will not be permitted.

TWO-COURSE CURB AND GUTTER.

Base.

28. Proportions—The concrete shall be mixed in the proportion of 1 sack Portland cement, 2½ cubic feet fine aggregate and 5 cubic feet coarse aggregate.

29. Consistency—The materials shall be mixed wet enough to produce a concrete of a consistency that will flush readily under slight tamping, but which can be handled without causing a separation of the coarse aggregate from the mortar.

30. Placing—After mixing the concrete shall be handled rapidly and the successive batches deposited in continuous operation completing individual sections. Under no circumstances shall concrete be used that has partially hardened. The gutter forms shall be filled and the concrete struck off and tamped to a surface the thickness of the wearing course below the established grade of the gutter. The concrete for the curb shall be placed and tamped so as to permit of the application of the required wearing course to the face and top so as to bring the work to the established line and grade of the curb. The work shall be executed in a manner which will insure perfect joints between abutting sections. Workmen shall not be permitted to walk on freshly laid concrete, and if sand or dust collects on the base, it shall be carefully removed before the wearing course is applied.

Wearing Course.

31. Proportions—The mortar shall be mixed in the manner hereinbefore specified in the proportion of 1 sack Portland cement and not more than 2 cubic feet of fine aggregate.

32. Consistency—The mortar shall be of a consistency that will not require tamping, but which can be easily spread into position.

33. Thickness—The wearing course of the gutter and top and face of the curb shall have a minimum thickness of ¾ of an inch.

34. Placing—The wearing course shall be placed immediately after mixing, and in no case shall more than 50 minutes elapse between the time the concrete for the base is mixed and the time the wearing course is placed.

35. Finishing—After the wearing course has been brought to the established line and grade it shall be worked with a wood float in a manner which will thoroly compact it. When required, the surface shall be troweled smooth, but excessive working with a steel trowel shall be avoided. The section markings shall be made in the wearing courses directly over the joints in the base with a tool which will completely separate the wear-

ing courses of adjacent sections. If excessive moisture occurs on the surface, it must be taken up with a rag or mop, and in no case shall dry cement or a mixture of dry cement and sand be used to absorb this moisture or to hasten the hardening. The edge of the curb on the street side and the intersection of the curb and gutter shall be rounded to a radius of about 1½ inches. All other edges shall be rounded to a radius of ¾-inch unless protected by metal.

36. Coloring—If artificial coloring is used, it must be incorporated with the entire wearing course and shall be mixed dry with the cement and aggregate until the mixture is of uniform color. In no case shall the amount of coloring used exceed 5 per cent. of the weight of the cement.

One-Course Curb and One-Course Curb and Gutter.

The general requirements of the specifications covering two-course work will apply to one-course work, with the following exceptions:

37. Proportions—The concrete shall be mixed in the proportion of 1 sack Portland cement and not more than 2 cubic feet of fine aggregate and 3 cubic feet of coarse aggregate passing a one-inch ring.

38. Placing and Finishing—The forms shall be filled, the concrete struck off and the coarse particles forced back from the surface, and the work finished in usual way.

Protection.

39. Treatment—As soon as the concrete has hardened sufficiently to prevent being pitted, it shall be sprinkled with clean water and kept wet for at least 4 days. The work shall not be opened to traffic until the engineer so directs.

40. Temperature Below 35 Degrees F.—If at any time during the progress of the work the temperature is, or in the opinion of the engineer will within 24 hours drop to 35 degrees Fahrenheit, the water and aggregates shall be heated and precautions taken to protect the work from freezing for at least 5 days. In no case shall concrete be deposited upon a frozen sub-grade or sub-base.

An Advertising Sidewalk

By James W. Beebe.

About three years ago some of the more enterprising citizens of Hope, Ark., extended a concrete walk about one-half mile to a new park that had recently been acquired by the city. As the city had no funds to pay for this improvement the work was paid for by selling advertising space on the walk.

Under the original plan the width was to have been 6 feet. This was later changed to 5½ in order to save cost.

The estimated cost was determined and from this the cost per square. About 10 per cent. was added to cover the cost of constructing squares that might not be sold. Using this price as a basis, about $5.00 per square, advertisements were solicited from all leading manufacturers selling thru the local merchants.

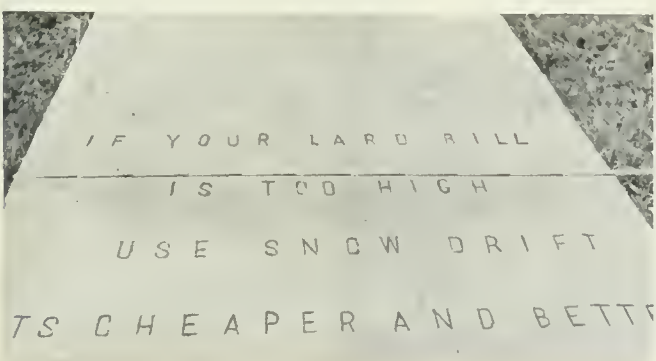
Form letters were used, signed and mailed by the local merchants. Postage and envelopes as well as the letters were furnished by the committee in charge.

A few manufacturers refused to purchase any space but many took two or more spaces. However, before construction work was started the committee found it necessary to reduce the width from 6 to 5½ feet in order to bring the cost within the fund obtained.

The advertisements are all very plain and readable, excepting a few well known trade marks.

Three or four of the advertisements were made by placing metal letters in the top of the walk, the remainder were made by stamping with bronze letters. These are the more readable. About all of the letters are 3 inches high and of a corresponding width.

Several squares were used to give a short history of the town and county and the names of the committee who originated the plan and carried it to a successful completion.



Lighting

Business Block Lighting

"No more dark and dingy principal thorofares in a modern city." This seems to be the key note of the times regarding street illumination. The principle applies not merely to the more effective lighting of streets by the ordinary public lighting systems, of which there are many varieties, but extends beyond this to the use of thousands of tungsten lamps on ornamental standards set at regular intervals along the curb. These are maintained by individuals who arrange thru business men's associations, improvement clubs, and even individually, with the central station company which installs the posts, provides the current, cleans the globes and maintains the lamps in good order for a specified sum per post per month.

A few years ago this scheme was tried out in a small way as a more attractive form of street lighting than the use of high candlepower arc lamps, and was found to be an immediate and tremendous success as a business stimulator and booster in any neighborhood to which it was applied. Since then the idea has grown to tremendous proportions in cities like Chicago, where many miles of business streets are thus illuminated.

As might be expected, the smaller towns all over the country have developed the idea even more rapidly than the big cities, probably because local associations are closer and the arrangements are more easily consummated among local business men, all of whom are more familiar with each other than those who are further apart in the big cities. If you go to any live town you will find some special forms of street illumination on perhaps two or three thorofares among which the ornamental street lamp post is sure to be conspicuous. Festoon lighting does not give the same air of permanence to the enlivened aspect of the street as lamp posts set at regular intervals along the curb. It smacks more of the fleeting brilliance of a carnival occasion of some sort; also, it fails to benefit store windows or light the sidewalk to the same degree. As a matter of fact, it is these latter which require the illumination and not the narrow strip between the car tracks.

Our illustration will give some idea of some recent installations in Chicago. In one section, on the northwest side, reached by evcellent transportation both on the surface cars and the Northwestern elevated, the Ravenswood branch of which is here extended on the surface, there is a large tract of desirable property which is being sold to people who are erecting homes thereon. At both sides of every street entrance to this tract will be found ornamental, substantial looking, brick columns, each surmounted by a large globe containing a powerful tungsten lamp. For half a mile on Western avenue, in the center of the tract, tungsten street lighting posts are installed along the curb on both sides of the road, and passengers riding out there cannot fail to realize as soon as they come within that bright zone that they are in a section which is distinguished from its surroundings, a section where enterprise and energy and the spirit of improvement are manifesting themselves. The lighting continues along Lawrence avenue and along other arteries of transportation. There is no doubt that the promoters of this tract have chosen a very wise and effective method of hastening its improvement.

High Efficiency Incandescent Lamps

This extract from a paper by S. E. Doane, chief engineer of the National Lamp Works of the National Electric Company, gave an explanation to the Wisconsin Electrical Association at its January convention of the principles upon which the efficiency of the modern gas pressure incandescent lamps depends, as compared with the vacuum lamps of the past.

The incandescent electric lamp gives light because the filament is hot. Anything which tends to cool the filament requires more energy to maintain the requisite temperature. Lamps burn out for two essential reasons in general: First. The filament becomes attenuated by evaporation. Second. The metal of the filament is attacked chemically. The economics of the incandescent lamp and its application to the industry all have to do with the cost of the lamp and its life. The life of the lamp is regulated, speaking generally, by the filament diameter. Two perfectly obvious laws apply, as one would expect. The thicker the filament the slower it is to evaporate to the time when it becomes too weak to maintain its structure. The thicker the filament the less quickly it is destroyed chemically. The cost of the lamp is not in the ratio of its wattage or candle power or any other size determinant, consequently there must exist between small lamps and large lamps that same relation which we find in anything else, from central stations to agriculture.

Incandescent lamp design must at all times maintain a nice balance between various factors. The incandescent lamp could not exist without this nice balance, and the industry exists but haltingly unless this balance is maintained. We must forever abandon the idea that anyone can run a pair of wires and stick a lamp at one end and a dynamo at the other and furnish lighting service. The early lighting service was almost as crude, and the principal progress we have made between the early days and the present is progress in the adjustment of this balance, both on the part of the lamp manufacturers and the central station industry. We have not as yet fully assimilated this idea.

The efficiency of the incandescent lamp in its most modern, its latest, its most extreme development, is only about 12 per cent. on basis of black body maximum, so that while we are pleased to talk about the high efficiency lamp, the term is a misnomer. It is a most inefficient piece of electrical apparatus. This latest development is tungsten wire coiled into a small area to reduce convection loss when operated under gas pressure to reduce evaporation. Commercially it will, of course, modify your practice to some extent. Unless the arc lamp people get out something new the end of the arc lamp is indicated as clearly as is that of all of the other older types of electrical illuminants. Absolutely every type of electric lamp of every size from the battery lamp to the arc size is being replaced by the tungsten filament lamp. Special applications in which the other illuminants for one reason or another are useful may endure for some time, but as a general business proposition there is nothing left which can compete with the tungsten filament lamp. Any real competitor to the new lamp must come from new development; whether it will be arc or something else, no one can foresee.

I anticipate that there will be much inquiry relative to these lamps. It is needless to say that they are of so recent birth that we do not know enough about them, but it would seem as if at the highest amperage (perhaps 20) we might reach as low as ½-watt per candle at present. As we progress downward toward the lower amperages there comes a place where the vacuum lamp is more efficient, the reason being, of course, that the less mass of wire allows a greater percentage of loss due to heat convection and conduction.

The same old differentiation holds that low voltage lamps of a given wattage will be of a higher efficiency than the high voltage lamps of the same wattage. The bulbs of these lamps get hot. It may be necessary to protect them from the weather. It is an open question in my mind as to whether or not you can afford to use individual compensators at each street series socket to obtain the high efficiency of the 20-ampere lamps. I am inclined to think that the use of high efficiency street service lamps will be made possible thru the use of higher amperage in street series circuits to the limit of good engineering practice. In the substituting for arc lamps it may prove to be feasible to introduce a small compensator in each lamp where a circuit is not to be changed thruout, or can not take a high amperage safely.

The principle underlying this application of gas pressure to the lamp is the same principle by which you can heat water in a steam boiler under pressure to a temperature higher than the temperature at which it boils in the open air. If instead of having pressure on your boiler you have a negative pressure, that is, a vacuum, we know that water boils at a lower temperature than in the open air. Similarly ice in a vacuum may be made to pass into vapor without melting.

So it is that every substance can exist as a solid, liquid or vapor under proper conditions of pressure and temperature.

It is obvious that the incandescent electric lamp has consisted during many years of a conductor heated electrically in a vacuum. The reason for the vacuum is to avoid chemical action and convection losses. The heated conductor evaporates at a lower temperature in the vacuum than it would under pressure.

Another law comes into effect in connection with the operation of these lamps which has been very little considered, and that is that the amount of convection loss from a heated wire is considerably greater if this wire is suspended in an open coil or not carefully concentrated.

It is obvious that we have not had to pay attention to this law with a lamp filament operated in a vacuum, but in these non-vacuum lamps it is necessary to mass the filament. We use a thick filament coiled closely upon itself.

The most wonderful thing about this recent development is the fact that for the first time in the history of the industry incandescent lamps are commercially made without a vacuum. The business effect of this invention is not revolutionary as is the scientific effect of it. The new development will simply extend the commercial fields to which incandescent lamps have been applied in the past.

Without any thought of detracting in any sense from the fullest credit for the scientific value, I wish to speak a word of caution. There are many other achievements which have been made, which will undoubtedly be made and which will be employed, but which will not obtain the publicity of this particular one. I would suggest in referring to lamps of this character in any discussions that the lamps be referred to by their efficiency and size, without regard to the particular construction which makes these efficiencies possible at the sizes given.

Elements of Charge for Public Utility Service

The summary of an address by M. E. Cooley at the annual dinner of the Western Society of Engineers gives in brief space a classification of the sources of expense which must be met by the charges for service by a public utility plant, which is apparently complete, and may be considered by some as leaving the way open for duplicating some of the charges.

It will be convenient to bring together the several elements which take part in determining a reasonable charge for public utility service. Not all of them take part at the same time necessarily, for some may appear in one case and not in another; or several may be combined in a single item. In a general way, and in a somewhat natural order, they may be summarized as follows:

First. Capital Investment.

1. Preliminary costs covering investigations as to feasibility of project.

Note.—Organization, promotion, administration and legal expenses, engineering and superintendence during construction, which are distributed over the whole period of construction, are more conveniently placed later in the schedule.

2. The physical property; the several items making up the whole arranged in order, each affected with its proper allowances to cover contingencies, special engineering, and other costs peculiar to the item; land first, followed by clearing and grubbing, then the various structures and equipment; sub-contractor's profits included with the separate items.

3. General contingencies applicable to the property as a whole as distinguished from special contingencies applicable to particular items.

4. General contractor's profits; or, the profits to an engineering firm building the property on the "cost plus a percentage" plan.

5. General engineering, and superintendence during construction.

6. Insurance and taxes.

7. Organization, administration and legal expenses.

8. Cost of promotion and promoter's profits.

9. Interest during the construction period.

10. Office furniture and fixtures.

11. Stores and supplies.

12. Working capital.

Second. Operating Expenses.

13. Operating expenses per se; that is, salaries, wages, fuel and other supplies, repairs and upkeep; all expenditures required in rendering the service of the utility, including insurance and taxes.

14. Interest on the capital investment (the actual cost of the property), i. e., interest on securities which must be paid regularly.

15. Interest on floating debts; this may include the discount on bonds, and the cost of financing, if these have not been incorporated with the capital.

16. Cost of establishing the business; the sums of money required to be borrowed, with interest on the same, to make good the differences between the earnings and expenditures up to the time the earnings become sufficient to meet all expenditures. This may be made a capital charge, or carried as a floating debt to be paid out of future earnings.

Third. Depreciation Fund.

17. The regular contribution to the

depreciation fund, out of which the integrity of the property is to be maintained.

Fourth. Sinking Fund.

18. The annuity required to retire such portions of the securities as may be necessary at the expiration of the franchise life of the property, in order that the investor may receive back his entire principal when the business is closed out.

It will surprise everyone not familiar with the cost of building public utility plants to learn that the so-called overhead charges are in the aggregate a large percentage of the costs of labor and the material things entering into their construction. An examination of the various percentages, omitting items 1, 4, 8, 15 and 16, will disclose that if the individual contingencies of construction, special engineering charges, and contractor's profits be assumed to be embraced in item 2, the total percentage may vary from 12 to 25 per cent.; and if these inside percentages be added to the outside or general percentages, the total percentage may vary from 30 to 60 per cent.

It is to be regretted that engineers and others who have had experience in building properties, and valuing them afterwards, have not done more towards disseminating knowledge of the actual conditions found in such work. We should then be much further along towards the mutual understanding which must exist before the public service corporation can get together on common ground. But engineers have many times hesitated to use the larger percentages, fearing to be accused of favoring the corporation.

Flower Boxes in Chicago

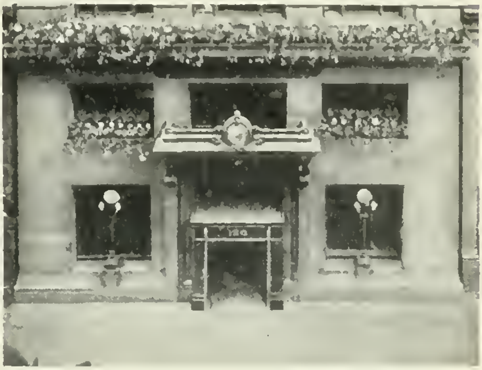
By L. A. Dumond, Chairman Committee on Downtown Streets, Chicago Association of Commerce.

The Committee on Downtown streets has been working in conjunction with business men and officials in its campaign to introduce growing plants into the loop district of Chicago. Almost every building in the loop district should bloom with flower boxes.

This plan is in no way experimental. Minneapolis has maintained flower boxes successfully for two years and in that city those who tried the plans are without exception enthusiastic supporters of the idea of bringing nature into the business districts.

Many large business concerns in Chicago are preparing to fit their windows with flower boxes and it is our intention to have a demonstration of flower boxes for trolley poles ready for inspection in a short time.

The use of flower boxes has a favorable effect upon one's trade and one's employes. Progressive manufacturers in Chicago and elsewhere have found that more and better work can be secured from employes when the windows of the working rooms are filled with growing plants.



What is true of the manufacturers is true of all other lines of business. Those who have tried the plan find that they cannot afford to be without the growing plants. Flower boxes exert an influence both from the inside and from the outside. In other cities tenants in offices too high to be seen from the street have maintained flower boxes for the influence they seem to have upon their employes and their clients. In a mechanical age, when surrounded on every side by things artificial, the use of growing plants is the one touch of nature that brings us back to real things.

Experience with flower boxes in Chicago and elsewhere has proven that growing plants can be maintained for months with a little regular attention, that the flower boxes do not fall down on pople's heads, and that they do not leak and stain the building. The best results seem to have been obtained by the use of a sub-irrigated flower box. Wherever flower boxes are cared for by the tenants, this box is preferable.

There is no hard and fast price per lineal foot. Much will depend upon the kind of plants selected and upon whether the boxes are cared for by the tenant or by the florist. Ordinary wooden and galvanized iron boxes cost about 50 cents per lineal foot. The sub-irrigated flower box about 88 cents per lineal foot. The cost of summer plants will vary from \$1.00 to \$1.50 per lineal foot. Winter plants will cost about 60 cents per lineal foot.

The plants may be cared for by the tenants or by the florist. If cared for by the tenants regularity in watering is essential to success. Growing plants may be rented from the florists for the summer season, in which case the work of maintenance is done by the florist.

MISCELLANEOUS

Iron and Steel Processes and Their Relation to Corrosion

By J. T. Hay, Chief Metallurgist and Chemist of Steel Rolling Mill Co., at College of Applied Science of Syracuse University, New York.

The progress in the art of manufacturing iron and steel has been most remarkable in the last few years and of all the factors which have contributed towards it none has been more influential than the destructive forces of corrosion, which have challenged the best efforts of man to produce a permanent iron or steel product, and it is a well-established fact that the processes of manufacture have much more to do with the final lasting quality of the material than was formerly supposed.

It is a recognized fact that the open-hearth furnace alone is suitable for the production of high-grade metal in large quantities. The electric furnaces are rapidly forging their way to the front, but they have not been long enough in the field for us to accurately determine their position. Therefore, we will deal with the open-hearth furnace and its production, and try to show some of the many factors in the process of manufacturing which have an influence on the corrosion of the finished products. To begin with, it is necessary that we have raw materials of good quality, pig iron, scrap and fluxes; the standard specifications of basic pig are suited for our requirements. Great care must be taken in the purchasing of scrap, as it requires but a small amount of impurities in the scrap to cause unlimited trouble in the finished product. Cast iron scrap of all kinds is to be avoided. Furnace operations are the next factor to be considered. The education of the men operating the open hearth furnaces is of the utmost importance, and too many manufacturers are prone to allow men of inferior education to carry on this work, and, as a result thereof, inferior products are made.

The proper regulation of the temperature of the furnace is a most important factor, influencing the quality of the product, and the ascertaining of the temperature with the eye, as it is customarily done, is an uncertain proposition at the best. It takes a melter of long experience to determine accurately the temperature by those means, and material which is needlessly overheated in open-hearth furnaces is injured beyond repair, unless it is melted again with new fluxes and pig iron. After the metal has become thoroly molten and the temperature has been carefully watched, a sample is then taken from the bath and carefully analyzed before the material is removed from the furnace. The old method of determining the amount of phosphorus and carbon in the metal by the visual appearance of a fractured test piece is being rapidly superseded by making preliminary chemical analyses before the material is tapped. Too much stress can not be laid upon this point, if quality in the material is aimed at. But even when these precautions are taken, many a heat is ruined by carelessness in tapping and handling the metal when in the ladle. The melter must have before him the conditions to which the metal was subjected during the three or four hours previous to the tapping, together with the preliminary analyses, to determine the necessary treatment in the ladle, as this is his last chance to add to or detract from the quality of the metal.

Many defects in steel can be traced to dirty molds or lack of care in pouring the molten metal therein.

When the ingot has been removed from the mold it is usually placed in a reheating furnace or soaking pit before the ingot is cold. The heat of these pits should always be controlled by a pyrometer, because the temperature must be regulated according to the chemical analysis of the metal. Much good material is ruined at this point for lack of knowledge as to its proper heat treatment. But at large plants chemists are working out these details and thus improving the quality and increasing the quantity.

We have now reached the stage of changing from a chemical to the physical treatment of the metal. The man in charge of the rolling operations must keep down the speed liimt, and this is true even for the rolling of sheets. After the sheets have been rolled, careful annealing at accurately determined temperatures is absolutely essential.

Let us outline now, but briefly, the theory and effects of corrosion. Corrosion, or the rapid rusting of iron and steel, may be considered as an effect of the combined action of water and oxygen, or, in a broad sense, of moisture and air. The most widely accepted theory of the cause of this rapid rusting or corrosion, called the electrolytic, is based on the fact that when two substances, having different electrical potentials, are immersed in a suitable electrolyte, an electric current is set up and corrosion begins at once. In iron or steel the various impurities differ from the element iron in their electrical potentiality, and the moisture in the air contributes the electrolyte. It is also true that this action is of a chemical nature and that because of the very close connection between electrical and chemical action we are able to control this chemical action by stopping or accelerating the electrical action. The purity of iron has a marked influence on the rapidity of corrosion. The quantity of the impurities must not only be very minute, but those few elements which it is impossible to remove entirely must be absolutely homogeneously distributed. Because of the extreme sensitivity of iron, great care must be used at its physical treatment, or the work of having eliminated the impurities will be labor lost. The strains produced by excessive speed in rolling, unless removed by careful annealing, will generate active corrosion.

Some manufacturers have tried to offset their neglect to remove the objectionable impurities and their lack of careful physical treatment by the addition of copper. This doped steel, instead of being benefited thereby, has to undergo an increase of the total of its impurities, and thus the segregation of the latter is rendered easier, which two factors accelerate corrosion rather than retard it.

Technical Associations

The February 27 meeting of the New York Electrical Society was held at the new Two Hundred and First street generating station of the United Electric Light and Power Company, and included a history of the company and the development of alternating current supply in the city, an illustrated description of the station and an inspection of the station under special guides.

The second annual meeting of the Chamber of Commerce of the United States in Washington, February 11 to 13, was largely devoted to a discussion of anti-trust legislation and provided for careful committee consideration of all such proposed legislation and referendum of the same to the commercial organizations of the United States.

The American Institute of Quantity Surveyors, San Francisco, Cal., publishes a monthly bulletin of about four pages devoted to the promotion of better methods of estimating and dealing with bids.

The Indiana Sanitary and Water Supply Association held a successful meeting in Indianapolis, February 26 and 27. Water works management, water waste, floods, polluted water and its consequences, water purification and natural conditions, public utility commissions and regulation, machinery, hydraulics, sewage, fire losses, conservation of water, power, health, are some of the subjects considered, most of them by experts.

The American Concrete Institute held its convention with the Chicago Cement Show the third week in February and was attended by about 200 members and visitors. The papers presented were mainly of high grade, but were too numerous to permit much discussion.

The Conference on Concrete Road Building held in connection with the Chicago Cement Show, on February 12 to 14, was organized and the material was presented by committees appointed in advance from the field of experts on the subject. Two of these reports are given elsewhere in this number of Municipal Engineering, and others will follow later. The attendance was very satisfactory, and the discussions, partly provided for beforehand, were intelligent and to the point. President Goss proved himself an ideal presiding officer and the cause of concrete roads was advanced by showing both the successes and the sources of failures.

The convention of the National Brick Manufacturers' Association opens at New Orleans, March 4. On the program is a paper by W. T. Blackburn, Paris, Ill., on "Brick Paved Highways as an Investment."

The Eastern Paving Brick Manufacturers' Association at its Bradford, Pa., meeting, February 5-7, elected C. E. Foster, Bradford, Pa., president; G. W. Lenkerd, Indiana, Pa., secretary, and C. P. Mayer, Bridgeville, Pa., treasurer.

Technical Schools

Howard E. Phelps, city engineer of Boulder, Colo., has been appointed assistant professor of civil engineering at the University of Colorado, taking the place of Professor C. C. Williams, who resigned to take the position of professor of railway engineering at the University of Kansas, Lawrence, Kan.

The short course in highway engineering at the University of Illinois was attended by about 200, including 63 of the 66 county superintendents provided for in the new Illinois highway law.

Lectures on highway engineering will be delivered at Columbia University, New York, in March, as follows: On the principles of efficiency engineering applied to highway engineering, by Frank B. Gilbreth, consulting engineer, New York, on the 2d; on the administration of municipal public works, by Nelson P. Lewis, chief engineer, board of estimate and apportionment, New York City, on the 9th; on the essential physical and chemical properties of creosoting oils for wood blocks, by C. N. Forrest, New York Testing Laboratory, Maurer, N. J., on the 16th; and on the relative cost of transportation by waterways railways and highways, by John A. Bensel, state engineer, Albany, N. Y., on the 19th.

Personal Notes

Benton R. Anderson has been appointed city engineer at Carroll, Iowa.

James E. Sutton is city engineer of Alameda, Cal.

A. S. Zinn, recently resident engineer in charge of the fourth division of the chief engineers' office, Isthmian Canal Commission, has been appointed consulting engineer with the department of public works of the Republic of Panama.

D. W. Johnson becomes city engineer of South Saanish, B. C.

Prof. A. H. Blanchard of the Columbia University graduate course in highway engineering, has recently delivered courses of lectures at the Ohio short course in highway engineering and at the University of West Virginia.

H. E. Brauer is the new city engineer of Shreveport, La.

J. J. Smith, the newly appointed city engineer of East Grand Forks, Minn., will immediately prepare plans for 3,800 square yards of pavement.

D. F. Austin, for many years city engineer of Auburn, N. Y., died recently, aged 83 years.

Hugh L. Cooper, having completed the water power development of the Mississippi River Power Company at Keokuk, Iowa, has opened offices at 101 Park avenue, New York City, for the practice of general hydraulic engineering, including design, construction and management of hydro-electric power plants.

H. F. J. Porter, M. E., and A. L. A. Himmelwright, C. E., have opened offices in Masonic Hall, Twenty-third street and Sixth avenue, New York City, for the purpose of advising architects, owners, public officials, commissions and others on safety to life in buildings, especially with reference to the new factory laws in New York.

New Publications

The Scientific American Reference Book for 1914 has been thoroly revised and brought up-to-date, which has necessitated the correction of more than half of the pages, in many cases new pages having been substituted.

It is a handy, compact, reliable and up-to-date compendium for everyday reference, containing a remarkable aggregation of facts, statistics and readable information along industrial, commercial, scientific and mechanical lines of interest to every one. It contains over 75,000 facts and is illustrated by about 1,000 engravings, many of them being diagrammatic comparisons. A great deal of the information can not be found elsewhere without considerable trouble and inconvenience.

In the preparation of this volume immense masses of government material have been digested with painstaking care and with the collaboration of government officials. The assistance of competent professors of world-wide reputation has also been secured. No expense and effort have been spared to make the volume interesting as well as authoritative.

The scope of the book is so broad and the information so varied that it is impossible to give in a table of contents an adequate idea of the vast amount of information that it contains or the range of the subjects treated. It is complete and comprehensive—a revelation of facts and figures. If information regarding anything of present-day interest is wanted, it is almost certain to be found in this volume. It will prove invaluable on the desk of the business man, as well as the library of the home.

Chapter headings cover population and social statistics, farms, foods and forests, mines and quarries, manufactures, commerce, merchant marine, railroads, the Panama canal, telegraphs and cables, wireless telegraphy, telephone statistics of the world, postoffice affairs, patents, trade marks and copyrights, armies of the world, navies of the world, aviation, chemistry, astronomy and time, meteorology, machine elements and mechanical movements, geometrical constructions, weights and measures. It has nearly 600 pages and costs $1.50 net.

Publications Received

The Determination of Internal Temperature Range in Concrete Arch Bridges. By C. S. Nichols and C. B. McCullough. Paper, 101 pp. Bulletin No. 30 of Engineering Experiment Station, Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa.

Flood Control of the Mississippi

River; an address by Col. C. McD. Townsend, U. S. A., president of the Mississippi River Commission, before the National Drainage Congress. Paper, 16 pp. Published by the Mississippi River Levee Association, Scimitar Bldg., Memphis, Tenn.

Municipal Handbook of Dallas, Tex., 1913. Leather, 106 pp. S. J. Hay, mayor.

Yearbook of Burlington, N. J. Paper, 105 pp. E. Ellsworth Mount, mayor.

Organization and Administration of the Department of Health of Dayton, O. A report based on an investigation by Carl E. McCombs and prepared for the Department of Health by the Dayton Bureau of Municipal Research and issued by the Board of Health to show its needs. L. D. Upson, director of bureau.

The Prevention of Waste of Oil and Gas from Flowing Wells in California, with a discussion of special methods used by J. A. Pollard. By Ralph Arnold and V. R. Garfias. Paper, 15 pp. Bureau of Mines, U. S. Department of the Interior.

Modern Cities: Progress of the Awakening for Their Betterment Here and in Europe. By Horatio M. Pollock, Ph. D., (Leipzig) and William S. Morgan, Ph. D. (Yale). Cloth, 418 pp. $1.50 net., by mail $1.63.

Business Methods in Municipal Works: An informal record of the operations of the Department of Public Works of the city of Philadelphia, under the administration of Mayor Blankenburg. By Morris Llewellyn Cooke, director of Department of Public Works. Paper, 64 pp. Published at private expense. Copies can be obtained at Room 216, City Hall, Philadelphia, Pa.

Proceedings of Thirty-Third Convention of Indiana Engineering Society for 1913. Paper, 301 pp., 50 cents. Charles Brossmann, secretary, Merchants' Bank building, Indianapolis, Ind.

An Irish Channel Railway. By Henry Grattan Tyrrell, consulting engineer, Chicago, Ill. Paper, 5 pp.

History of Bridge Engineering. By Henry Grattan Tyrrell, C. E. (Toronto), bridge and structural engineer, Evanston, Ill. Cloth, 480 pp., $4. Published by the author.

The Wisconsin State Aid Highway Law. Bulletin No. 3 of Wisconsin Highway Commission. Paper, 54 pp. Madison, Wis.

Seventh and Eighth Annual Reports of the State Highway Department of Ohio, years ending November 15, 1911 and 1912. Paper, 112 and 276 pp. James R. Marker, state highway commissioner, Columbus, Ohio.

Municipal Year Book of the City of New York for 1913. Paper, 190 pp. Robert Adamson, secretary to the mayor.

Work Done for the Prevention of Water Waste in the City of New York and Results Accomplished Thereby. By I. M. De-Varona, Brooklyn, N. Y. Paper, 33 pp.

Text-Book on Highway Engineering. By Arthur H. Blanchard, C. E., A. M., professor of highway engineering in Columbia University, and Henry B. Drowne, C. E., instructor. Cloth, 774 pp. $4.50 net. John Wiley & Sons, New York City.

Proceedings of Brooklyn Engineers' Club for 1912. Paper, 256 pp., $2. Joseph Strachan, secretary, 117 Remsen street, Brooklyn, N. Y.

The Art of Roadmaking: Treating of the various problems and operations in the construction and maintenance of roads, streets and pavements. Written in non-technical language, suitable for the general reader; with an extensive bibliography and a descriptive list of reliable current books and pamphlets on these subjects. By Harwood Frost, B. A. Sc. Cloth, 544 pp., $3 net. Engineering News, New York.

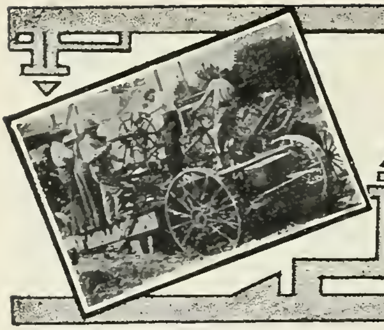
Highway Construction: A practical guide to modern methods of road building and the development of better ways of communication. By Austin T. Byrne, C. E., and Alfred E. Phillips, C. E., Ph. D., professor of civil engineering, Armour Institute of Technology. Cloth, 136 pp., $1 net. American School of Correspondence, Chicago, Ill.

Twenty-Eighth Annual Report of the Board of Gas and Electric Light Commissioners of Massachusetts for 1912. Paper, 717 pp. Forrest E. Barker, Morris Schaff, Alonzo R. Weed, commissioners, Boston, Mass.

Elements of Water Bacteriology: With special reference to sanitary water analysis. Third edition. By Samuel Cate Prescott, associate professor of industrial microbiology in the Massachusetts Institute of Technology, and Charles-Edward Amory Wilson, associate professor of biology, College of the City of New York, and curator of public health, American Museum of Natural History. Cloth, 330 pp., $1.75 net. John Wiley & Sons, New York City.

Vitrified Brick as a Paving Material for Country Roads. By Vernon M. Pierce, chief engineer, and Charles H. Moorefield, senior highway engineer, Office of Public Roads. Paper, 33 pp. Bulletin No. 23 of the U. S. Department of Agriculture, Washington, D. C.

Water Purification and Sewage Disposal. By Dr. J. Tillmans, director of the chemical department of the Municipal Institute of Hygiene, Frankfort-on-Maine. Translated by Hugh S. Taylor, M. Sc., Univ. of Liverpool. With 21 illustrations in the text. Cloth, 143 pp., $2 net. D. Van Nostrand Co., 25 Park Place, New York City.



MACHINERY AND SUPPLIES

Aztec Asphalt in Baltimore Pavements

The, asphalt pavements of Baltimore Md., are laid under the standard specifications of the American Society of Municipal Improvements, which are open enough to permit the use of all asphalts suitable for asphalt pavements in cities, at the same time that they are strict enough to exclude asphalts which will not produce good pavements.

The work of the new paving commission of Baltimore was described in part in MUNICIPAL ENGINEERING, January number. Under that body Baltimore is passing rapidly from under its old reputation as a cobble town and now has many miles of pavements which are equal to the best anywhere. Progress would be still more rapid were it not necessary to wait for the construction of sewer lines in the system of sewers and drains which is under construction.

During the past two years a number of streets have been paved, using Aztec asphalt under these specifications, which are now giving satisfaction, under a traffic which is classed as light to medium. The accompanying table gives data concerning these streets. The yardage given includes the granite and brick gutters, intersections, etc.

A number of streets are included in the printed city report in which Aztec and Bermudez were used together in about the percentage of Bermudez 60 and Aztec 40 per cent.

The city has under contract at the present time for early construction about 74,000 square yards of asphalt pavement.

Aztec asphalt has also been used in bituminous concrete streets on Augusta, Madison and Mosher streets to the extent of some 8,500 to 9,000 square yards.

Sand Sprinkler for Smooth Streets

American cities are gradually coming to the point of sprinkling their smooth streets with grit at times when ice or fog make them slippery. Foreign cities have had this habit for some years and save many falls and much congestion of traffic thereby. The skidding of automobiles on streets in slippery condition is frequently a very dangerous occurrence and will be prevented by a light sprinkling of the grit. One objection to sand-sprinkling the slippery streets is the cost of putting on the sand and then taking it off, but our climate is dry for so much more of the time than that of London, for example, that we would not be obliged to do this sanding and sweeping up every day

STREET.	Base.	—Asphalt— Top. In.	Binder. In.	Length.	Sq. yds.	Cost per sq. yd.
Castle, Fayette to Madison	6-in. conc.	2	1½	1,818.2	6,347.5	$1.65
Chester, Baltimore to Lombard	6-in. conc.	2	1½	285.0	......	.....
Collington, Orleans to Ashland	6-in. conc.	2	1½	1,748.9	......	.....
Conway, Sharp to Charles	6-in. conc.	2	1½	730.4	......	.....
Front, Gay to Hillen	6-in. conc.	2	1½	134.0	......	.....
Lanvale, Linden to Park	6-in. conc.	2	1½	645.8	2,884.6	1.65
Lanvale, Madison to Eutaw place	6-in. conc.	2	1½	289.2	1,300.3	1.65
Linden, Biddle to Dolphin	6-in. conc.	2	1½	1,189.2	2,470.8	1.70
Lombard, Chester to Patterson Park ave	6-in. conc.	2	1½	1,189.2	2,470.8	1.70
	Cobble	1½	1½	701.4	......	.....
McCulloh, Lafayette to North	6-in. conc.	2	1½	3,410.2	14,393.6	1.65
Montford, Baltimore to McElderry	6-in. conc.	1½	1½	140.0	......	.....
	Cobble	1½	1½	1,892.6	......	.....
Mulberry, Monroe to Fulton	6-in. conc.	2	1½	447.4	......	.....
Park, Lafayette to McMechen	6-in. conc.	2	1½	787.1	4,046.7	1.65
Richmond, Cathedral to Howard	6-in. conc.	2	1½	942.5	......	.....
West, Light to Riverside	6-in. conc.	1½	1½	906.2	3,203.9	1.65

for many days together as they do, and so the cost should be much less with us than with them.

Another reason for lower cost is found in such apparatus as the new wagon for sprinkling sand and gravel, made by Chas. Abresch Co. and sold by the Kindling Machinery Co. of Milwaukee, Wis. This wagon has a revolving disc with vanes on its upper surface which distributes the gritty material uniformly by centrifugal force as the wagon moves along. It is fed by a chute from the wagon bed above which is governed by a gate operated by a lever at the driver's seat, so that one man can drive and operate.

Milwaukee has one of the wagons which sanded three miles of pavement one day late in January and, according to one team owner, saved no less than $2,000 worth of horseflesh by the operation. At the First avenue viaduct the roadway was so icy that some forty loaded coal wagons could not cross until the roadway had been sanded. Such classes of evidence as these two demonstrate the economy of the sanding wagon.

The next problem will be to remove the sand when the occasion for it has passed and it is being ground into dust to be blown about. While this must be reckoned with, it is evident that the benefit from the sanding is far greater than the total cost with this subsequent removal added on.

Park Fences of Artistic Design

An illustrated description of the construction features of the fences designed and manufactured by the Van Dorn Iron Works Company of Cleveland, O., was given in the January number of MUNICIPAL ENGINEERING. A view of one of the fences will be found elsewhere in this number. That the designs are popular and the construction is satisfactory is shown by the list of parks, cemeteries and like public and semi-public grounds in which they have been used. A few of these are noted as follows:

Maplewood Park, Rochester, N. Y., has 1,200 feet of fence 4 feet 6 inches high, using the ⅝-inch square picket, and 1,500 feet 5 feet high has been built around Highland Reservoir by C. C. Laney, the superintendent of parks. It has also been used around Mount Hope cemetery in Rochester. Another design is used for a playground which requires 1,500 feet, 6 feet high.

The National Volunteer Soldiers' Home at Los Angeles, Cal., is surrounded by 6,400 feet of one design, which is 6 feet high.

One popular design is used by several cemeteries such as the Fort Hill Cemetery Association, Auburn, N. Y., J. H. Woodruff, chairman, which uses 3,000 feet of it, 5 feet high. It is also used by state institutions such as the State Hospital for Insane at Warren, Pa., J. W. Greenland, steward, which is surrounded by 3,500 feet of 5-foot fence. Such corporations as the Burden Iron Co., Troy, N. Y., find use for a good looking as well as a good fence, that plant having in use 1,800 feet, 6 feet high, with the ⅝-inch square pickets. Park commissioners use a similar design, the board of park commissioners of Brookline, Mass., having 1,000 feet of the 5-foot fence in use under specifications of A. H. French, their architect.

This list can be indefinitely extended by the manufacturers, the Van Dorn Iron Works Company, Cleveland, O., who will on request send full information about the fences they manufacture, as well as the other iron and steel work which their plant is fitted to turn out.

Police Signal System of South Bethlehem, Pa.

The city of South Bethlehem, Pa., has just begun the use of its new police signal system, which was installed at a cost of about $2,500 by the National Police Signal Company of Buffalo, N. Y. The system was installed under the direct supervision of its inventor, Louis W. Miller, and was thoroughly tested, the final tests being made Feburary 4, when the plant was accepted and put in operation. The construction was authorized about a year ago and some outside work was done early in the year, but Mr. Miller's work was done during the last two months.

The system of fifteen stations is operated by current supplied by batteries located at police headquarters, these being in duplicate so that one set is always ready for use. The batteries are charged from the alternating current used for street lighting thru the usual transformer.

Each station is on a separate circuit, so that trouble on it does not affect any other circuit. Fuses, automatic arresters of overcharge or lightning, etc., are ample, and trouble on a line is shown on the switchboard by its own red lamp, which remains lighted until the trouble is removed.

Each station is in a waterproof box and is supplied with a telephone, an emergency button, a loud ringing bell and a red lamp which is strong enough to be seen two miles. An officer can communicate with the central station by telephone and on occasion by pressing the emergency button, and the distress signal thus made will continue until the central operator responds by appropriate flashes of the light.

The bell and the light are to enable the central operator to call patrolmen to the box for communication with them. Any particular officer can be located in less than four minutes if he obeys his orders and is on regular duty. Any number of officers can be called at the same time. If the central operator is not in too great a hurry he can set a signal so that when the officer opens the station box to send in his report a whistle is heard which causes him to ask for the special communication.

Attached to the switchboard at headquarters is an automatic time recorder which registers the exact time a report is made and the box from which it is made. This recorder is locked and cannot be tampered with except by the holder of the key.

Mr. Miller added to his contract without charge a demonstrating box at headquarters containing all the apparatus in the outside stations, a motor-generator, a ringing motor-generator, an automatic controlling device and a "howler" circuit. A fire call to the fire department was also provided for.

The system is improved and perfected and is even more modern and complete than that installed by the same company in Buffalo, N. Y.

Fifth Avenue Pavement in New York

The first modern pavement laid on Fifth avenue in New York was of granite blocks put down in 1886. For years it was considered the only pavement which would stand the traffic, but in 1897 a Trinidad asphalt pavement was put down on the continuous demand of the shopkeepers and residents for something less noisy than the granite blocks. This pavement was put on a concrete foundation and consisted of the cushion coat of broken stone coated with asphalt, which was then popular, and a 2-inch wearing surface of the regular Trinidad asphalt specification.

For sixteen years this pavement on the eight busiest blocks of the street, from Thirty-fourth to Forty-second street, has stood what is the heaviest traffic of any street in the world with but two or three exceptions and has worn down smoothly so as to keep its uniform wearing surface until it was in many places not more than one-fourth inch thick.

It became necessary, therefore, to resurface the street, and this was done in fifteen days' time last September. The area resurfaced is about 13,600 square yards, so that this is very nearly a world's record for speed of performance. Trinidad asphalt was used in the repaving on account of its excellent record under the rapidly changing and the increasing traffic of the past sixteen years, and the same method of construction was used as in the first pavement, except that the cushion coat was made more dense and becomes more nearly a part of the top coat, except that the stones in it are larger, so that it is an asphaltic concrete layer rather than a true asphalt pavement wearing surface.

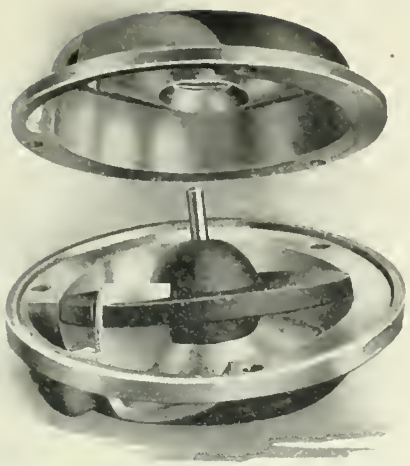
It is said that Fifth avenue has had so many concrete foundations put under it iu the past that in some places the pavement base is from nine to twenty inches thick. This may well be true where it has been required that trenches dug in the street be thoroly filled and the concrete base of the pavement be thickened in replacing the pavement over the filled trench.

Disk Water Meters in St. Louis

A recent paper by Fred L. Bock, of the St. Louis water department, before the Engineers' Club of St. Louis, gives a brief history of water meters in that city, beginning with the plunger meters in use in 1880. The rotary piston meter began to displace the plunger type in 1892. Later the disk and velocity types came in, and it it now the policy of the water department to give preference to the disk and velocity types.

The most popular meter at the present time in sizes smaller than 3-inch is the disk type, such as is made by the Buffalo Meter Company, Buffalo, N. Y., so called from the shape of its hard-rubber piston. The disk-shaped piston may be said to rotate or wobble about the ball and socket bearing at its center, as may be seen from accompanying cut. The chamber in which the disk mutates may be described as a portion of a sphere inclosed by the zone generated by the revolution of an arc about the diameter as an axis. There are two shapes of disk, one flat and the other conical. With a flat disk the top and bottom of the chamber are conical in shape and symmetrical. With a conical disk the bottom of the chamber is flat.

A diaphragm extending from the outer wall of the chamber to the ball of the disk at the center divides the chamber so that the water entering at one side of the diaphragm travels around the annular-shaped chamber, forcing the disk before it, and is discharged from the opening at the other side of the diaphragm. The two lines of contact between the disk and top and bottom of chamber divide it into four parts, of which two are continually filling and the other two discharging. This results in a continuous flow, and the volume displaced per revolution is the volume of the chamber minus that displaced by the disk.



DISK WATER METER, *open to show its simplicity and reasons for its durability.*

Impedance of flow is an important factor in meter design. At smallest rate of flow measurable by any type the impedance is negligible. The velocity type of meter impedes the flow least, but it is less accurate with low velocities. Next best is the disk type, which is accurate with low velocities, and this accounts for the popularity of this type as noted. The full capacity of tbe disk type can be regulated easily, within limits, by the relative size of inlet and outlet passages to the measuring chamber.

The disk type of meter maintains its accuracy well, generally 90 per cent. or better, until it fails entirely. The maintained accuracy can be explained by the fact that the wearing surface of a disk is concentrated at the ball and socket bearing. This affords only a small surface exposed to grit and slippage. When the wear in the bearing allows sufficient play, the edge of the disk will bind in the chamber and so cease to operate and probably break. These disks are quite cheaply replaced, and are very readily accessible for repair. The meter itself has low first cost.

Refuse Disposal at Trenton, N. J.

The city of Trenton, N. J., in the process of modernizing itself which is going on under the commission form of government inaugurated recently, bas taken up the question of refuse collection and disposal.

Last April an ordinance went into effect providing that garbage should be drained and wrapped in paper and collected with the refuse, to be burned in the existing Davis crematory. During one year previous the amount of refuse burned in the crematory was 18,349 tons, 270 pounds per head of population, the maximum in one day being 62 tons. To consume this refuse 275 tons of coal were required in addition to the combustible matter in the refuse. The total cost of operations was $6,632, or 48 cents per ton, not including deterioration or fixed charges.

The ashes were collected and dumped separately at a cost of 35 cents a ton for the 38,285 tons bandled, dumping lands costing nothing and hauls being short and level. The weight of ashes per capita per year was 730 pounds, making the total of ashes, garbage and rubbish 1,000 pounds per capita per year.

Hering and Gregory, consulting engineers, New York, were employed to give a report upon the subject and to recommend a course of procedure for the future. Using the information as to population and amount of refuse disposed of and making an estimate of the probable increase in population, they recommend the construction of two 60-ton high-temperature destructor furnaces to dispose of the 123 tons maximum daily amount of all refuse probable in 1930. One of these furnaces would take care of the present daily product, and the other would be in reserve until such time as the amount increases to such an extent as to require the use of the second furnace for part time and ultimately for full time.

The high-temperature destructors such as the Heenan-Froude plants in the Borough of Richmond, New York City, Milwaukee, Wis., Atlanta, Ga., and elsewhere, are supplied with boilers, and the heat of the combustion produces steam in sufficient quantities to produce power for the uses of the plant itself with a residue which can be sold if the operation of the plant is sufficiently uniform to make the supply of power steady.

Trenton must pump its sewage, and it is proposed to equip the garbage destructor to supply the necessary power. It is estimated that the plant when run at the maximum rate of 123 tons a day will produce about 350 k. w. of current, whereas the power required for pumping sewage is about 275 k. w. Ultimately, therefore, the one plant can fully serve the other, tho the average run of the destructor plant will be about 60 per cent. of the maximum, and the maximum stated will not be reached for over 15 years under the estimate. Meantime some outside power must be provided to make up the deficiency or the collection of refuse must be stimulated.

Another source of revenue or conservation is the clinker produced by the destructor. Assuming 25,300 tons of refuse garbage and ashes as disposed of in 1930, the quantity of clinker estimated is about 5,000 cubic yards, which could take the place of that amount of broken stone now used in street paving, more than that volume being used for this purpose each year. Broken stone now used costs $1.83 a cubic yard, and the value of the clinker is estimated at $1. The present quantity of mixed refuse would supply about half this amount.

The engineers' report compares this kind of plant as to results with others and recommends the high-temperature destructor.

Concrete Hollow Walls for School Building

The constantly advancing price of building materials and labor and the obvious need of fire protection in buildings, both public and private, makes timely an account of a method of construction that promises better structures at less cost.

The new school building of the Berkshire Industrial School at Canaan, N. Y., is not a fireproof structure, but is one of the highest fire-resisting types, and cost no more, or actnally less, than the usual frame or brick and frame construction.

Some small buildings had been erected for the school the previous year by a comparatively new method of concrete construction known as the Van Guilder Hollow Wall System, using machines manufactured by the Van Guilder Hollow Wall Company, 734 Chamber of Commerce building, Rochester, N. Y., which consists of two reinforced concrete walls separated by a 2½-inch air space at every point, yet bonded by thousands of galvanized steel tires. This form of construction eliminates all form work and it dispenses with the use of building units, which means that the concrete is handled but once, and most of the work is done by unskilled labor.

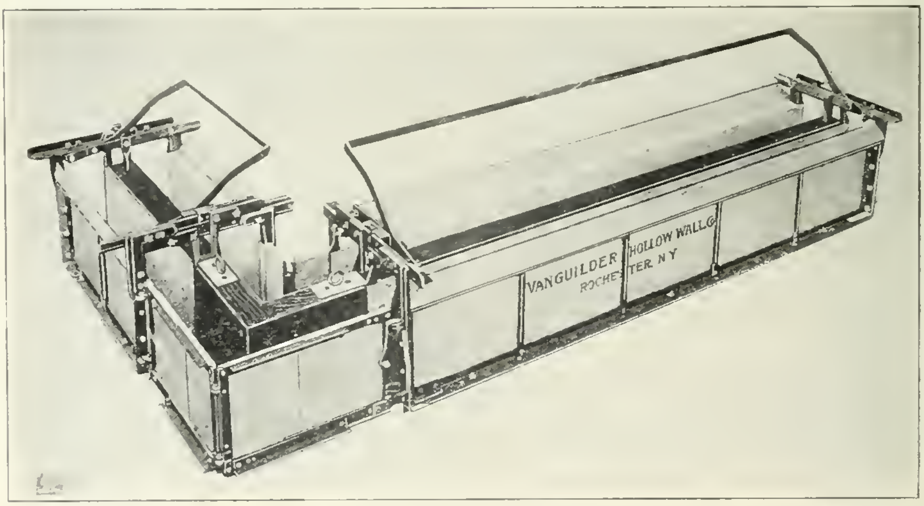
The machine shown in the photograph is tamped full of concrete and the lever raised, which releases the machine. The machine is at once moved along and again filled, and so in a complete course around the building, the remarkable fact being that no interval of time is allowed for the concrete to set.

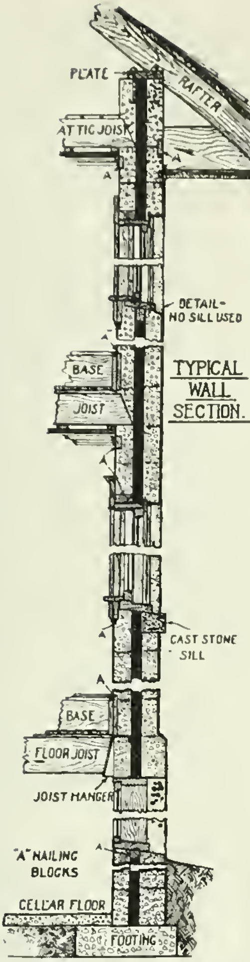
Provision is made for coupling two machines at the corners so as to insure jointless work, continuously reinforced; also for adjusting the machines to different wall thicknesses and for building in door and window frames in any desired position.

Both inside and outside surfaces of the rough wall are in effect scratch coated and form a perfect bond for plaster and stucco.

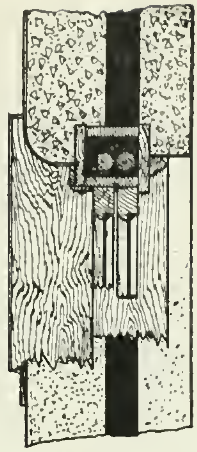
The outside walls consist of a 6-inch inside and a 4-inch outside concrete wall of bank-run sand and gravel mixed with cement 1:6 and reinforced with No. 9 galvanized wires in each wall 9 inches apart around the building. Over each opening, less than four feet, were placed two ½-inch twisted rods, and over the mullion windows were placed steel lintels consisting of two 7-foot channels bolted

MOLDS *for making Van Guilder hollow concrete walls, set for making corner.*





SECTION *of Van Guilder hollow concrete wall.*



DETAIL OF WINDOW TRIM *for Van Guilder hollow concrete wall.*

together with pipe separators and covered with wire mesh to receive stucco and plaster.

Two chimneys were carried up with the walls and each has two 10-inch round flues lined with vitrified flue lining. One also carries a 14-inch square vent flue ventilating kitchen and bakery.

The dimensions of the building are 48x80. In the basement are three storerooms, boiler room, two rooms for detention, common room for the boys and bath room with six shower baths and other toilet arrangements.

The first floor contains four dining rooms seating thirty boys, a sitting room for the staff and kitchen and bakery.

The second floor contains a large, airy dormitory for twenty-five beds, with toilet appointments. On the same floor there are six rooms for workers and one for guests, sewing room and bath rooms.

The third floor has a bath room and four rooms for the staff.

The floor and partitions have wood joists and studding, metal lath, plaster board and cement plaster, as shown in part in the typical wall section.

An interesting detail in line with modern sanitation is the elimination of wood trim, wherever practical, at a considerable saving in cost. All windows are finished as shown in the cut, corners being rounded in the rough wall and finished in plaster. The roof is of frame covered with green slate and the exterior of the building is finished with white stucco.

This building was erected by the school under the direction of Assistant Superintendent McClain. The actual construction was in charge of Mr. Chas. DeGroat, an expert representing the Van Guilder Company. The cost was considerably less than the building could have been erected for by other methods, and no other construction shows such economy in maintenance.

The architect is Mr. Cecil Evers, 184 Montague street, Brooklyn, N. Y.

Goodyear Believes in Safety First

One hundred and fifteen factory foremen of the Goodyear Tire and Rubber Company, Akron, Ohio, have been organized into a compact and aggressive "safety first" battalion. This organization was perfected at a banquet presided over by President F. A. Seiberling of the Goodyear Company, and addressed by him and other Goodyear officials, as well as other outside "safety first" experts of note.

Introducing the subject, President Seiberling said:

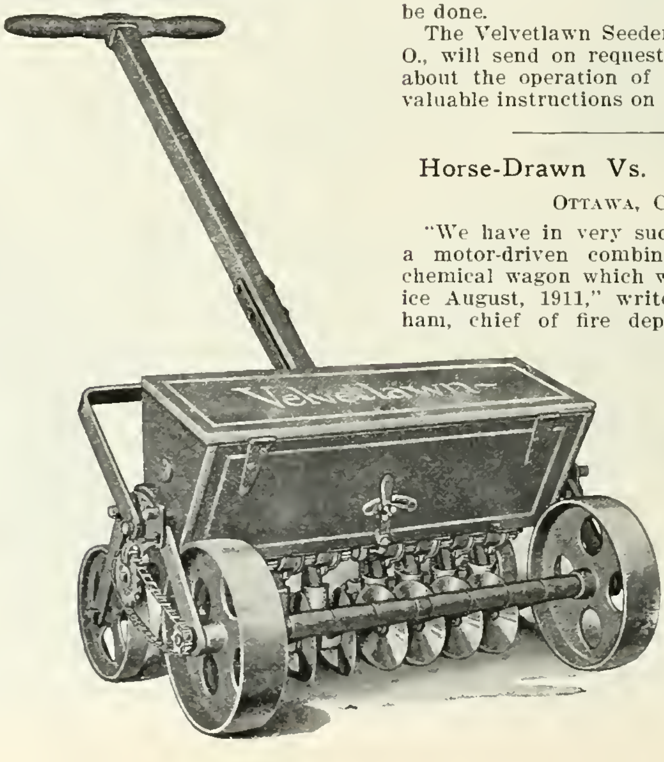
"During the past year 8,000 men have worked for Goodyear. During the coming year this number will be increased to 10,000. It is inevitable among such a multitude that accidents will happen. Goodyear foremen need to realize the necessity of safeguards and constant vigilance. This company holds the safeguarding of the lives and well-being of its employes as a high moral obligation."

Moving pictures showing safety devices and the danger of their absence illustrated various talks, and a squad was organized to patrol the 41-acre factory constantly, looking for dangerous operations, instructing workmen and suggesting safety devices.

Tho installed but a short time, the "safety first" organization has already caused a noticeable reduction in the number of minor accidents reported among the thousands of Goodyear workmen.

How to Keep a Perfect Lawn

Two of the principal necessities of a permanently good lawn are frequent seeding and proper fertilizing. These have heretofore been difficult to secure without great labor, and then the results are liable to be uneven. A piece of apparatus intended to reduce the labor and increase the efficiency of lawn seeding and fertilizing is the "Velvetlawn" seeder, with its variation, the fertilizer sower.



The Velvetlawn seeder is made as a hand-power machine for putting greens for golf courses and for small lawns. A one-horse machine is made for use on larger areas, making new lawns or improving old ones.

The principle of the seeder is that of the disk plow, the disks opening trenches deep enough so that the seed, which is fed automatically by hoots alongside the disks, drops into the deepest part of the trenches. The seeder may be equipped with individual automatic press wheels traveling behind the disks to close the trenches and press the seed down, or the water-weight roller is supplied, with which the green can be rolled both ways wtih the same result. The disks also have the effect of cultivating the grass roots. They are 2 inches apart on the hand machine, and by lapping half the width of the machine the rows of seed can be laid 1 inch apart.

The one-horse seeder is fitted with the automatic press wheels or with drag chains for smoothing the sod, or the roller can be used after the seeder has passed over.

The saving in grass seed and the saving in labor together far more than pay the cost of the roller in a season, if there is any considerable amount of lawn work to be done.

The Velvetlawn Seeder Co., Springfield, O., will send on request full information about the operation of the machine and valuable instructions on the care of lawns.

Horse-Drawn Vs. Motor-Driven

OTTAWA, CAN.

"We have in very successful operation a motor-driven combination horse and chemical wagon which we placed in service August, 1911," writes John W. Graham, chief of fire department, city of

Ottawa, Canada. "This 6-cylinder 80-h. p. machine is proving most efficient and economical, as will be seen by the following expenditures for the department for the year 1912:

New horses (annual estimates)	$1,500.00
Horse feed	5,220.00
Harness repairs	160.20
Veterinary	403.25
Horseshoeing	668.75
Repairs to stables	94.00
Total cost for year	$8,046.20
Cost of maintaining 46 horses per year	$8,046.20
Cost of maintaining 1 horse per year	174.91
Cost of maintaining 1 horse per month	14.57
Cost of maintaining 1 horse per day	46½
Cost of maintaining 1 Seagrave combination hose and chemical truck per year, which includes gasoline, repairs, etc.	126.48
Cost of maintaining combination per month	10.54
Cost of maintaining combination per day	34½
Making a saving per day of	$0.12
Making a saving per month of	3.72
Making a saving per year of	44.64

Charleston, S. C.

"The motor driven combination which we placed in service September 1, 1912, eliminated without loss of efficiency one chemical engine, one hose wagon and five horses and afforded a superior and more economical service," state Louis Behrens, chief of fire department, Charleston, S. C.

"This 80-h. p. Seagrave combination also serves as a tractor for pulling of a second size steamer, and its cost of operation from September 1, 1912, to August 31, 1913, is as follows:

Cost of repairs, including labor and material	$36.80
Cost of lubricating oil	16.65
Cost of charging batteries	17.00
Spark plugs	7.00
Cost of gasoline, 170 gallons	28.94
Total cost	$106.39

"The cost of operating and maintaining a horse drawn chemical engine, steamer and hose wagon for a period of twelve months, including forage and shoeing of five horses, averages $800, as against $106.39, cited above, thus making a saving of $693.61. The substitution of our motor combination for above listed pieces of horse-drawn equipment also eliminates salaries of three drivers at $900, thus effecting a saving in salaries of $2,700, or a grand total of $3,393.61."

Asheville, N. C.

J. H. Wood, chief of fire department, Asheville, N. C., furnished the following data on the operation of two 80-h. p. Seagrave combinations, each equipped with two 20-foot extension ladders, one 45-gallon chemical tank and 200 feet of 1-inch chemical hose:

From September 1, 1912, to September 1, 1913:

Cost of repairs, including labor and material	$ 88.73
Cost of lubricating oil	10.82
Cost of gasoline, 550 gallons	88.00
Total cost	$187.55
Distance traveled	487.2 miles
Cost per mile	$ 0.388
Cost of horse drawn apparatus (same equipment) for same period	915.50
Cost of horse drawn apparatus per mile	1.92

Napa, Cal.

"We have in operation one piece of motor-driven fire apparatus, viz., an 80-h. p. Seagrave combination chemical and hose wagon," writes C. F. Otterson, chief of fire department, Napa, Cal. "This piece of apparatus has been in service for thirty-four months, answering 148 alarms. Its cost for this period, including spark plugs, batteries, lubricating oil, gasoline and waste, totals $44.50. This makes a total per month for upkeep of but $1.25, as compared with $24.00, the cost of horse drawn apparatus (same equipment) for same period. This motor combination has controlled 140 of the 148 alarms which it has answered, without outside assistance, at a gasoline consumption of 108 gallons, $16.50. The total cost of lubricating oil for above period is $2.50.

Iowa City, Iowa.

James J. Clark, chief of fire department, Iowa City, Ia., submits the following cost data based on the operation of a Seagrave motor combination chemical and hose wagon:

January 14, 1913, to October 1, 1913:

Cost of repairs, including labor an material	$ 3.00
Cost of lubricating oil	7.00
Cost of gasoline	30.00
Total cost	$40.00
Distance traveled	400 miles
Cost per mile	$ 0.10
Cost of horse drawn apparatus (same equipment) and traveling same distance for same period	240.00
Cost per mile	.60

Jefferson City, Mo.

John W. Case, chief of fire department, Jefferson City, Mo. (which city has no horse drawn apparatus), submits the following data on the operation of a Seagrave 80-h. p. motor combination chemaicl and hose wagon:

Cost of repairs, including labor and material	$ .65
Cost of lubricating oil	2.00
Cost of gasoline	11.25
Total cost	$13.90
Distance traveled	65 miles
Cost per mile	$0.213

Market Place, Fort Wayne, Ind.

The illustration accompanying shows the Fort Wayne, Ind., market house, constructed entirely of concrete except roof, and extending for a block and a half along Barr street from the rear of the city hall one-half block to Wayne street, and entire block from Wayne to Washington streets. There is an entrance into each of these sections from Wayne street and into the longer section also one from Washington street, a pavilion being provided at each entrance. The two pavilions facing each other on the opposite sides of Wayne street are connected by steel arches, from which electric lights are suspended, and contain the market master's office, as well as the public toilet rooms. The entire length of the market is 450 feet and the width from curb is 26 feet 8 inches. The teams back up to these curbs, outside the structure, while the purchasers use the passage through it.

The pavilions are of the Ionic order of architecture. The capitals of the columns were cast in glue molds, as were also the lions' heads over the drinking fountains, while the other architectural features, such as rosettes, keystones, etc., were cast in plaster molds and set in place as the structure went up. The drinking fountains were cast in place, all pipes, etc., being previously placed in position. The walls of the pavilions were built upon a core of brick work, presenting an unbroken surface of concrete made of white sand and Medusa white portland cement, with an aggregate of birdseye or roofing gravel. When the forms were removed the surface was scrubbed with wire brushes, exposing the aggregate, and the general effect is very pleasing. The columns were cast in place in the same manner as the columns of the main entrance.

In the main part of the structure there are 54 round columns, and 2 square columns at the end next to the city hall. The round columns are 8 feet 9 inches high, each resting on an octagonal base which varies in height with the elevation of the ground surface. The shafts are 24 inches in diameter at the base and 21 inches at the top, and each is surmounted with a plain molded capital and square cap. These columns support the roof, and within the space inclosed by them are the tables used by the market men, and the passage way for purchasers.

Medusa waterproofing was used in all of the concrete to the extent of about 1½ or 2 per cent. of the amount of cement used. Twenty-four hours later the forms were removed and the surface brushed. In casting the columns long bolts were

CONCRETE MARKET HOUSE, *at Ft. Wayne, Ind., immediately behind the City Hall.*

imbedded in the top of them in the line of their axis, and protruding for some distance for the purpose of anchoring the roof to the columns. The caps of the columns were cast with circular openings in the center, thru which the bolts would pass, and after the caps had been accurately adjusted to place this opening was filled with concrete, this serving the double purpose of holding the caps in place and giving additional anchorage to the bolts. The roof consists of a framework of wood covered with red roofing tile. A concrete floor is provided for the entire structure.

The architects for the market building were Mahurin & Mahurin, and the general contractors were Borkenstein & Son, while the cement and waterproofing were furnished by Wm. Busching Supply Company, all of Fort Wayne, Ind.

A Portable Plant Laying Asphaltic Concrete Pavement

The accompanying photograph shows the portable asphalt plant belonging to C. H. Atkinson, laying an asphaltic concrete pavement in Watertown, S. D., with which he completed 30,000 square yards of street in sixteen days.

The plant is 65 feet long, and is complete in every particular. It can be set up, ready for operation, or knocked down for transportation within a day. It will mix material for sheet asphalt, asphaltic concrete, Topeka specification or binder, and can be changed from one to another without causing any delay.

The plant was built by the F. D. Cummer & Son Co., of Cleveland, O.

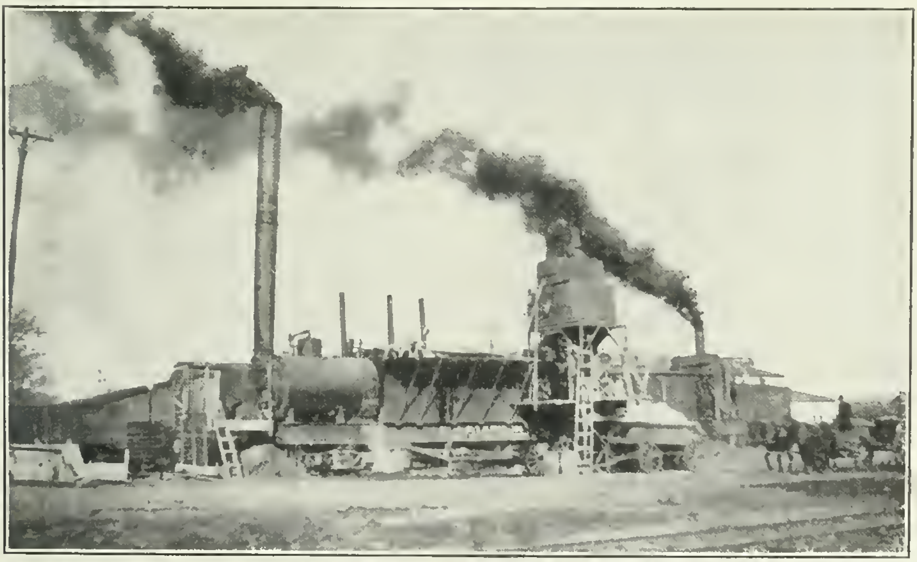
The Wylie & Hooper Refuse Destructor

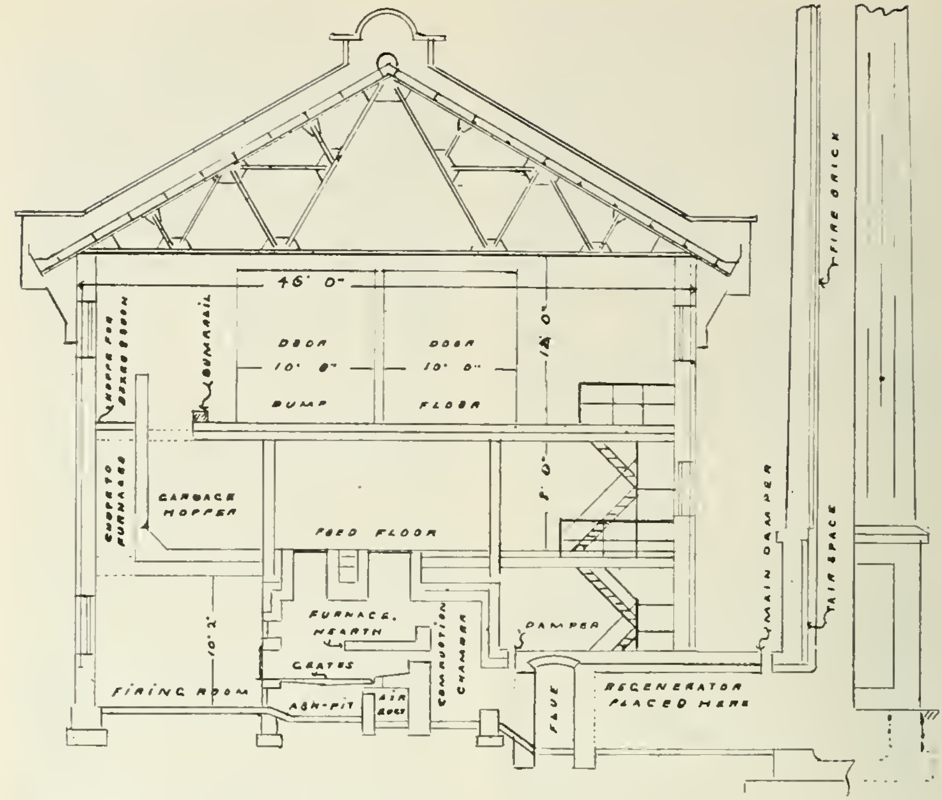
A new and improved type of destructor, for the purpose of destroying garbage, fruit, manure, and other town wastes, has recently been designed and patented in the United States by Messrs. Wylie and Hooper, of the city of Vancouver, B. C. This furnace has been designed by men experienced in destroying all classes of waste matter. Mr. Wylie has been superintendent of the garbage department for a number of years, while Mr. Hooper is an engineer of considerable ability and is in charge of the Incinerator.

This destructor is designed to meet any and all requirements, whether in an isolated place with a few hundred people, or in a large city with 1,000 tons per day. The destructor can also be built to suit private institutions, warehouses or hospitals. Actual experiences have clearly shown the inventors of this furnace that in all cases local conditions must be considered and they govern the class of furnace that will be best suited. It is ordinarily useless to try and make conditions to suit the furnace.

This destructor is designed on the unit basis, each unit being entirely separate from the other and having its own combustion chamber, which discharges into a flue common to all. Each unit is supplied

CUMMER ASPHALT PLANT *of C. H. Atkinson, laying thirty thousand square yards of street in sixteen days at Watertown, S. D.*





THIS SECTION *of a Wylie garbage destruction plant shows clearly its construction and method of operation.*

with a damper between the main flue and the furnace, so that any unit may be cut out for any purpose, without in any way affecting the other. Considerable difficulty is found in staying or supporting the walls of furnaces, such as are in general use, when several cells or furnaces are joined together, but no trouble is found in this respect, where each individual unit is independently supported.

The drying hearth, which is over the burning grates and projects back to the combustion chamber, is one of the best hearths yet invented and is one of the main features of this invention. This hearth is so placed in the furnace that the radiated heat from its soffit destroys quickly the garbage placed upon the burning grates. This hearth is only used for material that is too wet for immediate combustion, such as fruit, etc. All material that can be destroyed without drying out goes directly to the burning grates and is there consumed.

The method of stoking the garbage as it is delivered on the burning grates is the opposite to that employed by most other designs. As the material drops thru the roof of the furnace it is deposited immediately behind the clinkering doors, whence it is pushed back on the burning grates. This method of stoking is much preferable to the usual method of pulling forward from the back of the furnace over the hot fires, as it prevents the stokers' tools from getting so hot, and the stokers are able to keep the fires more evenly spread.

These furnaces are of the high temperature type, having the air for combustion pre-heated and delivered under the grates by pressure. The inventors of this furnace do not recommend the use of steam boilers in connection with the garbage destructor. When the cost of installing the boilers and the upkeep of a staff of engineers is taken into consideration, the amount gained cannot in most cases meet the extra expense. The primary object of a destructor is to destroy garbage and other wastes. Anything that may be had by way of steam boilers being a side issue, the patentees of this furnace place but very little reliance upon.

The designs of the furnaces are modi-

fied to suit the local conditions and the work to be done.

One furnace of two units has one unit for dry refuse and dead animals and the other handles garbage, fruit, and the like. The refuse, if dry, can be dumped thru one opening directly thru to the burning grates, on which it is deposited close to the clinkering door. It can then be pushed back so as to be distributed evenly over the grate bars, the rear of the fires being under the arch of the drying hearth. If the wastes are wet enough to require drying they are dumped thru a second opening in the top of the furnace onto the drying hearth from which the dried material not burned on the hearth can be pulled forward by rakes used thru the stoking door, to fall onto the burning grate below. A bridge wall behind the drying hearth separates it from the combustion chamber behind, thru which the burning and burned gases pass down to the smoke port and main flue to the chimney. Complete combustion is insured by the triple opportunity to consume the gases formed in the furnace. The flues are provided with dampers so that the direction of the gases can be changed as the use of the furnaces requires and the ducts leading the air to the furnaces lie along the main flues so that the air is heated before it reaches the fire and has a high velocity of movement.

A furnace for a small city with a single unit will destroy 15 tons of refuse a day and a double unit will destroy 30 tons. Such a furnace with steel stack and galvanized iron house over it has been built for $4,500. A side door above the level of the drying hearth is provided in this furnace so that wastes can be fed to the furnace by shoveling thru this door as well as dumping thru the openings in the top of the furnace. A hot water heater is provided in the combustion chamber, also, and a cleanout hole under the stack opposite the main flue.

A small furnace designed for use in hospitals and the like with a single unit can be built for about $1,000. Provision is made in the combustion chamber for the destruction of mattresses and such waste. This furnace can supply hot water or steam if desired. A feed door is provided on the side over the drying hearth and the clinkering door is also used as a feed door. An opening can be put in the top for feeding purposes if the location of the furnace permits. The air duct surrounds the combustion chamber on sides and bottom to absorb heat and increase rate of combustion. The steam or hot water pipes are located in the combustion chamber.

A still smaller furnace, which can be built for $600 and up, is designed for use in large stables, warehouses, department stores, and the like. It is quite similar to the hospital furnace and can be so placed that the wastes can be sent directly into the furnace from the various floors of the building without re-handling. It can also supply steam or hot water if desired.

Peter Wylie, 242 Thirteenth avenue, E., Vancouver, B. C., will supply any details of information that may be desired.

Power from Garbage

A handsome advance catalog of the Harris garbage incinerator or destructor and power house combined has been issued by J. M. DeFord, 514 Penobscot Building, Detroit, Mich., which shows in perspective and by floor plans and sections plants proposed for Detroit and for Los Angeles, and the details of the design of the furnaces and boilers. The incinerator is designed for the destruction of mixed city wastes, such as garbage, rubbish, ashes, street sweepings, manure, dead animals and night soil, without odor or smoke and at the same time generating steam to drive dynamos or supply other power as desired.

Dust Collectors for Machinery

Conservation of health of the worker and making his surroundings more cheerful is being recognized more and more each day as a most certain way of earning dividends. This is so because a healthy and cheerful worker does more and better work than the average.

Polishing work is receiving the atttention of health and factory authorities all over the country to the extent that some means must be provided for sucking away the dust, whether the amount of work to be done is large and the operation of the shop continuous or the quantity small and the operation of the shop only occasional.

Our illustration shows a new device of this kind. It will be noted that the blower or suction apparatus is directly underneath the bench in such a position as to create a powerful suction directly at the buffs. This constant stream of air draws in every particle of dust and deposits it in the tank shown. It is then subsequently removed, and if of value the latter is then easily recovered.

Many devices for the removal of the disagreeable dust particles have from time to time appeared on the market, but this one seems to embody to a greater degree than any of them the principle of efficiency with compactness.

Note also the clever way in which provision is made for polishing various classes of work. One side is equipped with a long spindle. This allows ample

working space for buffing on articles of considerable dimensions, such as trays, pitchers, silverware and articles of odd shapes. The hood over the buffs is of such constrnction as to allow the raising of the top and lowering the under section. This provides additional room for swinging these large pieces of work.

The opposite side has a short spindle, at which all small work may be easily polished and at the same time subjected to the powerful current of air which sweeps the dust particles into the lower dust tank.

A machine of this kind may be operated with the electric motor as shown, or it may be connected by a belt to an overhead shaft.

The principal feature of a machine of this kind, aside from its main one of removing the dust, is its compactness and power-saving ability.

Heretofore, when it became necessary to install a dust-collecting system, a great deal of figuring of sizes of piping, dimensions of suction blower, style of disposal tanks, etc., became necessary. With this machine, however, it would appear that all of this work has already been done, and the complete machine may be purchased all set up and ready to run.

It is only necessary to know that the machine will accommodate buffs as large as about 8 inches diameter by 2 inches wide.

One-and-a-half-horse-power motors are generally used, but small outfits are also supplied with motors as small as one-third-horse-power. Small work and lighter work, of course, can only be done with the smaller machines. It is surprising, however, to see one of the machines at work, to see the strength exerted at the buffs of even the smallest size machine, and, best of all, to note the power of the current of air that is sucked into the machine at the buffs.

Much work doubtless is yet to be done by mannfacturers of this class of machinery before the ultimately perfect machine arrives, but until that time comes every factory, shop, college or manual training school, however large or small, should not overlook the desirability of securing a dust-collecting outfit for keeping their premises in a neat and presentable condition and at the same time to preserve health.

Twenty-seven Carloads of Pipe Covering for New York's Municipal Building

The most costly municipal building in the world is practically completed, and New York has established another high-water mark in the raising of colossal structures. So enormous is New York's new home for its municipal offices that the quantity of material used in its construction reaches stupendous figures.

The ordinary visitor, for instance, would not guess that one contract alone for covering the vast maze of pipes which thread this building involves 27 carloads of pipe covering material.

The various lines covered include steam, hot water, ventilating, cold water and ice water for drinking purposes.

This contract was awarded to the H. W. Johns-Manville Company, New York.

Hendricks' Commercial Register

The twenty-second annual Revised Edition of Hendricks' Commercial Register of the United States for Buyers and Sellers has just been issued. Its aim is to furnish complete classified lists of manufacturers for the benefit of those who want to buy as well as for those who have something to sell. The total number of classifications in the book is over 55,000, each representing the manufacturers or dealers of some machine, tool, specialty or material required in the architectural, engineering, mechanical, electrical, railroad, mine and kindred industries. It has 1,635 pages, with upwards of 390,000 names and addresses. The book is revised, improved and issued annually. It is expressed to any part of the country on receipt of ten dollars. S. E. Hendricks Company, publishers, 74 Lafayette street, New York.

Trade Notes

Contracts have been awarded the MacArthur Concrete Pile & Foundation Co., for the concrete pile foundations of the new Canadian Bank of Commerce building, Quebec, P. Q.; of the new High School of Commerce building, Springfield, Mass.; and a fifth contract for pedestal concrete pile foundations at the Canadian-Vickers, Ltd., ship building plant, Montreal, P. Q.

The Toronto branch of the Canadian Johns-Manville Company, Limited, announces its removal to more spacious quarters at No. 19 Front street, East. This new store and warehouse has a floor area of approximately 35,000 square feet and is situated in the heart of the wholesale district. In their new quarters this firm will be able to carry a larger stock and have ample space for the display of their complete line of J-M asbestos roofings, packings, pipe coverings, building materials, electrical and railroad supplies, automobile and plumbing specialties, etc. The entire building will be lighted by their well-known Frink and J-M Linolite System of Lighting and one room will be used for exhibiting these systems of lighting.

CONTRACTING NEWS

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Albany, N. Y.—March 6, until 1 p. m., for construction of sections of state highways, aggregating 70.59 miles. Certified check 5 per cent. of bid. John N. Carlisle, state highway commissioner.

Cincinnati, O.—March 6, until noon, for reconstruction of Geist road, from Big Four railroad tracks at Elizabethtown, to Cleves and Dugan Cap road; certified check, $3,000; for improvement of Powder House road, from south corporation line of Cincinnati, southeast to west corporation line of Cincinnati; certified check, $500. Fred E. Wesselman, president board of county commissioners.

Cincinnati, O.—March 13, until noon, for repair of Bridgetown pike, from Ferguson road to Five Points, at Muddy Creek; certified check, $1,000; for improvement of Campbell road, from Kilbey road west, 1,300 feet; certified check, $500; for improvement of Miami avenue, in Maderia, from Camargo pike to Shawnee road, certified check, $500; for improvement of Rose street, in village of Sharonville; certified check, $2,000. Fred E. Wesselman, president board of county commissioners.

Cleveland Heights, O.—March 16, until noon, for grading, draining, paving with brick, asphalt or macadam, and constructing sidewalks on Compton road, from south line of Mayfield road to north line of Euclid Heights boulevard; for grading Lee road, from Superior street to Fairfax road; for grading, draining, curbing and paving with asphalt, brick or macadam on Sycamore road, from Lee road to Ivydale road, Somerton road from Wilton road to Superior road, and on Euclid Heights boulevard, from Superior road to Lee road. H. H. Canfield, village clerk.

DeQuincy, La.—Until March 10, for constructing about 60,525 square feet of concrete sidewalk and 114,480 lineal feet of curbing. Plans and specifications may be obtained from mayor or T. H. Mandell, engineer, Lake Charles, La.

Grand View Heights, O.—March 14, until noon, for grading, draining and paving with macadam with bituminous surface treatment and constructing curbs and gutters of concrete on First avenue, from west corporation line to Grand View avenue; Broad View avenue, between First avenue and Goodale boulevard; Ashland avenue, First to Glenwood; Westwood avenue, First to Bluff avenue, and Paul avenue, Third avenue to Fifth avenue. Certified check, 20 per cent. of bid. V. W. Jones, village clerk, R. F. D. No. 5, Station A, Columbus, O.

Kokomo, Ind.—March 12, until 10 a. m., for construction of four stone roads in Howard county. E. B. Swift, auditor.

Racine, Wis.—March 7, until 10 a. m., for paving on Washington avenue, requiring 16,606 square yards brick paving, 6,854 lineal feet concrete gutter and 350 lineal feet concrete combined curb and gutter; for paving on North Wisconsin street, requiring 17,535 square yards brick paving, 8,112 lineal feet combined curb and gutter, 1,151 lineal feet concrete gutter; for paving Superior street, requiring 8,372 square yards brick paving, 4,141 lineal feet combined curb and gutter, 339 lineal feet concrete gutter. P. H. Connolly, chairman board of public works.

Silvis, Ill.—Until March 16, for paving six blocks on Eighth street, with brick. Wallace Treichler, engineer, Springfield; B. Walsh, mayor.

Struthers, Ohio.—March 11, until noon, for construction of sidewalks, crosswalks, curbs and gutters, during year 1914. Certified check, $100. Jonah Richards, village clerk.

Superior, Wis.—Until March 4, for repaving Ogden avenue, from North Third street to Belknap street. Materials—concrete, brick, asphalt and creosoted blocks. E. B. Banks, city engineer.

CONTRACTS AWARDED.

Baltimore, Md.—To Baltimore Asphalt Block & Tile Co., for paving with sheet asphalt on several street in Northwest and West Baltimore. Bid, $109,334.90. To P. Reddington & Sons, for laying vitrified brick pavement on several streets, at total bid of $57,487.34.

Concordia, Kan.—To Watts & Ammerman, of Salina, Kan., at about $50,000, for construction of five blocks of vitrified brick and six blocks of asphaltic concrete pavement.

Corsicana, Tex.—To General Construction Co., of Ft. Worth, for paving certain streets with vitrified fiber brick, with asphalt filling on cement foundation. Bid, $52,000.

Detroit, Mich.—For cedar block paving as follows: Cavalry avenue, from Fort street to Dix avenue, J. A. Mercier, $21,066.82; Delaware avenue, from Hamilton boulevard to Merrill street, Julius Porath, $3,994.23; Hulburt avenue, from Charlevoix street to Mack avenue, J. A. Mercier, $12,585.79; Pennsylvania avenue, from Mack avenue to alley south of Gratiot avenue, Thos. E. Currie, $50,208.40. All are local contractors.

Evansville, Ind.—To John Fridy, of Evansville, for construction of rock road in Knight Township, Vanderburgh county at bid of $9,900.

Joplin, Mo.—To Ozark Paving Co., of Joplin, for paving Broadway from proposed viaduct to High street about 10,000 square yards with asphalt. Total cost $19,697.30. Bid $1.89½ per square yard. Boyd Construction Co. of Kansas City bid $1.90 per square yard.

Park Ridge, Ill.—To Boyd & Graziano, of Chicago, for construction of 37,500 square feet of concrete sidewalk. Bid $4,545.00.

Rockport, Ind.—To Bennett & Scamahorn, of Rockport, for construction of Armstrong township road, Vanderburgh County at bid of $8,310.

St. Paul, Minn.—To Chicago Creosoting Co., for about 144,080 yards of creosoted block paving in University, Hastings, Prior and Hamline avenues at bid of $1.25⅞ per yard. Other bidders were: Republic Company, $1.27¼; A. W. VanHafften, $1.287; Phil W. Herzog, $1.297; Kettle River Company, $1.365.

Winfield, Kansas.—To Elliott & Vance, of Parsons, for 32,000 square yards of paving. Bid $1.82 per square yard for standard brick block on 5-inch concrete base.

CONTEMPLATED WORK.

Asheville, N. C.—30,000 square yards bitulithic, 2 miles street grading, 20,000 square yards cement sidewalks, and 12,000 lineal feet curb and gutter. B. M. Lee, city engineer.

Augusta, Me.—25 miles bituminous macadam roadway 16 feet wide, 5 miles cement concrete, roadway 16 feet wide, and 190 miles gravel roadway 21 feet wide. Paul D. Sargent, chief engineer, state highway department.

Barre, Vt.—5,000 square yards bituminous macadam, 3,000 square yards cement sidewalks, and 1,500 feet granite curb. H. Ward, mayor.

Bellingham, Wash.—Two miles of asphalt, three-fourths mile brick, 12 miles of either asphalt concrete or cement concrete,

2 miles cement sidewalk and 2 miles of concrete curb and gutter. W. H. North, city engineer.

Buffalo, N. Y.—245,336 square yards asphalt, 31,343 square yards brick, 11,198 square yards sandstone, 14,379 lineal feet street grading, and 18 miles cement sidewalks. Louis P. Fuhrman, mayor.

Canton, Ohio.—13,830 square yards asphalt, 13.3 miles of brick, 72,652 cubic yards street grading, 46,590 square feet cement sidewalks, 146,240 square feet stone sidewalks, 9,250 lineal feet concrete curb, and 35,160 lineal feet sandstone curb. W. E. Sarver, city civil engineer.

Canton, Ohio.—70,000 square yards of brick and 70,400 square yards cement concrete, and 42,240 lineal feet concrete curb in Stark county. W. L. Bender, county engineer.

Dunkirk, N. Y.—14,134 square yards sheet asphalt, 3,581 square yards concrete, 9,000 square yards cement sidewalks and 12,000 feet concrete curb and gutter. H. B. Lyon, mayor.

El Paso, Ill.—10,000 square yards cement concrete road construction in Woodford county. A. B. Hurd, county superintendent of highways.

Galesburg, Ill.—9,000 square yards brick on concrete foundation and 38,750 lineal feet concrete curb. F. N. Connolly, city engineer.

Indianapolis, Ind.—Paving of Riley avenue, from Washington to New York street, and Bancroft avenue, from New York to Michigan street. Estimated costs, $14,461.00 and $7,559.00. B. J. T. Jeup, city engineer.

Lawrence, Kans.—20,000 square yards asphalt concrete, 20,000 square yards brick, and 7,000 square yards cement concrete. E. N. Bond, mayor.

Long Island City, N. Y.—20,000 square yards asphalt, 24,200 square yards asphalt concrete, 5,500 square yards bitulithic, 37,000 square yards granite, 14,000 square yards wooden block, 560,000 cubic yards road grading including 1,000 yards rock, 72,000 square yards cement sidewalks, 32,000 square yards stone sidewalks, 3,000 lineal feet cobble gutter, 14,200 lineal feet of highways in Queens county.

Los Angeles, Cal.—32 miles of asphalt and asphalt concrete, 2 miles bitulithic, .75 miles vitrified brick, 3.5 miles cement concrete, 25 miles gravel and oil, 3.5 miles macadam, 1.5 miles warrenite, 100 miles cement sidewalks, 81.5 miles concrete curb, and 101.4 miles of granite block gutter, cement concrete gutter and brick gutters. C. R. Brawner, city engineer.

Minneapolis, Minn.—25,000 square yards asphalt concrete, 25,000 square yards bituminous concrete, 15,000 square yards brick, 50,000 square yards cement concrete, 150,000 square yards wooden block, 30 miles cement sidewalks and 75 miles concrete curb and gutter. W. G. Nye, mayor.

Peoria, Ill.—15,000 square yards asphalt, 150,000 square yards brick, 2,000 square yards concrete, 10,000 cubic yards street grading, 12 miles cement sidewalks (private), and 10 miles concrete curb 6 inches by 22 inches. E. N. Woodruff, mayor.

Oakland, Cal.—Three miles asphalt, 12 miles oiled macadam, 20 miles surface oiling and screenings on old waterbound macadam, 25 miles cement sidewalks, 2 miles brick gutter, 2 miles cobble gutter, 12 miles concrete curb, 26 miles concrete gutter, and 18 miles wood curb. Perry F. Brown, city engineer.

Seattle, Wash.—12 miles asphalt, 6 miles brick, 25 miles sandstone, 20 miles street grading, 43 miles cement sidewalks, 1 mile wood sidewalks, 18 miles brick gutter, 20 miles concrete curb, and 2 miles granite curb. A. H. Dimock, city engineer.

Springfield, Mo.—39,000 square yards asphalt concrete, 67,000 square yards cement concrete, 21,000 square yards sarcolithic, and 27,000 lineal feet cement sidewalks, 47,000 lineal feet concrete curb, and 20,000 lineal feet limestone curb. George W. Culler, mayor.

Vallejo, Cal.—10,500 square yards asphalt, 100,000 square yards asphalt concrete, 5 miles cement sidewalks and 10 miles concrete curb. Lawrence Thompson, city engineer.

Wenonah, N. J.—9,857 square yards bitulithic, 39,000 square yards bituminous concrete, 7,000 square yards bituminous macadam, resurfacing 2 inches thick, 5,200 cubic yards gravel, 6,000 tons of stone, 22,000 cubic yards road grading, and 20,000 square feet concrete gutter. Wm. C. Cattell, county engineer.

SEWERS.

CONTRACTS AWARDED.

Appleton, Wis.—To Lamars & Grignon, of Little Chute, for sewer work. Bid 65c per lineal foot for 9-inch pipe, $28.00 for manholes and $1.65 for "Y" branches.

Lamoni, Iowa.—To A. A. Dobson Co., Lincoln, Neb., at $23,014.00 for construction of 30,000 feet of 8, 10 and 12-inch sewer pipe and Imhoff tank and three filter beds.

Tampa, Fla.—To Sullivan & Greeson for construction of sections 1, 2, 3, 5 and 10 of sewer system at bids of $58,800, $17,900, $28,413, $120,728.88 and $41,977.00 respectively; to Edwards Construction Co., for section 4 at bid of $33,500, and to McNeil, Davis & Webb for sections 6, 7, 8 and 9 at bids of $110,274.35, $81,166.75, $136,751.50 and $31,433.25.

CONTEMPLATED WORK.

Ft. Wayne, Ind.—20,600 lineal feet 12, 15 and 18-inch vitrified pipe, 60 manholes and 18 catchbasins. Frank M. Randall, city engineer.

Galesburg, Ill.—2,000 feet of 12-inch sewer construction. F. M. Connolly, city engineer.

Minneapolis, Minn.—Five miles reinforced concrete and 20 miles vitrified pipe. N. G. Nye, mayor.

Seattle, Wash.—25 miles brick, 5 miles reinforced concrete, 20 miles vitrified pipe, 500 manholes and 750 catchbasins. A. H. Dimock, city engineer.

Springfield, Mo.—Twelve miles vitrified pipe and 225 manholes. Geo. W. Culler, mayor.

WATER WORKS.

CONTRACTS AWARDED.

Manhattan Beach, Cal.—To Municipal & Industrial Equipment Co., of Los Angeles, for construction of municipal water system at about $111,000.

BRIDGES.

BIDS REQUESTED.

Cedar Rapids, Iowa.—March 9, until 10 a. m., for construction of reinforced concrete bridge to replace the present "B" avenue bridge, extending across Cedar river, from east bank of river at "B" avenue east, across the river to west bank at "F" avenue, and for removal of present steel bridge, foundations, etc. Certified check, $5,000. L. J. Storey, city clerk.

Hamilton, Ohio.—Until March 30, for construction of a 520-foot span bridge. Bid will be received on submitted plans, both on riveted steel truss bridge and a concrete bridge. Estimated cost $150,000. W. W. Crawford, Butler county auditor.

Hamilton, Ohio.—Until March 30, for construction of a concrete bridge with an attached viaduct at Middletown, Ohio, over the Miami river. Estimated cost, $300,000. W. W. Crawford, Butler county auditor.

Knoxville, Iowa.—March 10, until 1:15 p. m., for construction of 90 reinforced concrete culverts and eight small steel bridges. J. D. Shlotterback, auditor.

Melrose, Minn.—July 17, until 8 p. m., for construction of a 100-foot steel bridge on concrete abutments. S. S. Chute, engineer, St. Cloud, Minn.

New Castle, Ind.—March 21, until 10 a. m., for construction of several arches and bridges and repair of others. P. H. Wolford, auditor Henry county.

Noblesville, Ind.—March 11, until 10 a. m., for construction and repair of a number of bridges and culverts in Hamilton county. W. O. Horton, auditor.

CONTRACTS AWARDED.

Clarion, Pa.—To Whittaker & Dieht, Union Trust Bldg., Harrisburg, Pa., at bid of $16,997.00 for construction of a 325-foot 3-span reinforced concrete arch bridge over Clarion river.

Holcombe, Wis.—To Continental Bridge Co., Chicago, Ill., at bid of $3,574.00, for construction of a concrete bridge.

Roseburg, Ore.—To Cowlitz Bridge Co., of Portland, for erection of bridge across Cow creek. Bid, $2,197.20.

Sandpoint, Idaho.—To J. H. Forbes Co., Ltd., of Caldwell, Idaho, for construction of two steel bridges on Eastport-Addie road, at bid of $10,234.00.

Wharton, Tex.—To A. A. Alsbury & Co., of this city, for erection of a bridge at Glen Flora, at bid of $11,900.00, and of Spanish Camp bridge, at $2,280.00.

CONTEMPLATED WORK.

Baraboo, Wis.—Four steel girder and ten concrete bridges in Sauk county. G. F. Post, highway commissioner.

Bethany, Mo.—Three steel truss, 18 steel girder, and five concrete bridges in Harrison county. John J. Werminger, county surveyor.

Benton, Mo.—Six or eight 10-foot arch concrete bridges. W. S. Murray, Scott county engineer.

Chattanooga, Tenn.—Plans have been accepted by city officials for the proposed reinforced concrete East End avenue viaduct and bids will be advertised for immediately so that work will be under way by April 1. Length of structure, 970 feet, width, 60 feet, and will cost approximately $70,000. Robert Hooke, city engineer.

Celina, Ohio.—Six steel girder and 30 concrete bridges. D. R. Smalley, county engineer, Mercer county.

Coalgate, Okla.—Six steel girder bridges in Coal county. I. L. Bowman, county surveyor.

Dana, Ind.—10 or 15 steel girder bridges ranging in length from 20 to 60 feet. H. Kaufman, county road superintendent and surveyor of Vermillion county.

Durand, Ohio.—Two concrete bridges 24 feet by 16 feet, in Pepin county. G. A. Goss, county highway commissioner.

El Paso, Ill.—Three steel girder and three concrete bridges in Woodruff county. A. B. Hurd, county superintendent of highways.

Freemont, Neb.—About ten steel girder bridges in Dodge county. John O'Connor, county clerk.

Galesburg, Ill.—Two concrete bridges. F. M. Connolly, city engineer.

Los Angeles, Cal.—One concrete bridge and two tunnels. C. R. Brawner, city engineer.

Minneapolis, Minn.—$900.000 will be expended on concrete bridges and $500,000 on viaducts for grade elimination. W. G. Nye, mayor.

Morrison, Ill.—One steel truss bridge and ten concrete bridges in Whiteside county. V. M. Taggett, superintendent of highways.

AUTOMOBILES.
FIRE APPARATUS.

BIDS REQUESTED.

Montreal, Que.—March 26, until noon, for following apparatus: (a) One automobile salvage wagon. (b) Four automobile tractors. (c) Two automobile hose wagons. (d) One 85-foot aerial ladder, automobile truck. (e) One automobile fire engine, of a capacity of 1,200 American gallons. Further information may be obtained at office of Purchasing and Sales Agent, city hall. L. N. Senecal, secretary board of commissioners.

CONTEMPLATED WORK.

Aberdeen, S. D.—One combination automobile truck will be installed after July 1, 1914. E. M. Hall, mayor.

Chickasha, Okla.—500 feet of hose will be purchased and probably a hose cart. Address J. V. Burton.

Ft. Wayne, Ind.—1,500 feet of hose will be purchased. Wm. J. Hosey, mayor.

Gary, Ind.—One auto chemical wagon, and one automobile for fire chief, and six motorcycles. W. J. Fulton, city engineer.

McKees Rock, Pa.—2,000 feet of hose will be purchased this year, and purchase of automobile fire apparatus and horse-drawn patrol wagon is being considered. Geo. H. McGinniss, city engineer.

Millville, N. J.—One auto chemical engine and hose cart. Appropriation $5,000. Newton B. Wade, city engineer.

Milwaukee, Wis.—One engine and one combination truck. Appropriations $10,000 and $5,500 respectively. Fred G. Simmons, commissioner of public works.

Philadelphia, Pa.—About $6,500 will be expended in replenishing hose. Three combination wagons, a repair truck, light wagon for repair purposes, and probably six motor patrol wagons will be purchased. Installation of 75 additional street fire alarm boxes is also contemplated. Geo. D. Porter, director of public safety.

Pomona, Cal.—$15,000 has been voted for purchase of fire apparatus. W. A. Vandergrift, mayor.

Pontiac, Mich.—One auto hose and chemical wagon. J. B. Austin, fire chief.

Vallejo, Cal.—One combination hose and chemical wagon. Lawrence Thompson, city engineer.

GARBAGE DISPOSAL.

CONTEMPLATED WORK.

Peoria, Ill.—Ten garbage wagons or carts will be purchased. E. M. Woodruff, mayor.

Saginaw, Mich.—This city and Bay City are considering the establishment of a joint garbage disposal plant midway between the two cities. H. H. Eymer, city engineer, Saginaw.

BUILDINGS.

BIDS REQUESTED.

Detroit, Mich.—Until March 10, for erecting Northeastern high school. Bids to be submitted on the work as a whole, or separately on masonry, carpentry, heating, plumbing and electrical wiring. Malcomson & Higginbothan, architects, Moffat building. Chas. A. Gadd, secretary board of education.

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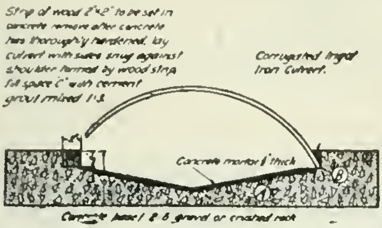

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Fountaintown, Ind.—March 28, until 10 a. m., for erection of a two-story four-room brick school house with heating plant, etc. Charles M. Jackson, trustee Van Buren township, Shelby county.

Grass Creek, Ind.—March 14, until noon, for construction of an addition to Grass Creek high school. E. O. Weeks, trustee Wayne township, Fulton county.

Kingman, Ariz.—Until March 9, for erecting a court house. Probable cost, $70,000. J. W. Morgan, clerk, county board of supervisors.

Marshalltown, Iowa.—March 10, until 1:30 p. m., for construction of and equipment of school building in Liberty township Independent School District. Plans will be ready February 28. Certified check, $500. J. R. Howard, president, Clemons, Iowa.

Staples, Minn.—March 10, until 8 p. m., for construction of city jail. Certified check, 10 per cent. F. W. Findsen, city clerk.

St. Francis, Minn.—March 10, until 1 p. m., for erection and completion of a school building, also installation of heating, plumbing and ventilation. Plans may be obtained after February 18 at office of Kiby T. Snyder, architect, 751 Plymouth Building, Minneapolis. F. E. Vrooman, clerk board of education, District No. 12, Anoka county.

Sulphur Springs, Ind.—March 11, until 10 a. m., for construction of a high school building, also for heating and ventilating plant. Samuel Allen, trustee Jefferson township, Henry county.

CONTRACTS AWARDED.

Bishop, Texas.—To C. B. Patterson, of Bishop, for erecting of main school building at bid of $39,293.00, and to Kendall & Jenkins for erection of three grade school buildings at bid of $12,100.

Lake Charles, La.—To McBride & McCammon, of Pine Bluff, Ark., at bid $20,718, for erection of high school at Benton, La., exclusive of plumbing, heating or electric wiring.

Monticello, Ind.—To J. C. Bardoner, of Reynolds, Ind., for construction of brick school building at bid of $14,706. Other bidders were James E. Barnes, Logansport, $16,999; Baker & Price, Logansport, $16,150; Hogshire & Young, Monticello, $15,930; Earl Wickersham, Logansport, $15,765.

CONTEMPLATED WORK.

Columbia City, Ind.—H. A. Phend, architect of this city, is preparing plans for construction of new school house in Schrader district, south of city. Contract will be let about April 1.

Hartford City, Ind.—Elmer E. Dunlap, architect, 909 State Life Bldg., Indianapolis, is preparing plans for a new $40,000 addition to the present high school building on North High street. Work of construction will begin in the spring.

Rushville, Ind.—Elmer E. Dunlap, architect, 909 State Life Bldg., Indianapolis, has prepared plans for a 2-story school building for Walker township, Rush county, and bidders may see plans and specifications at his office.

STREET SIGNS.

CONTEMPLATED WORK.

Canton, Ohio.—6,000 enameled street signs. W. E. Sarver, city civil engineer.

Lawrence, Kans.—825 enameled street signs. E. N. Bond, mayor.

Martinsburg, W. Va.—200 cast iron 8-inch by 24-inch road signs for Berkeley county. H. H. Ness, county surveyor.

Minneapolis, Minn.—1,000 four-way street signs. W. G. Nye, mayor.

Oakland, Cal.—300 wooden street signs. Perry F. Brown, city engineer.

Penn Yan, N. Y.—A number of concrete post road signs, two to each section in Yates county. Address M. McEvoy.

MISCELLANEOUS.

BIDS REQUESTED.

Cuba, Ill.—March 6, until 7:30 p. m., for a 60,000-gallon steel tank, brick pumphouse, 12x12 feet, and one deep well pump driven by electric motor or oil engine. Specifications on file with city clerk and Fuller-Coult Co., St. Louis, Mo., engineers. V. L. Durand, city clerk.

Manhattan Boro, New York City.—March 4, until 2 p. m., for furnishing and delivering 16 asphalt rollers. Marcus M. Marks, president of Boro, room 2034 Municipal Building.

CONTRACTS AWARDED.

Indianapolis, Ind.—To Barber Asphalt Co., for 300 tons California B grade asphalt, price bid, $20.61 per ton.

St. Paul, Minn.—To Magnolia Petroleum Co., for 300 to 600 tons of asphalt at bid of $19.55 per ton.

CONTEMPLATED WORK.

Los Angeles, Cal.—Purchase of one settling basin and one pumping station for sewage disposal plant. C. R. Brawner, city engineer.

Mansfield, Ohio.—Purchase of one settling tank, four septic tanks, and five filter beds for sewage disposal plant. E. A. Merkel, city engineer.

Philadelphia, Pa.—Replacements of pumps and boilers at Belmont pumping station are contemplated. Boilers to capacity of 3,000 h. p., and pumps to capacity of 30,000,000 to 40,000,000 gallons per day are under consideration. Geo. D. Porter, director of public safety.

Ford City, Pa.—Managers of Municipal electric light plant expect to erect a new power house and to install two 300 k. w. turbine driven units; also to purchase two 200 h. p. boilers, two 300 k. w. three phase, 60 cycle, alternating current generators, two 200 h. p. turbines, 3-panel switch board, complete with street lamp regulator for two circuits (100 250-watt tungsten lamps to each circuit), 50 40-foot poles, 8-inch top, 20,000 feet No. 4 weather proof wire, and 500 6-pin fir cross arms. W. H. Ellis, superintendent and chief electrician.

Harrisonburg, Va.—Installation of an auxiliary plant to cost about $12,000 has been recommended by J. M. Snell, chairman of electric light committee. It is proposed to install a large generator to be directly connected with one of the present turbine wheels or to a new wheel.

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

BROCKTON, MASS., HAS THREE AUTOMOBILE COMBINATION CHEMICAL AND HOSE WAGONS AND A TRACTOR FOR A HOOK AND LADDER WAGON.

VOL. XLVI. APRIL, 1914. NO. 4.

LIFTED.

"Saw a chap out on the road,
Having trouble with his load.
Mine was rather heavy, too,
But I helped to see him thru;
And before the task was done,
I forgot about my own.
Funny how a load will lift,
Taking on another shift."

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THE MUNICIPAL ASPHALT PAVING PLANT *of* SPOKANE, WASH.

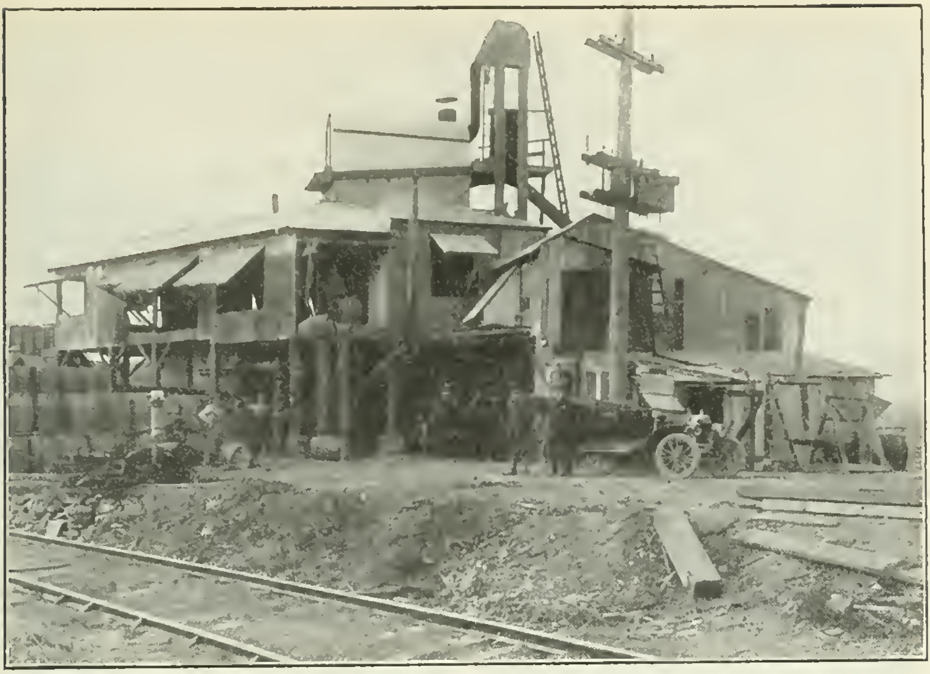
The city of Spokane, Wash., has not gone into the paving business in competition with paving contractors, nor to make money, but to save it, and has shown that it can reduce the cost of bituminous pavements to the property owners by its offer to lay the bituminous portions at a figure which will meet all the charges against the plant. As a consequence it does most of this work for the paving contractors as well as doing its own repair work. This article is prepared from data supplied by the city engineer.

THE city of Spokane has made great progress in the construction of pavement during the past three years. On January 1, 1910, there was approximately 10 miles of paving in the entire city, and today there are about 65 miles, most of which are bituminous pavements.

To maintain these pavements efficiently and cheaply, as a safeguard against combinations of paving companies to uphold exorbitant prices, and to enable the small contractor to bid on pavement work, the city has invested about $50,000 in a modern asphalt plant, steam rollers, auto trucks and complete paving equipment. It does not monopolize paving, or shut out private contractors, but makes the city independent of paving combinations. No arbitrary standards regarding the type of pavement have been laid down. During 1913, approximately 100,000 yards of asphaltic-concrete pavement have been laid, most of it on a concrete base. For light traffic, a 4-inch concrete base, and a 2-inch wearing surface of the asphaltic concrete has been used, while for streets of heavier traffic, a 5-inch concrete base and a 3-inch asphaltic concrete wearing surface have been used.

The specifications under which this pavement has been laid are approximately the same as those which have been standardized by the leading engineering societies and paving experts of the country. It consists of a uniform and well graded mixture of crushed stone and sand varying in size from one-half inch down to stone dust and mixed while hot with asphaltic cement. The grading of the mineral aggregate of which the wearing surface is composed, the character and the amount of the asphaltic cement, and all parts of the work are under the control of the superintendent of paving, who is an asphalt chemist. Daily laboratory tests are made of the mixtures and materials.

Under the present system, when bids are asked for on a paving improvement, the city posts an agreement to supply and lay the asphalt or asphaltic-concrete wearing surface at a given price per yard, the contractor to do the sewer work, grading, curbing and concrete base. The bids are taken on a lump sum basis and the contractor may use his own plant if he has one, or if not, he may avail himself of the city's offer. This method secures greater competition in bidding and secures for the propertyholders the asphaltic-wearing surface at very close to actual cost. The cost of asphaltic wearing surface during 1913 under these conditions has ranged from 40 cents to 60 cents per square yard, according to the thickness of the wearing surface, and the length of haul from the



THE MUNICIPAL ASPHALT PAVING PLANT *of Spokane, Wash., operated by the Department of Public Works, built by Hetherington & Berner.*

plant. This price includes all the labor and material, for mixing, hauling and laying the wearing surface and includes a fixed charge of 10 per cent. for overhead charges, superintendent's salary, etc., and in no case has the city lost any money on its estimates during 1913.

The fact that the city owns a rock-crushing plant and uses some of the rock blasted out in street grading operations has been a factor in securing cheap crushed rock.

It is claimed that prior to the time the city began to operate its paving plant, the cost of asphaltic pavements was from \$2.00 to \$2.25 per sq. yd., and that under present conditions the cost has been as low as \$1.25 per sq. yd. for the completed pavement, including the concrete base.

Another favorable feature of a municipal paving plant is the satisfaction and dispatch with which the maintenance of the city's pavements can be kept up.

The city also has a contract to do the paving maintenance work as well as to do new work for the street railways, and is thus able to keep the streets in excellent condition.

In the course of the summer's work the superintendent of paving has worked out a system of resurfacing old macadam pavements with a wearing surface of asphaltic concrete at a total cost as low as 33c per sq. yd., including the repairing of the old macadam base.

Herewith is given an illustration of the municipal plant in which the paving mixtures are prepared. It has a capacity equal to 1,900 sq. yds. of 2-inch top per day. The sand and crushed stone are delivered at the plant either by railroad cars or auto trucks. The material is heated in the usual revolving drum type of dryer, is then elevated to the top of the building, where it passes thru a screen and is separated into six different sizes, and discharged into a corresponding number of bins. The material from each bin can be drawn off into a measuring box, set on scales in order to get exact proportions. After the crushed mineral matter reaches the measuring box it is ready for the mixer, in which the mineral aggregate and asphalt are mixed by two-bladed cylinders.

Three steel kettles, each 30 bbls. capacity, are used for melting asphalt, the barrels of asphalt being handled with an electric hoist. In this hot liquid state it can be transferred from the two open kettles to the closed kettle by a suction pump, operated by compressed air, the air compressor for this purpose being driven by a 40-h.p. motor. In a like manner the hot asphalt is drawn from the closed kettle to the measuring bucket that also hangs on scales at the mixer. This is done by pulling a compressed air lever. At the mixer, where the crushed rock and asphalt processes come together, the mixerman, by the use of a lever, measures and weighs out the different grades of crushed rock, sand and asphalt to form a batch for the mixer. The batch of hot mix is dropped thru a chute to the bed of an auto truck and is ready for delivery to the street.

In operating the plant, as high as 400 batches of 1,000 lbs. each are turned out in one day. The equipment of the plant was installed about three years ago. That the plant has been kept busy this season is shown by the fact that the department has used about 900 tons of asphalt and about 7,000 cu. yds. of sand, gravel and crushed stone. It was built by Hetherington & Berner, of Indianapolis, Ind., and cost $18,000.

The Department of Public works, managed by Commissioner F. K. McBroom, has had much important work this year, and the branch pertaining to street paving, with which this article deals, has made an excellent showing in efficiency and economy. In this work Commissioner McBroom has been ably seconded by F. N. Bingham, superintendent of the asphalt paving division, who has had direct supervision of the asphalt plant and street paving. Mr. Bingham has had a wide experience in various cities in paving work —both as a paving chemist and superintendent of paving construction. He represented his city and served on the asphalt committee at the Chicago, New York and New Orleans meetings of the association for standardizing paving specifications and at a time while he was serving the city of Spokane as asphalt chemist, he directed the construction of the city paving plant. The plant has been improved some since it was first built and is modern in every way.

A 20,000-gallon concrete storage tank for fuel oil has just been completed and oil will be burned hereafter under the sand drier and kettles.

This winter the city rock crushers have been run to give work to the unemployed and thus made crushed rock exceptionally cheap.

THE PAVING CREW *of the city of Spokane, Wash., showing also the cart for heating tools, the small steam roller, an automobile truck for delivering asphalt to the street, and the superintendent's car, being a large part of the street equipment.*

BITUMINOUS PAVEMENTS
in WILMINGTON, DEL.

For several years the Department of Streets and Sewers of the city of Wilmington, Del., has been laying its own bitulithic pavements, being one of the increasing number of cities owning and operating its plant for the repair of old asphalt and bituminous streets and for the construction of new pavements. This article gives the results of the successful municipal operation of a good plant.

THE first bitulithic pavements laid in Wilmington, Delaware, were laid in the year 1905, when, after a thorough investigation, contracts were awarded for approximately 13,000 square yards.

Market street from Fourth to Fifth street was selected as one of the streets to be improved at that time. This street is in the heart of the business section and has the heaviest traffic of any street in the city. The bitulithic laid on this street is the standard 2 inches in thickness and is laid on a 6-inch concrete base. There have been no repairs necessary on this street, except a water cut and a slight disturbance of the pavement along the railroad tracks due to repairs made by the street railroad company to the rails. This piece of pavement is in perfect condition and from the present appearance will give many years of service.

In 1908 the directors of the Street and Sewer Department purchased a complete bitulithic paving plant from the Warren Brothers Co. of Boston and equipped themselves completely for the laying of this class of pavement, laying during the year of 1908 approximately 59,000 square yards of bitulithic pavement.

Since the purchase of the plant the Wilmington directors have been laying bitulithic pavement each year, and some 50,000 square yards will be laid during 1914.

The curb used is ordinarily the same as that already in, usually of granite, and the gutter is made of concrete. On new streets either granite or concrete is used for curbing, according to the conditions on the street.

All the pavements in the city are laid on 6-inch concrete base and lately the department has been putting this concrete down by what is termed the pouring method, producing what is called the "Wilmington" base. After the street bed is excavated and the sub-grade is thoroly rolled, the crushed stone, being all that passes the 1½-inch screen at the crusher, is hauled in and deposited on the bed of the street, and is spread to a uniform thickness of 6 to 7 inches and then thoroly rolled. A grout of one part cement and one part fine sharp river sand and water is poured over the stone bed until the voids are completely filled. This base is then allowed to set for 6 days, until it is well hardened, when the bitulithic surface is put in place.

The Wilmington base is reported to cost about 10 cents a square yard less than the regularly mixed concrete as ordinarily used.

The wearing surface is mixed at the plant, which is ideally located within 100 feet of the quarries from which the stone is taken and crushed, the various sizes of broken stone being delivered direct to the foot of the elevator at the plant.

The hot mixture of bitulithic wearing surface is composed of the various sizes of stone, accurately proportioned to give the least percentage of voids, and is mixed with the proper quantity of bitulithic cement, hauled to the streets in covered wagons, and dumped on shovelling boards

MARKET STREET, *Wilmington, Del., between Fourth and Fifth, laid with bitulithic in 1905 and now in perfect condition.*

and then shoveled into place and raked to a uniform grade to give a full 2 inches in thickness after compression.

This surface mixture is then thoroly compressed with heavy 3-wheel 10-ton rollers having the wide wheel in front and two narrow wheels in the rear, the greater part of the compression being done by the narrow rear wheels. After thoro compression is secured a bituminous flush coat is spread evenly over the surface in a very thin layer, which completely seals up the surface of the pavement, closing up any small pores that might exist. This is followed immediately, while the pavement is still warm, by a coating of fine screenings or stone chips, which are spread hot over the entire surface of the pavement and immediately rolled in with the rollers. This coating of stone chips takes up any excess of bitumen that may be on the surface and leaves a slightly rough finish which gives an excellent foothold for horses. Immediately after the rolling in of the stone chips the pavement may be thrown open to traffic.

The bitulithic surface in Wilmington is laid not only on the standard concrete base, but the directors are also laying it over old bricks and old asphalt blocks.

FRENCH STREET, *Wilmington, Del., more than one mile of bitulithic pavement, laid in* 1912.

GENERAL VIEW *of Wilmington's municipal bitulithic paving plant, showing driveway under mixer, bitumen weigh scales and bucket.*

THE WILMINGTON PAVING GANG *on Twenty-second street, laying material. The wagon is just dumping a load of the bitulithic mixture on the shoveling boards.*

NINTH STREET, *Wilmington, showing bitulithic laid on old brick pavement and a section taken up, to show high quality of the pavement thus made.*

On Ninth street from Shipley to Monroe street, one of the thorofares of heaviest traffic, the bitulithic surface was laid over an old worn-out brick pavement. In paving this street, the bricks were first broom-swept as clean as it was possible to sweep them, and the city flushing machines were then used and the street thoroly flushed crossways, from the center towards the curb. This was done repeatedly, to clear all possible dirt from between the joints of the bricks, so as to give the wearing surface an opportunity to bond well in between the joints. The street was then allowed to dry thoroly and the bitulithic surface 2 inches in thickness was laid as above described. This street is a most excellent piece of work, was improved in 1910, and is in perfect condition in spite of heavy traffic.

French street from the Pennsylvania Railroad depot to the water department pumping station at Sixteenth street is also a beautiful street about one mile in length, with no car tracks, paved with bitulithic, laid in the year 1911. West Market street from Twenty-third street north, one of the main arteries into the city, looking north from Twenty-third, is a fine piece of bitulithic work and as fine a piece of railroad track work as can be seen anywhere.

All of the work on the streets in Wilmington is done by the directors of the Street and Sewer Department with their own force of men.

In 1905 there were laid by contract 8,310 square yards of bitulithic. In 1908 the city laid with its own plant 59,147 square yards; in 1909, 29,296 sq. yds.; in 1910, 20,002 sq. yds.; in 1911, 6,341 sq. yds.; in 1912, 38,058 sq. yds.; a total of 161,154 sq. yds.

In November, 1911, the Market street pavement was put to a severe test, a team of 35 horses pulling over it a 6-ton truck loaded with a 32-ton girder for the Dupont hotel building, then under construction. No mark was made on the bitulithic pavement, tho granite crossing stones where the truck turned onto Market street were broken by the weight on the rear end of the truck.

CONCRETE ALLEY PAVEMENTS

By John N. Edy, Ass't City Engineer, Billings, Mont.

There are some novel features about this concrete alley construction, and the usual methods used are so well described that the article is well worth reading.

IN 1911 and 1912 the city of Billings, Montana, improved certain alleys in the business district. Brick and wood block, at a probable cost of $3.55 and $3.35 per square yard, respectively, were considered too expensive; and it was finally decided to construct a 7½-inch concrete pavement on a 6-inch gravel base. The contract here described provided for the paving of approximately 900 linear feet of 20-foot alley, or a total of 2,000 square yards; 1,650 square yards was constructed in the fall of 1911, the remainder being placed in September, 1912. The contract price was $2.25 per square yard, which included grading but did not include the construction of inlets and catch basins.

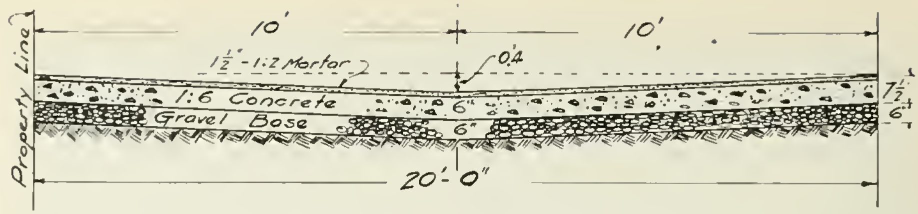
The drainage problem was perhaps unusually complex. The alleys were 3-way or "T" alleys. At each of the three street ends permanent concrete sidewalks and alley-crossings had previously been constructed, the grades of which had been established without regard to the probability of paving the alley. A small strip of brick paving in one of the alleys, numerous area-ways and variable floor elevations, all added to the difficulty of making this adjustment. A minimum longitudinal grade of 0.3 per cent. was adopted, and after careful consideration it was decided to drain all three sections of the alley to the center of the block. At this point were placed three inlets leading into a catch basin, which, in turn emptied into a Y-branch of the main sewer in the long alley.

The catch-basin was built of concrete, with 6-inch walls, 3 by 4 feet inside bottom dimensions, vertical walls 3 feet high. The basin is 6 feet deep and was covered with a 22 by 22 inch open c. i. grate.

The typical pavement section is shown in the accompanying drawing. A transverse slope of 0.4 feet in 10 feet was deemed ample, and it has so proved. (As will be noted in a succeeding paragraph, it was not always possible to secure just this section, on account of existing alley-crossongs, the necessity of observing floor grades, etc.) The sketch shows the design as originally adopted, and as carried out on about half the work. The contract called for the construction of a two-course pavement; 6 inches of 1:6 gravel-concrete base, and a 1½-inch topping or wearing coat of 1:2 mortar. It is likely that this plan would have been followed thruout, had it not happened that near the completion of the first alley the contractor was unable to obtain sands. He was then permitted to finish the day's work with one course, or 7½ inches, of 1:4 concrete. This one-course pavement proved so easy to lay, and appeared to be so satisfactory, that supplementary plans were drawn providing for such construction on the remainder of the contract.

The sub-grade was shaped to conform to the cross-profile of the concrete and a sub-base of 6 inches of gravel or cinders was placed thruout.

The pavement was divided into square sections by placing a ½-inch transverse expansion joint every 20 feet. These



Cross-Section of Pavement.

joints were usually made by removing the wooden expansion strips and filling the opening with a tar filler. On the 1912 work, however, the expansion strips of soft wood were not removed, but were trimmed off to the surface of the pavement and left in place.

No provision was made for a longitudinal joint in the center, nor at the sides of the alley. Where no building interfered the inside of forms was set to exact line and left in place. In case the adjoining building was on line, thin strips were set for the sole purpose of guiding the templet used.

The pavement herein described has been referred to as of reinforced concrete, when in fact the reinforcement was used only over sewer trenches. For this purpose ½-inch round steel rods were used, spaced 12 inches on centers. The length of the rods was not less than 4 feet greater than the width of the trench. In case of two parallel sewers 5 feet apart, the rods were sufficiently long to span both trenches.

After preliminary grading had been completed, finish grade for the sides was marked on buildings or on stakes. The idea was to have these side forms accurately set, enabling the transverse slope and center grade to be secured by means of a properly shaped templet. The sub-grade and sub-base were also checked by measuring down, from the bottom of the templet, 13½ and 17½ inches, respectively.

It will readily be seen that the cross-slope of existing alley crossings might not conform to that of the pavememnt. In fact, not one of the six crossings in place did so conform. In some instances it was necessary to reconstruct portions of the crossing, when it was possible to make the sides and center of the pavement parallel. In one case it was not possible to use the templet at all, a row of finish-grade stakes being set down the center of the alley. These stakes were set uniformly 4 inches low, and upon them were placed 2 by 4's set on edge. The concrete was then rodded off on both sides of the center and finished, after which the 2 by 4's were removed and the space flled with mortar.

Usually, the center grade was made straight between the lowest point at inside of alley crossing and the cover of catch basin. The sides of the pavement were then run out approximately level with the sides of the crossing until the proper section was obtained, when the templet was put in use.

In order to mark permanently the side elevations along brick buildings, wire nails were driven into the mortar joints. In all cases straight grades were "shot in" by setting up at one controlling point and tilting the telescope of the level to the proper H. I. above the other.

After the sub-grade had been prepared and thoroly rolled, the gravel or cinder base was placed, shaped, and compacted. This sub-base was sprinkled with water before the concrete was deposited. The machine-mixed (wet) concrete was conveyed to place in one-horse concrete carts. This method of handling the concrete was satisfactory, except to this extent: On account of the narrowness of the alley and the projection of area-ways and other obstructions, it was extremely difficult for the horses to turn and back into position without roughing up the gravel sub-base. In fact, where cinders were used, it was not at all unusual for the horses' hoofs to throw cinders onto the surface of the placed concrete, and for the cart wheels to completely ruin the finished grade of base. Under such circumstances it was necessary to provide an extra crew to reshape the cinder bed. However, this difficulty was not so apparent where gravel was used in the subbase, in which case a slight sprinkling of sand kicked on the concrete caused no great damage.

The reinforcement was placed by an inspector, who also checked the grade of the pavement surface by means of the templet. The expansion strips were placed by the contractor, as located by the inspector.

While the two-course work was in progress, it was customary to place 20 lineal feet of 6-inch concrete base, which was shaped to a rough surface, and then immediately covered with the 1½-inch mortar coat. The surface was floated and brushed at the proper time. But in constructing the one-course pavement, the men spreading were forced to exercise more care, in order to work mortar to the surface and properly shape and smooth the concrete. With this type of pavement much of the success of the finisher depends upon the good work of the spreaders.

The "finish" referred to was obtained by thoro floating with a wood float and then brushing with a stiff broom.

As soon as the concrete was sufficiently hardened it was covered with a layer of earth or sand, and kept moist for a period of five days. In good weather the pavement was thrown open to the public after the expiration of five to seven days.

Pit-run bank gravel was used thruout, no river gravel being permitted in the concrete.

The pavement described in this paper has been in use nearly 3 years; and while that is a very short time as compared with the probable useful life of the improvement, it is nevertheless possible to form certain conclusions as regards its apparent serviceability. In the first place, altho the concrete has passed thru extreme changes in temperature, no expansion or contraction cracks have developed, and altho subjected to a very heavy traffic, there appears no appreciable evidence of wear. Within a month after some of this pavement was placed it was necessary to cut an opening to repair a leaky heating main. This opening was filled with gravel and permitted to remain until spring, when the concrete patch was laid. The new concrete has bonded perfectly to the old, it being difficult to detect the patch; there has been no raveling whatever. During the past summer numerous openings were made to permit the laying of gas mains, and these patches are also hard to locate.

The concrete pavement is, of course, more noisy than the wood block, but not so noisy as the pitch-filled brick. The writer is advised by the street commissioner that the paved alleys are very easily cleaned.

The drainage system is giving good satisfaction, except that, in the writer's opinion, the minimum longitudinal grade had better be 0.5 instead of 0.3 per cent. The transverse slope might be reduced to 0.25 or 0.3 feet in 10, altho there is no apparent reason for doing this. It would be possible, the writer believes, to reduce the thickness of sub-base to 4 inches, and of the concrete to 6½ or 7 inches, without affecting the usefulness of the pavement. The writer favors the one-course work, mixed wet in the proportions of 1:2:4, or 1:4 or 1:4½ (local) pit-run-gravel.

There appears to be no need for a longitudinal expansion joint.

The pavement was designed and constructed under the direction of Mr. C. E. Durland, city engineer, and is in every respect satisfactory to the city officials, taxpayers, and those who use it.

The contractors' equipment consisted of one 14-foot Smith mixer with steam power; two single-horse carts for conveying; wheel barrows, etc.

The mixer was loaded from barrows, the distance from gravel pile to mixer being 40 to 50 feet. Cement was delivered to the mixer platform by team from the sheds.

Maximum haul for concrete was approximately 315 feet; minimum haul, 20 feet.

The earth sub-grade was rolled by a gasoline traction engine, which gave better service than a roller for the reason that areaways, manholes, poles, etc., rendered the use of the roller impracticable.

STERILIZATION OF WATER SUPPLIES

RESULTS OF HYPOCHLORITE PROCESS

By C. A. Jennings, Union Stock Yards, Chicago, Ill.

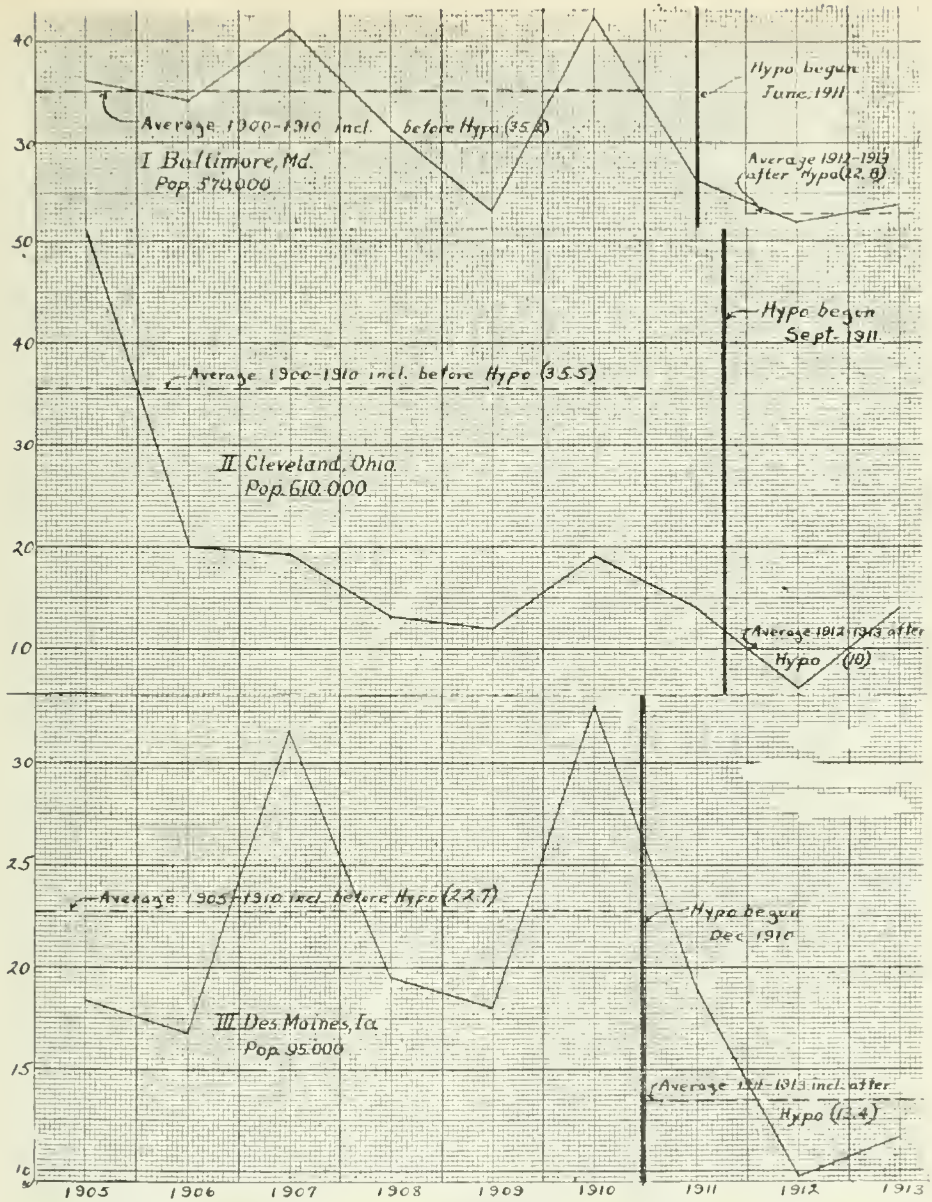
An expert in the use of hypochlorites in the sterilization of water supplies brings together in this article the results upon the health of the communities affected and shows some truly remarkable results in the reduction of death rates from typhoid fever.

There can be no question now about the efficiency of hypochlorite treatment of public water supplies. Its adoption has spread very rapidly since its introduction at the Bubbly Creek filter plant in Chicago in 1908. The writer believes that there must be at least 600 cities in this country now using this method of disinfecting their water supply. Wherever a proper survey was made and it was decided by capable authorities that hypochlorite treatment was needed and the chemical was properly applied thereafter, good results have followed. The writer knows of no city following this procedure, that has found it necessary to discontinue the use of this treatment. It is true that in some cities, hypochlorite treatment has come into bad repute with the water consumers because of a taste in the treated water at times. In the experience of the writer, such cases are always due to either a poorly designed plant, improper application, expecting a removal of bacteria beyond what was practical, or to the fact that hypochlorite treatment was not adapted to remedy the particular water troubles.

Hypochlorite has its sphere of usefulness, and beyond that it is practically useless. It is to be used primarily to eliminate from a water supply the disease producing organisms of intestinal origin, such as typhoid fever, para-typhoid, dysentery, etc. The efficiency of the treatment will vary inversely with the turbidity of the water. Hypochlorite is now used in conjunction with rapid sand filters, slow sand filters, coagulation and sedimentation, plain sedimentation, impounding reservoirs, well water and alone.

With the layman of today so widely awakened to matters pertaining to health, more and more thought is being given by him to the purity of his drinking water. He is beginning to realize that the physical properties of a water do not necessarily denote the health giving properties.

It is acknowledged that hypochlorite treatment is not a substitute for filtration but there are some water supplies that do not need filtration because of their physical condition. Within the past two months, Mr. Rudolph Hering, of New York, reporting on the Buffalo water supply said: "It is my opinion that sterilization by either method (hypochlorite of lime or liquid chlorine gas), will safeguard the public health at a very much lower cost than the adoption of filtration at this time. As soon as the city is prepared to pay the cost of giving the water at all times an excellent appearance, filtration is the system to be adopted." It is often a question of whether the results accomplished by filtration of a given water supply, are worth the expenditure, provided, of course, that the water as



furnished the consumers is free from patbogenic organisms. Many lake cities are situated similarly to Buffalo, as regards water supply. Erie, Pa., and Evanston, Ill., are now completing the installation of rapid sand filters. Cleveland, O., has broken ground for the first of two filtration plants. Filtration has been recommended for the water supply of Chicago. All of these cities have been using hypochlorite treatment for two years or more, producing a water that is bacteriologically safe and each city has reduced its typhoid fever death rate very appreciably.

Hypochlorite treatment is now firmly established because it has accomplished what its conservative advocates originally claimed for it. Its selective action for the germs of water-borne diseases has been proven by bacteriological analyses over a period of almost six years and by typhoid fever statistics during the same period. The writer has collected typhoid fever death rates from a number of cities and selected a few as being representative. The water supplies used include lake water with only hypochlorite, very turbid river water with coagulation, sedimentation and disinfection, impounding reservoirs with hypochlorite, plain sedimentation and hypochlorite and rapid sand filtration with disinfection. The statistics cover a maximum period of eleven years previous to disinfection and five years following its introduction. Obviously the latter figure is limited because hypochlorite was not introduced until 1908.

Figure 1 shows that for the eleven years previous to the use of hypochlorite, Baltimore had a typhoid fever death rate of 35.2. Eliminating the year 1911, during the last six months of which hypochlorite was used, the death rate was reduced to an average of 22.8 for the years 1912 and 1913 while using hypochlorite, a reduction of 35 per cent. Baltimore uses chemical coagulation and sedimentation and hypochlorite. A rapid sand filter plant is being installed at this time.

The average typhoid death rate in Cleveland, O., for the eleven years previous to the introduction of hypochlorite in September, 1911, was 35.5 as shown in Figure 2. The average for 1912 and 1913 while using hypochlorite, was 10, a reduction of 72 per cent. Cleveland uses no other treatment than disinfection at this time.

At Des Moines, Ia., the water supply is collected in filter galleries under the old bed of the river. Hypochlorite treatment was begun in December, 1910, during a typhoid epidemic. Figure 3 shows that the average typhoid death rate for the years 1905-1910, inclusive, was 22.7, and for the three-years while using this process, it was 13.4 per 100,000, a reduction of 41 per cent.

During the winter of 1910-1911, Erie, Pa., experienced a typhoid epidemic of a very severe form. The death rate from this disease was 197 per 100,000 for the year 1911. Hypochlorite treatment was begun in March, 1911. Figure 4 shows the effect that this treatment has had in reducing typhoid fever. The average typhoid death rate for the eleven years, 1900-1910, inclusive, was 38.4, and for 1912 and 1913 while treating the water supply, it averaged 13.5, a reduction of 65 per cent.

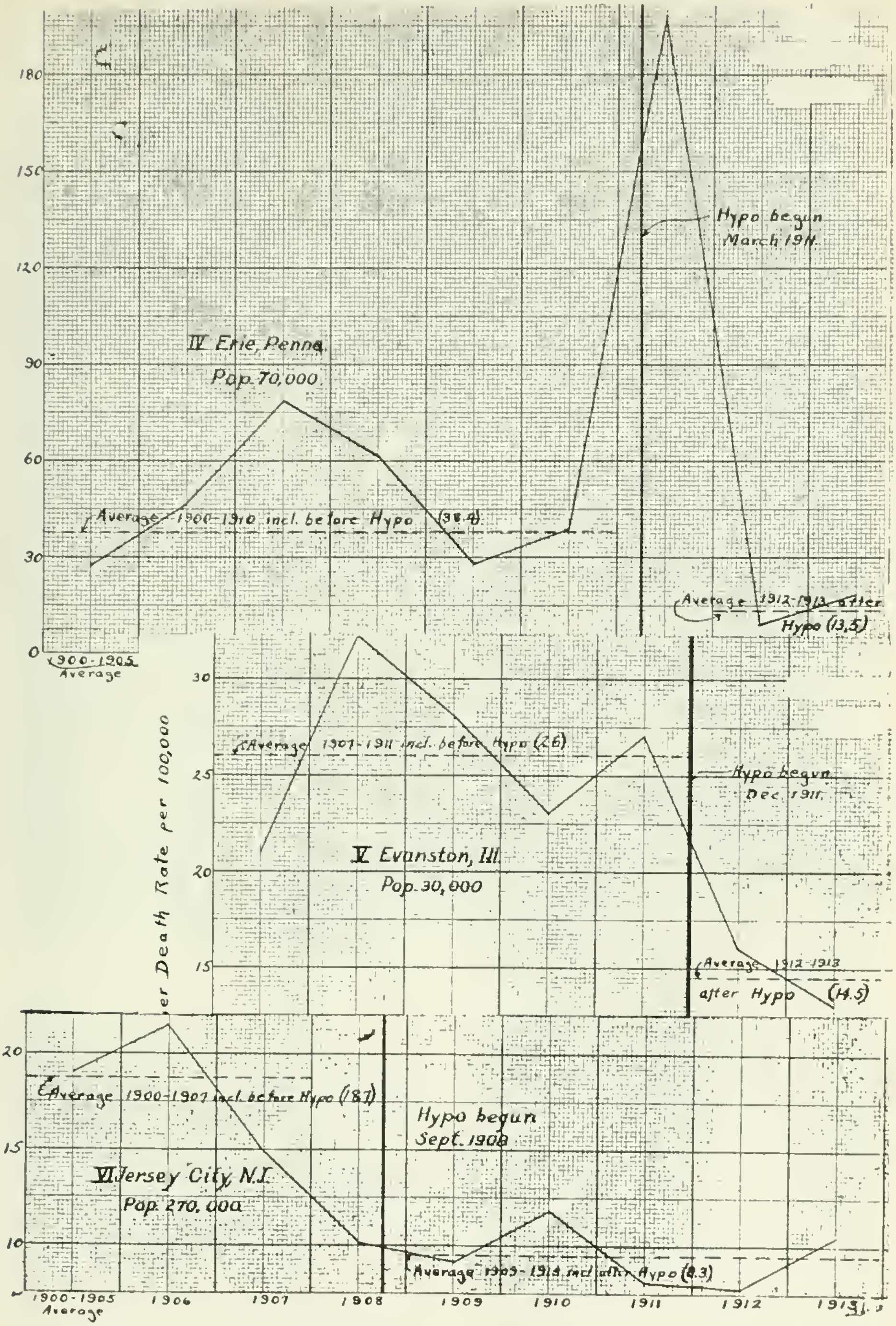
Evanston, Ill., is another city on the Great Lakes that suffered a typhoid fever epidemic in 1911, but it was prevented from assuming large proportions by the introduction of hypochlorite in December, 1911. Figure 5 shows that an average typhoid death rate of 26 per 100,000 for the years 1907-1911, inclusive, dropped to 14.5 as the average for 1912 and 1913, a reduction of 44 per cent.

Jersey City, N. J., was the first city to adopt hypochlorite treatment for a municipal water supply, which was in September, 1908. The water is stored in an impounding reservoir, and then treated with hypochlorite. Figure 6 shows the average typhoid death rate for the years 1900-1907, inclusive, to have been 18.7 per 100,000. The average death rate since the introduction of hypochlorite, for the years 1909-1913, inclusive, has been 9.34 which is a reduction of 50 per cent.

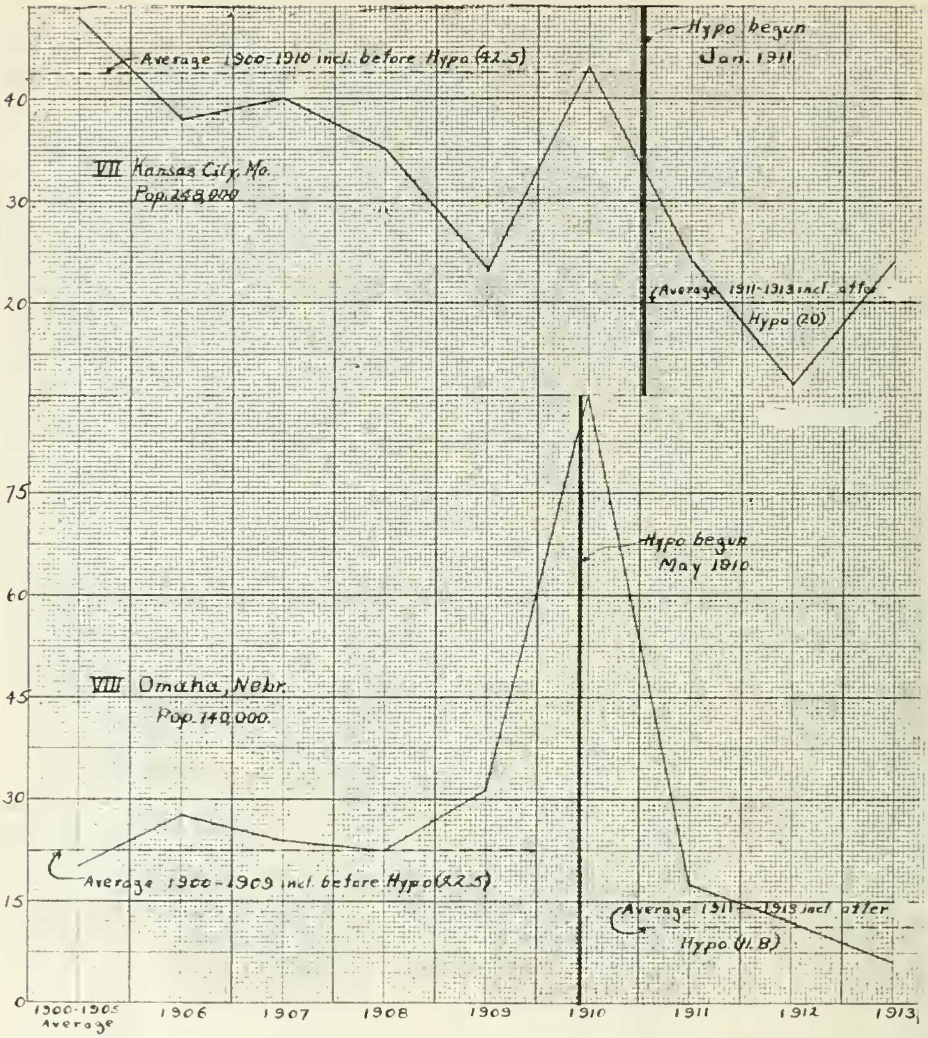
Kansas City had a typhoid death rate of 43 per 100,000 during 1910. Hypochlorite treatment was begun in January, 1911. The average typhoid death rate for the years 1900-1910, inclusive, shown in Figure 7, was 42.5 per 100,000. During 1911, 1912 and 1913 the average was only 20. This was a reduction of 53 per cent. from the former rate.

The water supply of Omaha, Neb., has been coagulated and settled in basins and then treated with hypochlorite since May, 1910, when disinfection was installed because of the large amount of typhoid fever in the city at that time. The typhoid death rate in 1910 was 89 per 100,000. Figure 8 shows that the average typhoid fever death rate for 1900-1909, inclusive, was 22.5. For the years 1911, 1912 and 1913, the death rate averaged 11.8, a reduction of 47 per cent.

Summarizing, it is seen that in each city a substantial reduction in typhoid fever was effected following the introduction of typochlorite. These reductions have been consistent. For the eight cities, the maximum reduction was 72 per cent. (Cleveland), and the minimum was 35



per cent. (Baltimore). The average percentage reduction was 51, which is very satisfactory. The total population of the eight cities is 2,033,000. With an average reduction of 15.8 deaths per 100,000 population ... each year and with a value of



$5,000 for each life saved, the saving to these cities amounts to $1,606,000 per year. Certainly the hypochlorite treatment has proved a blessing.

Formerly it was thought that the water supply of any city with a typhoid fever death rate of 20 or less per 100,000 was above suspicion. This view has changed recently. Of the eight cities named, only one had a typhoid death rate less than 20 previous to the use of hypochlorite (Jersey City with 18.7). The average was 30.2. The average since disinfection was begun, is 14.4 and only one city (Baltimore with 22.8) has a rate above 20 per 100,000.

It is to be noted in conclusion, that of the eight cities, six showed a higher typhoid death rate in 1913 than in 1912. It has been said that 1913 was a typhoid year. During 1910 and 1911 there were many typhoid epidemics. What the death rates in these cities would have been if hypochlorite had not been in use will never be known. However, it is safe to say that hundreds of lives were saved during 1913 that would otherwise have been sacrificed to that preventable disease, typhoid fever, had the water supplies not been disinfected with hypochlorite.

Laying Out a Sub-Division

AS AN ADDITION TO THE CITY RESIDENTIAL DISTRICTS

Too often additions to city building areas are laid out by the owner and his surveyor, with the one idea of getting as many lots out of the plat as the prospective purchasers can be induced to buy. Here is a sub-division made under the plans and supervision of an architect, expert in the beautiful as well as the practical, who has produced nearly the same result as the surveyor working on rectangular lines as to number of lots, and has made money for his clients by enhancing the value of the lots thru their attractiveness and greatly influencing the rapidity of their sale, as may be seen by comparing it with that of a neighboring addition not having the advantage of such expert service. The article is prepared from data furnished by the landscape architect, William Pitkin, Jr., Rochester, N. Y., and the E. H. Close Realty Company, Toledo, Ohio.

THE plan of Home Acres was designed to meet three conditions:

First. To subdivide the property into lots averaging 60 feet by 200 to 225 feet.

Second. To provide adequate street system which would take advantage of all the interesting characteristics of the property and give streets of pleasing line and profile with the minimum cut and fill and the least possible sacrifice of existing tree growth.

Third. To keep the cost of engineering and construction work as low as was consistent with the character of the development.

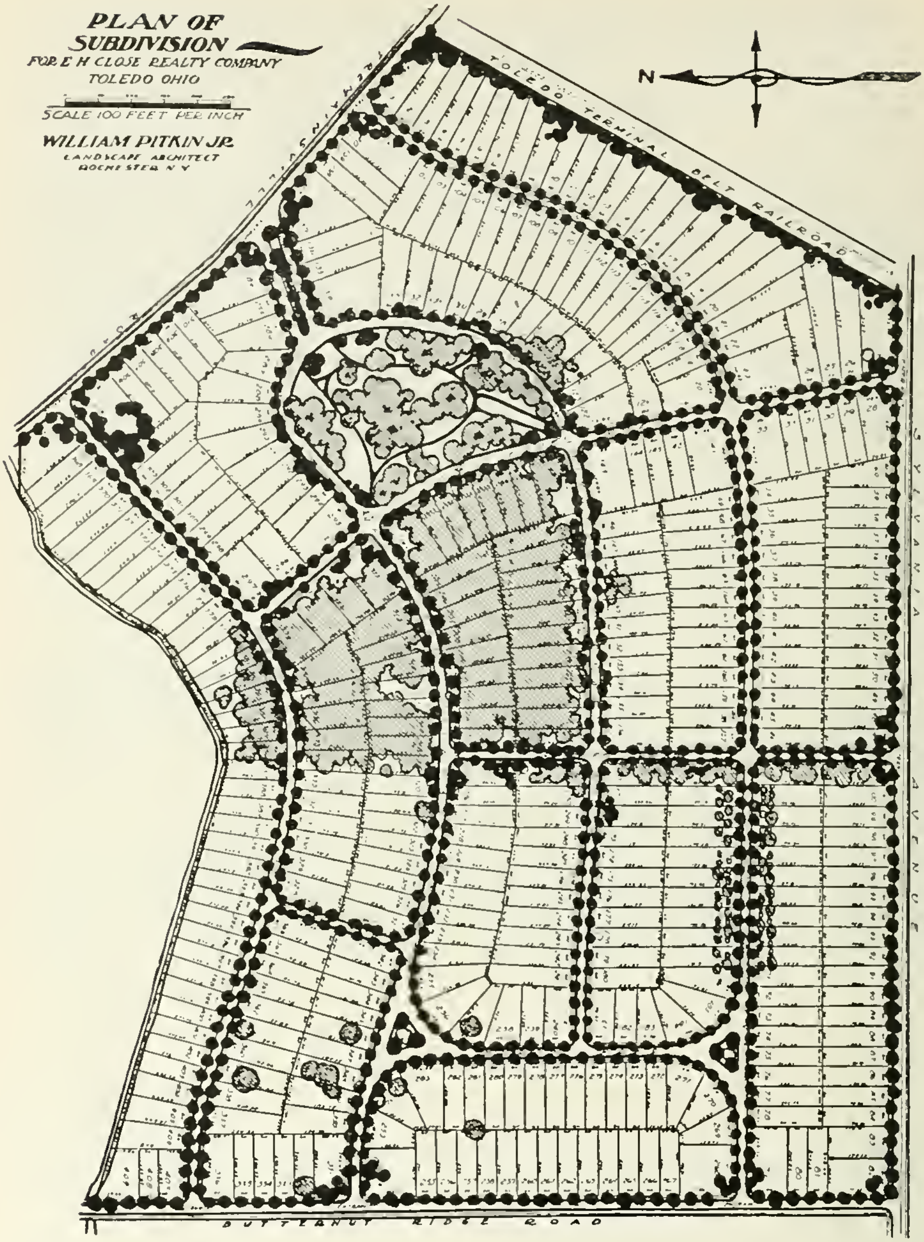
The size of the lots was entirely determined by the requirements of the class of people expected to purchase. It was expected that 60 feet frontage at the price to be charged would be all that the average buyer could handle, and that the lots would have to be of sufficient depth to provide space for lawns, gardens, chickens, fruit trees, etc.

It is interesting to note that the uniformity in the depth of lots was obtained without the use of a parallel type of streets. This was accomplished by means of the careful gradation in the curves of the east and west streets. This gradation was necessitated by the straight line of the highway on the south and the decided curve of the creek forming the northern boundary.

Wherever possible the streets and walks were kept slightly in cut, and the result of this treatment is that the streets fit the ground and become less conspicuous, while the houses and lawns are brought into a more pleasing relation with them. This also serves to avoid the necessity of filling any of the lots.

Careful consideration has been given to the existing tree growth, and it has influenced quite largely the arrangement of streets. In fact, the design of the main entrance to the property is determined entirely by an existing row of very large and beautiful trees. These trees are set in a 30-foot grass panel which is bordered on each side by a 24-foot road, outside of which are 15-foot parkings and 5-foot walks, making a total width of 120 feet.

The six-acre wooded part terminates an entrance parkway and is reserved for common use. The fact that every lot in the vicinity of this park was purchased during the first two days of the sale is a splendid argument in favor of the setting



NOTE *the lots of practically equal width and depth, the beautiful curves of the streets which are not in the least confusing. The shaded areas show where there are standing trees. The black dots show where tree planting will be done along the streets. The park area in the irregular oval was a most valuable feature, for it sold all the adjoining lots immediately upon the opening of the subdivision to the market. All the lots were sold in record time.*

aside of such areas in subdivisions of this kind.

In order to simplify the engineering work, both on the plan and on the ground, the streets were laid out with regular curves, and wherever possible the lot lines were made radii of these curves or were made at right angles to the center line of straight streets.

The chief item of interest in connection with the construction work is that the plan included only 16-foot roadways with the exception of the main entrance. The abutting highways took care of all thru traffic, so that the Home Acres streets needed only to be of sufficient width to accommodate local traffic. This not only effected a considerable saving in the cost of road construction, but added greatly to the attractiveness of the development.

A restriction requires that all houses shall be placed 50 feet back of the property line and applies equally to corner lots so as to obtain a uniform building line, which is essential on curving streets.

Careful consideration was given to the improvements to be made by the company, and it was decided to furnish permanent roads of solid concrete, cement walks, and the street trees, and to install sewerage, lighting and water systems. All of this work has been carried out in a strictly first-class and substantial manner. Particular care has been taken to have the construction work conform absolutely to the plans of the landscape architect, and the work has been carried on under his supervision.

THE MAIN ENTRANCE *to Home acres, which utilizes a row of standing trees with fine effect. The plan shows that trees will be planted on each side of the street also. The small building on the left of the row of trees is the sales office, which is on the park space, also taking advantage of a fine group of standing trees, so that the addition starts with a practicable park and a good supply of trees. The buildings in the background on the right are the farm buildings, which will be removed.*

AUTOMATIC TILTOMETER

FOR APPLYING CHEMICALS TO WATER IN PURIFYING PROCESSES

The chemists in charge of water purification plants have long been asking for an automatic apparatus for injecting the chemicals into the water in proportion to the rate of flow of the water. The application of the Venturi meter to the problem was suggested some time ago, and this English adaptation of the suggestion offers a design for the necessary machinery.

THE accompanying illustration, Fig. 1, and drawing, Fig. 2, show the design and indicate the method of operation of a novel tiltometer chemical injector. Its object is to add any desired quantity of a chemical reagent to a stream of liquid to be treated with the same and for continuing to supply by automatic means an invariable proportion, notwithstanding any change which may take place in the rate of flow of the liquid to which the reagent is to be added, and, at the same time, to permit of the proportion being varied as desired by an easy adjustment of the apparatus during its working.

This English apparatus was designed for the treatment of very large quantities of liquid, such, for instance, as that required for a city water supply, during its purification by means of aluminoferric or other precipitating or softening agent, but it is equally adaptable for the introduction of similar agents into sewage or trade wastes. This apparatus is also constructed on a small scale so as to be used by such industrial establishments as are under an obligation to purify their effluents before discharging them into streams or public sewers.

Hitherto the application of such reagents has been generally effected in a purely empirical manner, the main object being to insure the addition of a sufficient quantity so that under any circumstances the degree of purity fixed as a legal standard shall be attained. The practical effect of this is that very frequently a great excess of such reagents is employed, the resulting expenditure and other drawbacks being regarded as necessary evils.

This will be seen by the great divergence between the proportion of reagent to treated liquid considered necessary in various purification works. Lime for sewage treatment varies, for instance, from 4 to 30 grains per gallon, and as a general rule it may be stated that the proportion becomes smaller as the quantity of liquid to be treated becomes larger, or, what amounts to the same thing, as the need for economy becomes more evident. It is not, however, noticeable that the efficiency of the purifying operation is reduced in any degree commensurate with the saving effected.

It is held that by means of this automatic apparatus the best proportion of reagent to be added to the liquid to be treated can be adjusted and, when once determined, is maintained constant, altho the volume of the latter may vary.

It will be noted that the apparatus consists essentially of two parts, one of which, actuated by the rate of flow of the liquid to be treated, so adjusts the other as to enable it to pass into that liquid the required proportion of a solution of the reagent. Any change in the flow of the liquid is, therefore, at once productive of a proportionate change in the flow of the reagent, and thus, over any length of time, the quantity of reagent admitted must be proportionate to the quantity of liquid which has flowed in the same time.

The whole of the liquid to be treated is made to pass under a slight pressure thru a line of piping between the reservoir or tank from which it is discharged in its crude condition, into that in which the purification has to be effected. One portion of this pipe consists of a Venturi meter tube as indicated at A in the accompanying drawing.

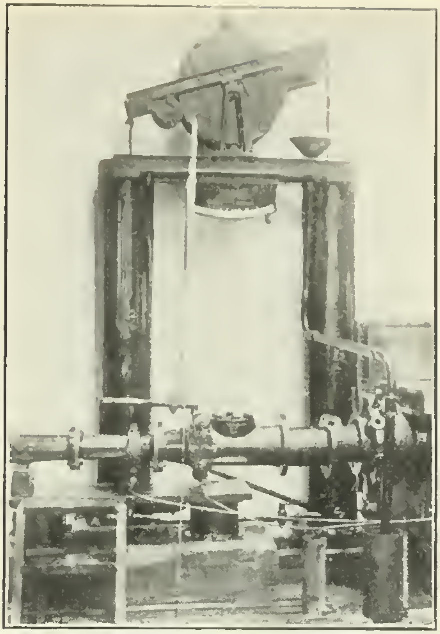
When a flow of water is passing thru a Venturi meter tube the velocity thru the neck will be greater than in the full-sized portion, and the loss of head, which corresponds to every increase in the velocity of the fluid, will indicate a reduction of pressure in the neck compared with that in the remainder of the pipe.

In order to enable this change of pressure to be utilized as a motive power for actuating the movable portion of the apparatus, pipe connections are made between the Venturi tube, where its diameter is greatest and where it is least, to each of the two vertical pipes marked respectively B and C in the diagram.

The liquid will then stand in these two pipes at levels depending upon the respective velocities of flow in the two portions of the Venturi tube, the difference of these two levels being, therefore, a measure of the quantity of liquid passing.

The second portion of the apparatus consists of a lever D balanced upon a fulcrum E, at a point midway between the two vertical pipes and slightly above their upper ends. From the ends of this lever there are suspended cylindrical bodies, termed displacers, F and G, made of some material heavier than water, which are free to move up and down in the vertical pipes and are of such a length as to be strictly submerged whatever may be the level of the water in these pipes. The lower part of the apparatus must, therefore, be set at a level lower than that of the purification tank.

It will be noted that by the displacing



TILTOMETER *for applying chemicals to water in purification processes. Note the Venturi tube across the view, the small tubes transmitting the pressures to the two large vertical tubes, the tilting cylinder at the top which regulates the flow of the chemical, and the funnel and tube which transmit the fluid to the water to be treated.*

action of these cylinders the lever is always made to take up a position of equilibrium whatever may be the levels, absolute or relative, of the water in the vertical pipes, and this position will be unchanged during any variation of water level which may be due to the filling up of the purification tank, but will be at once varied by any relative change of level of the water in the two vertical pipes due to a variation in the rate of flow through the Venturi tube.

The position of the displacers relative to the lever is so adjusted that the latter is tilted into its extreme, or zero, position when the height of the two water columns is equal, that is, when no water is passing thru the Venturi tube. Under such circumstances the apparatus is so set as to be inoperative, and no reagent can enter the purification tank. As soon as any liquid passes thru the Venturi tube the balance of the lever is disturbed.

The water level falls in both the vertical pipes, but more in C than in B, consequently the liquid will be withdrawn unequally from the two displacers, the unbuoyed weight of one will be greater than that of the other, thus one will fall and the other will rise until the balance is established, this movement being accompanied by a corresponding movement of the lever. By this movement of the lever, the admission of the reagent is regulated.

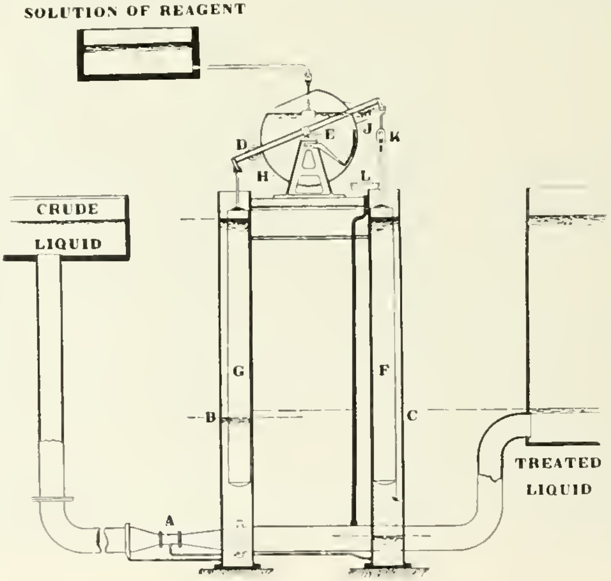
The means for effecting this admission are simple. A cylindrical vessel H is mounted horizontally upon the lever with its axis coinciding with the pivot upon which the lever turns. This cylinder has an open slit in the top side thru which it is fed with solution of a constant strength by means of a valve, actuated by a float, which maintains the level of the solution within the cylinder always constant.

There is a spout J, with a small orifice at the end which projects from the circumference of the vessel and the zero position of the lever is so adjusted by means of the turnbuckle K that when there is no flow thru the Venturi tube the lower edges of this orifice is just above the water level in the cylindrical vessel. There is, therefore, no discharge of solution under such circumstances, but the apparatus is ready to commence discharging when any disturbance, however slight, of the water levels in the two vertical tubes occurs, due to a flow of liquid through the main.

The solution thus discharged from the spout falls into the cup L, fitted with a rope, which conveys it to the down-stream end of the Venturi tube, or some other place where it will at once mix with the body of liquid to be treated. The exact maintenance by this apparatus of a fixed proportion between the volumes of solution and liquid is due to the fact that the vertical distance moved thru by the orifice J must always be a fixed proportion of the difference of the vertical movements of the two water levels in the vertical tubes B and C.

The factor determining the flow of solutions is one which is itself determined by the flow of the liquid to be treated. Theoretically, therefore, the accuracy of the apparatus would be perfect if it were possible to avoid certain errors connected with the Venturi effect and with the passage of water thru an orifice. These can be so nearly neutralized that the practical error under the most extreme conditions of working does not exceed 1½ per cent.

DIAGRAM OF TILTOMETER *action as described. Compare this with the photograph of the actual machine.*



It is maintained that to insure accuracy and uniformity in the amount of reagent admitted, it is best to work with a solution of constant strength, and to adopt such a size of orifice as will give with the standard strength of solution the required amount of reagent. These elements having been once determined will be invariable, and the apparatus will, therefore, work without further adjustment so long as the same percentage of solution is required to be added to the liquid.

¶ VARIATIONS *in the proportion between liquid and water to be treated must be made by hand by varying size of orifice.*

It is necessary to vary the proportion between the solution and the liquid to be treated when a liquid has to be dealt with in which the degree of impurity varies from day to day, as is the case with water from a river subject to floods. Here a solution of uniform strength would also be used, as the change of quantity of reagent can be most rapidly and easily effected by varying the size of the orifice, which would be changed from time to time as may be determined by a simple test of the capacity of the water taken as occasion might require.

In order to give a practical example of the apparatus which has been described, a case may be imagined where a flow varying from zero up to 1,000 gallons per hour requires to be treated by means of 7 grains per gallon of alumino ferric. Here the Venturi tube would have a diameter difference of level in the vertical pipes B and C being about 2 feet, the maximum head upon the orifice J would, therefore, be 12 inches. The strength of the solution would be 1 to 70, or 1,000 grains to of 4 inches and a throat of 2 inches, the the gallon. If the solution be added in the proportion of 1 to 1,000 of the liquid to be treated, the amount of aluminoferric introduced would be one grain per gallon and the amount of solution for the required amount of 7 grains per gallon would be 7 gallons per hour. This must be discharged with 12 inches of head, the diameter of orifice needed for this being slightly over 3/32 inch.

If it is found desirable at any time to change the proportion of reagent, say from 7 to 6 grains per gallon, it would only be necessary to partly close the orifice J so as to make it as much smaller as would give the required difference of discharge.

¶ THE APPARATUS *can be used for mixing any two liquids in definite proportions and recording the same.*

Altho the function of the apparatus has been referred to as the purification of effluents upon a large scale, yet it would appear that this invention is suitable for regulating the mixing of any liquids in definite proportions and in relatively small quantities and by the application of a scale the amount of liquid passing at any moment can be seen, or by means of an integrating apparatus the amount of liquid treated and of solution used can be measured and recorded.

It is claimed that the apparatus can be adapted for the supply of two or more solutions in different proportions at the same time, as, for instance, when using the apparatus for water softening.

Methods of Paving Construction *in* Baltimore, Md.

By Harry D. Williar, Asso. M. Am. Soc. C. E., Ass't Engineer Baltimore Paving Commission.

This is a continuation of an article by the same author, which appeared in the January number of MUNICIPAL ENGINEERING, *and goes into detail of methods of survey and specifications.*

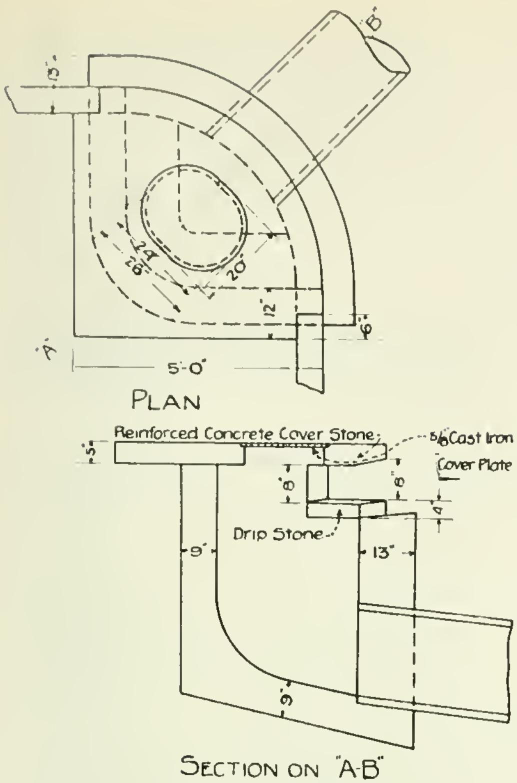
THE paving of Baltimore is not unlike other large cities. It consists mostly of converting rough streets already laid out into streets of improved paving. Conclusions reached here, therefore, are applicable, in a general way, to any section of the country.

The first step necessary, preparatory to construction, is to make a complete survey of the street. There may be some who think as long as the street is to be improved upon its original lines that this is unnecessary. It may look to be an extra and useless expense; to the contrary, however, it is a decided saving, and the only way to undertake the accurate construction of a street upon modern and economic lines. It is true that if the thorofare has already been "laid out" a survey becomes a very simple, but none the less necessary operation. Briefly, it consists in accepting some definite point as Sta. 0+00, from which pluses to everything of importance are taken. This is done on both sides of the street, width between curbs being taken at least at beginning and ending of every square. The exact location and names of all streets and alleys, location and size of inlets, manholes and drinking fountains; the plus to each and every kind of sidewalk, the condition and location of the different kinds of curb, and arrows, showing direction of drainage, should be plainly noted. In short, omit nothing. Too much information cannot be obtained on a survey of this kind, and too little is often gotten. All details will be of value to the office force in working up the plans and profiles, and will greatly facilitate the proper construction of the street.

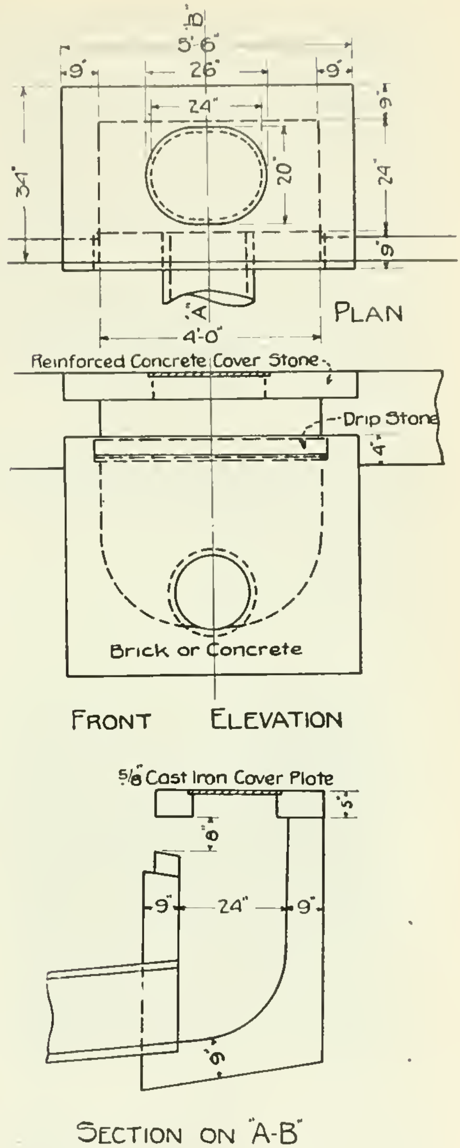
After this survey is completed, cross-sections should be taken every 50 feet or 100 feet, depending on conditions. Each section should have a sufficient number of readings so that their plotting will accurately show true conditions. On the average street, readings taken on both curbs, at both gutters, both quarter points, and center are sufficient. On car-track streets, it is important to get the elevation of all rails on each section. From this preliminary survey, plans, profiles and cross-sections can be plotted.

It is most important that the plan and profile, in conjunction with the same information on all cross streets, be carefully studied to design a complete storm water drainage system. Locate inlets so that they will drain the largest area in the smallest time. The paving around all inlets should be such that the water intended for that opening will go into it, and not run by to the next inlet. Unless this is done, the efficiency of the drainage system is greatly decreased. No storm water should be permitted to run by any cross street. Inlets properly arranged will avoid this obsolete use of "valley gutters."

The writer is in favor of two side in-



STANDARD CORNER INLET *on the rounded corner, showing details of construction and pipe to sewer.*



STANDARD SIDE INLET, *two for each corner where needed, so that storm water will not run across the track of pedestrians.*

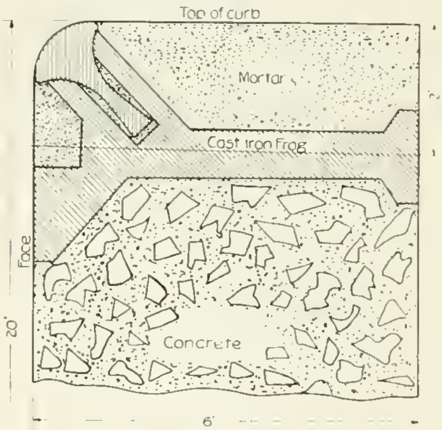
lets instead of one corner inlet, where the storm water from two streets, of 3 per cent. grade or over, drains to the same corner. The customary location for two such side inlets is on the building lines. This location is not, however, essential; to the contrary, it should be governed by the grades of the intersecting streets. The minimum curb exposure at the interesecting curb circle should be 3½ inches, and the two inlets should be so located that the water from this point will drain therefrom to both inlets.

The old fashioned silt basin, or more commonly termed catch basin, should not be used. It is obsolete. Aside from being expensive to construct, it is a germ and mosquito breeder. The filth which, of a necessity, enters any basin, will, in the case of a silt basin, be trapped in the bottom thereof and immediately become seriously objectionable to the public. True, the debris caught in this way will not enter the sewer and cause a stoppage. But, on the other hand, if this same filth enters an ordinary inlet, which has, in turn, been connected with sewers of proper size and having sufficient fall and carefully located manholes, this debris will pass on thru the inlet and thru the sewer to its outlet. In other words, what is wanted is a basin that will not hold the filth, rather than one that will; not a sewer thru which only liquids will pass, but one so constructed as to receive debris and carry it on to the proper outlet.

After the completion of the street, a similar survey to the preliminary survey is made, known as final, from which, in conjunction with the preliminary survey, quantities are worked up showing the exact amount of work done and to be paid for.

On the cross-sections of the original street are plotted the cross-sections of the street as it was actually constructed; the computed area between the two will give the earthwork or excavation.

In the construction of a street, there is no one thing upon which so many other features depend as the curb. It is



ARMORED CONCRETE CURB, *as used in Baltimore; Wainwright No. 1.*

the base line for construction. Once the two curbs are constructed, the limits of work are clearly defined and the grade of the street upon which all transverse and lateral lines are dependent, is plainly established. It is essential, therefore, that the curb should precede all other construction.

Stone Curb. There are two kinds of curb, stone and concrete. If the stone curb is used, it should be of sound granite, gneiss, sand stone or stone of equal quality, and, aside from being straight and out of wind, it should not be less than 4½ inches thick at top, and at least that thick on the bottom. The best results are gotten with curb not less than 20 inches in depth, and not less than 5 feet in length. If the face of the curb of these dimensions be thoroly axe-dressed 8 inches down from the top, point-dressed an additional 6 inches and fine pointed at the ends to its full depth, so as to make close joints, results will be found satisfactory.

The average cost of redressing old stone curb and resetting the same to new lines and grades is about 31 cents per linear foot.

Concrete Curb. Armored concrete curb is far preferable to the stone curb, and it should be used in all cases unless first class stone curb is already on the ground and it is only a matter of redressing and resetting it. If properly constructed, concrete curb gives an exceptionally neat edge to the thorofare, and its curves are far more regular and pleasing to the eye than any that can be obtained from the best of stone curb. Six-inch curb, 20 inches deep, are standard dimensions for concrete curb, constructed in 10-foot lengths. It can be built at an average cost of 62 cents per linear foot.

The setting of forms accurately to grade and line, substantially bracing them to prevent any bulging when the concrete is put in, and a good solid foundation, are the fundamental requisites for good results in concrete curb.

The concrete, thoroly mixed in the proportions of 1 cement, 2½ sand and 5 stone or gravel, should be placed in the forms and thoroly rammed and spaded in 4 or 5-inch layers until within 2 inches of the top. This top surface should be made of cement and stone or fine granolithic mixed in the proportions of one part cement and two parts sand or stone.

The upper edge on the face of the curb should be protected and reinforced by a galvanized iron or steel bar (Wainwright No. 1) securely anchored by four cast iron frogs to every 10 feet of curb.

It is important that a clean cut expansion joint, running the entire depth of the curb, be allowed between every 10-foot section, and that an iron or steel bar ½ inch in diameter and 12 inches long be imbedded in the concrete about 5 inches down from the top, anchoring every curb circle with every tangent.

¶ THE FOUNDATION, *with the new and heavier traffic, is recognized as the most important part of the pavement.*

A few years ago, it was the opinion that on streets of light traffic it was not essential to put smooth paving on a hard base. Sand, in a number of our old thorofares, formed the sole foundation for granite and vitrified block. In those days it probably served its purpose, but today it is far different. Traffic conditions have changed. The evolution of the automobile, from light pleasure cars of pounds to monstrous motor trucks of tons, has, in the last ten years, demanded that all city paving be laid on a concrete foundation. In fact, the foundation of a street is now considered the most important part of its construction, for upon this depends the stability, permanence and ease of maintenance of any pavement. With a weak foundation, the surface soon begins to settle unequally and forms depressions and ruts. With a strong foundation, the condition of the surface will depend entirely upon the material used and the manner of using it. A good concrete foundation will outlast several applications of wearing surface, thus reducing the cost of maintenance to a minimum. Its original cost is high, but this is balanced by its permanency and saving in cost of repairs to the pavement which it supports.

The essentials to the forming of a good concrete base are as follows:

1. That the sub-grade be graded and shaped to as near as possible the desired cross-section of the finished street.

2. That all soft or "spongy" places in the sub-grade be dug out and replaced with good, dry material.

3. That the sub-grade be thoroly compacted by rolling with a 5 or 8-ton roller until it forms a uniform and unyielding surface.

4. That the concrete be made of the best quality of American portland cement, sand and broken stone or washed gravel.

5. That the mixture be in such proportions as 1 part cement, 3½ parts sand and 7 parts of broken stone or washed gravel. (These proportions are by volume when the materials are well shaken or thoroly compacted in the measure.)

6. That all materials used in the mixture be carefully tested or inspected before they are used.

The requirements and methods for testing cement proposed by the committee on "Uniform Tests of Cement" of the American Society of Civil Engineers are accepted generally as standard.

The sand used for concrete should be clean, sharp and hard, free from loam and vegetable matter or other impurities. It should be tested for impurities in the following manner:

Put some sand in a glass vessel of uniform bore, partly filled with water and thoroly shake or stir the mixture. Allow it to settle for an hour or more, when it will be found that the impurities have come to the top, while the clean sand remains at the bottom. If the amount of impurities or loam is divided by the total contents of the vessel, exclusive of clear water, the result will be the percentage of impurities in the sand. In other words, if $P=$ per cent. of loam, $T=$sand plus loam, and $L=$loam, then $P=L/T$, wherein, L and T can be accurately scaled. To obtain good results, the amount of loam in sand should not exceed 5 per cent.

Broken stone for foundation purposes should be solid, hard and thoroly screened, trap, gneiss, granite or limestone, free from dirt or dust. For a 6-inch concrete base, the stone should be of the size that will pass thru 1½-inch ring and will be held on ¼-inch screen. For a 4-inch base, the stone should be as for the 6-inch base except that it should pass thru a 1-inch ring.

Washed gravel is an excellent substitute for broken stone in concrete for street foundation. It should, however, be clean, hard and entirely free from foreign matter. It should have both fine and coarse grains of sizes to pass 1½-inch ring for 6-inch base, and 1-inch ring for 4-inch base, and be held on ¼-inch screen.

For concrete mixed by machinery, the cylinder must make at least five complete revolutions after all the materials are put in. Thoro incorporation of the ingredients is a most essential element in the quality of concrete.

¶ COBBLESTONE PAVEMENTS *can be used as foundations for the modern pavements, but there is seldom any saving. Methods of using such base are given.*

The thickness of the concrete foundation for any street must be determined only after a careful study of the thorofare in question has been made. Present and future traffic conditions and the composition of the sub-soil are the prime factors that should govern. On streets of light traffic, with a good solid sub-grade, a 4-inch base will be found ample. Where the traffic is heavy or congested, the surfacing should be supported by a 6-inch foundation. Altho some engineers, in instances where the sub-soil is bad, recommend as high as 8 and 12-inch foundations, it is, in the opinion of the writer, but a decided waste. If the soil is soft, "spongy" or such that a 6-inch foundation will not hold, then it becomes necessary not to increase the foundation, but increase the carrying capacity of the subgrade by means of artificial drainage. In the last analysis, the stability of all pavements must depend, not upon the surfacing, not upon the base, but upon the ability of the sub-soil to support the base.

Baltimore has experimented somewhat with laying sheet asphalt and bituminous concrete directly on the old cobblestones as a foundation. The advisability of this plan will not be definitely known until sufficient time has elapsed to see if these streets will "hold up." It is the opinion of the writer that there is little or no saving in this form of paving, even on streets of light traffic. The risk of the settlement of ditches, probably entirely unforeseen at time of construction, is great, and the necessary filling in with concrete of all low spots gives unsatisfactory results. The method used for this form of construction is to first thoroly clean the cobbles and joints of all mud and surplus dirt. After this, an attempt is made, in the case of sheet asphalt, to get 1½ inches of binder spread uniformly over the cobbles, but it frequently takes more to obtain a passable cross-section. On the binder is put 2 inches of topping, or wearing surface.

In the case of bituminous concrete, after the cobble stones are cleaned, the wearing surface, 2 inches thick, is spread directly thereover, immediately covered with stone chips and rolled.

Altho Baltimore has laid over 6 miles of surfacing on cobble-stone base, the method would not be considered satisfactory. It would be recommended, therefore, that a plan cheaper in the long run, and certainly more satisfactory from every other viewpoint, would be to bar up the cobble stones, crush them to the required size and use them in a concrete foundation for the same street.

BRICK PAVEMENTS

Their Maintenance and Repairs

By F. F. Townsend, C. E., Ass't Engineer, Inspection Department, Dunn Wire-Cut-Lug Block Co.

The students of Ohio State University received this practical instruction in the repair and maintenance of brick pavements from an expert, who goes into detail concerning some points not usually considered with care. The author gives some definite reasons for difficulties with brick pavements, which will go far toward removing these difficulties, if his instructions regarding methods of construction are followed.

As one travels over the country inspecting various pavements, it is strongly impressed upon his mind that those in charge of the maintenance and repair of brick streets do not realize their importance or understand the necessary procedure to obtain satisfactory results. It is a well established fact that misuse of pavements does more to ruin them than the traffic ever does, and, as an engineering acquaintance of mine has said, "Brick pavements do not wear out, they are destroyed."

I asked a gentleman of high standing in the brick paving line the following question: "What are the principles of maintenance and repair on a properly constructed brick pavement?" His answer was: "There are none." This was altogether too optimistic for the purposes of this paper, so I found it necessary to drop the word "properly," developing the theory that repairs to brick streets are largely due to mistakes occurring either before construction or during the same, and not to any particular weakness in the materials themselves.

The critical period in the maintenance of the brick pavement is the first two years of its life. There are always a few bricks, even under the best culling, which are left in by oversight. As soon as these bricks commence to shatter or wear unevenly they should be replaced. There are some joints that may not have been properly filled. These should be watched for and refilled if possible. Some cracks may occur, due to frost or uneven settlement, and where these open up sufficiently they should be grouted to protect the edges of the crack. These are the principal items of maintenance on city streets. On country roads a further important item is the cleaning of the ditches. On large amounts of brick country roads around Cleveland, Ohio, and Buffalo, New York, attendance to drainage is practically the only item of maintenance that has been recorded.

Under the item of repairs we will consider all operations which require the removing of sections of pavement, and it will be well to state briefly some of the causes which lead to the necessity for them.

As stated previously, there are some mistakes which occur before construction. These are, generally speaking, mistakes of administrative and legislative officers and can be avoided by the engineer only thru advice. I refer to the leaving of underground work upon the street which is handled by city departments or public service corporations until about one week before construction starts. Then the sewer department decides that connections must be made to every lot, likewise the water company has to lower its pipes in order to get below the foundation of the pavement, or the telephone company must get its wires underground. It is a fatal error to leave this work until just before construction, because, as it is generally done in a hurry to get out of the way of the contractors, it has no time to become properly compacted and is very likely to cause settlement and eventually repairs will be necessary.

I was in a city recently where one week after the pavement was grouted the street car company came on and broke holes in the pavement about one foot square at every rail joint, having omitted to bond their rails before construction.

These matters should certainly be governed by ordinances prepared by the city authorities and enforced by them. In many cases the water or sewer connections are left until after construction and we hear everywhere the complaint that no sooner is a pavement laid than we begin to tear it up.

¶ MISTAKES IN CONSTRUCTION *which result in repairs are clearly set forth and should be avoided.*

Then there are mistakes during construction which will make repairs necessary. Some of these are as follows:

(1) Neglect to have the sub-grade properly prepared.

(2) Poor foundation laid upon the above.

(3) Failure to compact properly the sand cushion or have it of uniform depth.

(4) Improper filler or the poor application of the same.

All of these tend to one and the same result—the breaking up of the bond upon the street and the consequent displacement or shattering of the brick themselves.

Poor preparation of the sub-grade and insufficient care in replacing soil over underground work may sometimes be made up for by having an extra good concrete foundation; that is, one which will bridge over the bad places and overcome in this manner the settlement.

If, however, the foundation fails, there is only one way to repair the damage, and the general method will be the same for spots due to poor sub-grade and those due to improper covering of underground work. The bad spot must first be entirely removed down as far as the soft material extends. It is useless to take up the brick and just put in a little sand to bring the spot up to grade, relay the brick and leave it. This method will, in all probability, result in having to do the same thing over the next year and, although in time, after settlement has ceased, we may get a fairly good result, it will be more expensive, and it is better to remove, at once, the cause of the trouble. The next step is to get the cavity thus formed filled with the same material in more compact shape or with some other more suitable material. If the natural sub-soil is sand or gravel, the problem is comparatively easy and in fact it is very uncommon in such soils to have any trouble from this source. If, however, our sub-soil is of loamy nature or of clay, the problem is of a far different nature and must be handled with extreme care. I have known trenches filled with this material, when improperly backfilled, to keep on settling for a year or more after construction. Only last week I was over a pavement upon which the sewer could be traced for nearly the full length of the street. This sewer was constructed two years before the pavement, according to the records of the city engineer's office.

¶ BACK FILLING TRENCHES *is an operation of great effect upon the pavement laid over them.*

The method most commonly used for back-filling is that known as puddling, consisting of running water into the trench, throwing in the material and allow it to settle into place. This works very well in many cases, especially where we have deep trench work so that the superimposed material compacts the filling below. This may not, however, be the case in shallow trench work, say from four to five feet. While talking with the repair man of the city of St. Louis recently, he stated it as his belief that the trouble with puddled trenches was due to the top four feet not becoming properly compacted. He stated that trenches four feet deep, put in by puddling, settled about the same amount as trenches sixteen or seventeen feet deep put in by the same method. He prefers gradually to reduce the water up to the four-foot point and tamp the remaining material firmly into place. Every engineer must study the soil with which he has to deal and determine the best methods for his particular locality. In shallow trench work many engineers favor tamping or refilling with gravel and discarding the old material, while in very shallow patch work it is often a good plan to fill the whole space with the foundation course. There are some mechanical tampers now on the market which we believe should give very good results on this class of work. It is needless to say that no backfilling should ever be done with frozen ground, as this will always have large settlement, whatever the material.

¶ THE FOUNDATION COURSE *is equal in importance in its effect upon the pavement, and poor foundation will certainly ruin the pavement.*

Poor foundation course is the second trouble mentioned above. It may be caused by leaving the cement out of a batch of concrete or similar mistakes. The affected spot must be removed and put back with care. If it is other material than concrete it must be thoroly tamped into place, making it even with the remaining base. If concrete is used, the old concrete must be roughened and all loose material and dirt cleaned off so as to get a good bond. It is a good idea to slope the sides of the old concrete base in such a manner as to give the new concrete a bearing on the old, while in some places engineers require reinforcement to be placed in the bottom. After placing this base it must be allowed to set for at least four days before placing the paving upon it.

A poorly compacted sand cushion or one of excessive depth is the third cause of trouble mentioned above. Upon the properly laid base this should be placed with a uniform depth and thoroly compacted. It should be so placed that when the brick are laid and tamped they will be even with the old surface. The crowning of patches should never be tolerated. It is simply an admission of the poor quality of the previous work and it never gives satisfactory results. This is especially the case where cement grout filler is used, for the grout will not allow the bricks to settle without breaking the bond and this is the very thing which we desire to correct. If the crowning does not settle there will, of course, be a hump in the pavement, which will be unsightly and an annoyance to traffic.

¶ FILLING OF JOINTS *poorly is probably the most common reason for poor surface of brick pavements. There is no excuse for this, as the proper methods of filling joints have been fully demonstrated.*

The last item mentioned above, the improper filling of the joints, is one of the most common troubles making repairs necessary. Where sand filler is used, it is an easy matter to re-lay the blocks and sweep in the sand. This is also the case with asphaltic and tar fillers and the advantages of these are that traffic can be immediately permitted. They, however, will require much more repairing, so that the ease in putting them in is counterbalanced by the extra amount. They should never be used to repair grout-filled streets, as they will not harmonize with the rest of the pavement and the blocks put in with them will soon round and become unsightly.

There are two general ways in which grout-filled streets fail. The bond may break up in patches, due to poor spots in the foundation or to now and then a poor batch of grout, or they may fail for entire blocks, due to some fatal error in the method of application. There may be several things the matter with grout, such as poor cement, poor sand or poor mixing, but it is the opinion of the writer that much poor grouting is caused by not regulating properly the amount of water used in each batch. If too little water is used, the grout will not penetrate the joints and we have bridging which will soon break up. This is particularly so where the lugs on the blocks are not properly formed or are too small to give proper spacing. If too much water is used, the grout will be so thin that we will have separation, giving the same result as if it had been unmixed.

The writer has been on work this past summer where there was complete separation, due to excessive water, the sand having settled to the bottom and the cement run away with the excess water. Where either of the above conditions occur generally over the pavement, the whole will break up. Dumping the grout greatly aggravates this trouble, if it is done in large amounts; that is, a grout that if put on with scoops might cause no trouble, when dumped on in large amounts will cause separation or bridging.

¶ RELAYING *is the only cure for broken bond due to poor joint filling or letting traffic on before the set is complete.*

Where the bond has broken on a pavement there is only one way to correct it; that is to take up the bricks and relay them. Regrouting will do no good, as it will not go in far enough and the bond will soon break up again under traffic. If the pavement is broken up in small patches it is feasible to do this. If, however, the trouble is general, we must ordinarily leave it alone and be satisfied with a filler about as good as sand.

In making a patch the same care must be taken as in the original pavement construction. The brick must be laid smooth and even with the remainder of the pavement, properly tamped in and properly grouted. The traffic must be kept off for a period of from seven to ten days, according to the weather conditions. If these precautions are taken, when finished the patch should look equally well as the other paving. In doing this patching it is the custom in some places to dovetail the work in with the rest of the pavement. In other places they just cut out a square patch and lay the new brick independently of the others. The first method is preferable if it can be done without disturbing the bond on the other pavement, but this is often very hard to do. It is next to impossible unless the blocks used in repairing are of the same size as the original ones. City engineers have at times had trouble in finding blocks to make repairs, it being the custom for different firms to make blocks of different size. When repair time came the company having made the original blocks was out of business and no brick could be found which would fit. There is a commendable tendency at present among manufacturers to standardize sizes so that the different makes will be interchangeable. This is evidenced by the fact that the sixteen firms which which make the Dunn wire-cut-lug block have agreed to make a size which will lay just forty to the square yard and be interchangeable. This, we believe, will overcome the former difficulty.

Uniform joints of proper width are also very desirable on paving blocks, and this is attained in a high degree on the wire-cut-lug blocks. The lugs being cut on cannot be malformed.

In regard to the cost of maintenance and repair, little can be said, because records are very scarce. The Bureau of Municipal Research, of Cincinnati, Ohio, found the cost of maintenance and repair to be 1.2 cents per square yard per year. The city of Baltimore found the cost to be ½ cent per square yard. The representatives of both cities stated that the figure was hardly fair, as it took in some very poorly constructed streets. Some of the streets properly put in had shown no maintenance and repair charge for a long term of years.

Municipal Improvement for 1914.

What the Cities and Counties of the United States expect to construct during 1914.

By April 1 of each year a very fair idea of the amount of public improvements to be done during the construction season can be formed, and this annual construction number of MUNICIPAL ENGINEERING is published a few days late that the latest information up to the date named may be included.

The tables are devoted mainly to the cities of more than 10,000 population, a very large proportion of which have responded to the requests for information. A few of the responses have been too late to be included in the tables and they will be found in the space usually devoted to the department of "Contracting News" at the end of the editorial sections. Our thanks are due to the Mayors and City Engineers in particular and to many other officials for their courtesies in making the estimates and returns.

Quite a number of cities have been reported as not contemplating any material improvements this year and most of them are not mentioned in the table, so that the percentage of failures to reply is very small.

Some information from cities of less than 10,000 population has been obtained from city officials and from other sources and it is included in the tables also. There is a considerable promise of activity in the aggregate in these smaller cities, especially in such lines as brick and bituminous paving, and sidewalks, and in the smallest cities and the towns in the construction of water works and electric lighting systems, tho there are comparatively few large jobs. The activity in the larger cities and in the smaller places included in the tables will indicate what it is in the municipalities from which no attempt has been made to secure information. The line must be drawn somewhere and the practical place to draw it seems to have been chosen.

For the first time an attempt has been made to gather information regarding prospective county road work. The efforts were restricted to the states which have been working systematically, either under state or county organizations, long enough to have effective organizations. Considerable information has been gathered from other states also.

All the information is fresh, nearly all of it having been received in this office since February 10.

The data concerning pavements in cities and county roads have been tabulated as that seems to be the method of presentation most desired by the reader. The information concerning other improvements has been arranged in paragraphs. In all cases the arrangement is first alphabetical by states and then alphabetically by post offices in the states. In the tables of county work the arrangement is alphabetical by county seats under each state, the name of the county being given with the county seat.

STREET PAVEMENTS TO BE CONSTRUCTED DURING 1914.

City	Asphalt	Asphalt Concrete	Asphalt Macadam	Bitulithic	Bituminous Concrete	Bituminous Macadam	Brick	Cement Concrete	Granite	Gravel	Macadam	Oiled Macadam	Sandstone	Wood Block	Others,
Alabama—															
Birmingham	But little.														
Gadsden					20,000y					60,000y					
Montgomery		5,750y		15,000y						11,000y					
Selma								25,000yv							
Arizona—															
Phoenix				150,000y											
Arkansas—															
Argenta								88b							
Ft. Smith							30,000y	76,500y				15,000y		3,250y	22,000ya
Little Rock	10,000y	25,000y		25,000y										20,000ya	
Marianna		22,000y									8,900l				
Paragould							60,000y								
Pine Bluff	11,000yc	22,000y					11,000yc								
California—															
Alameda		14,540l									4,795l				
Anaheim	40,000y														
Chula, Vista	$13,755 for street improvements.														
Coronado Beach	$14,000 for paving.														
Dinuba								30,000yl							
Escondido														2m	
Eureka					1,500l										
Fresno	75bd										75bd				
Lindsay					50,000y										
Los Angeles	32md	32md		2m		1.5mg	.75m	3.5m			3.5m	25me			
Oakland	3m					20mh						12m			
Ontario								37,546y			21,120y	3.5m			
Oxnard											21,600g				
Palo Alto								64,000yi							
Pasadena	0.33m			1.1m			.05m				0.8mh	8.2m			
Pomona								9.25ml							
Porterville					23,000y										
Redlands														oiled	30m
Richmond				210,031			20,000y					230,206y			
Roseville	$17,000 for paving.														
San Jose	10m	3m								¾ m	1m				
San Mateo								100,000yi							
Santa Ana	90,000y														
Santa Barbara	132,000y									17,600y					$75,000j
Stockton															
Tulare					60,000y										
Vallejo	10,500y	100,000y													
Watsonville						20,000y									
Colorado—															
Boulder								4,000y		14,000y					
Colorado Springs	None														

Denver	26,100y				28,296y	82,070y	7,150y						23,500k		
Grand Junction							25,000y								
Longmont							20,000y				20,000y				
Connecticut—															
Ansonia									18,000y					9,500y	
Bridgeport								60,000yl	20,000y					7,200y	
Danbury						20,000y						100,000y			
Derby									3,000y					10,000	
E. Hartford											7,0001				
Greenwich								6m			2m				
Hartford	1m							½m							
Killingly											7,780y				
Meriden											25,000y				
Naugatuck			1½m							2m					
New Britain						35,000yk					54 000y				
New Haven	120,000yd					120,000yd								120,000yd	
Putnam											3,0001				
Torrington						5,000y				1m	5,000y	76,000y			
Wallingford						12,000y		12,000y							
Willimantic	None														
Delaware—															
Wilmington				12,000y											112,000ya
District of Columbia—															
Washington	76,000y				7,000y			13,000y			35,000				
Florida—															
Barton	35,000d			35,000d			35,000d								
Clearwater							8,000y								
Gainesville							4,000y	2,000y							
Jacksonville	26,141yd	71,700y					63,466y	4,826y			12,000y				
Lake City								2,600yl							
Pensacola															
St. Petersburg							1p								
Sarasota							1.8m								
Georgia—															
Americus															35,000a
Brunswick															20,000yg
Macon	None contemplated for 1914 yet.														
Savannah									25,000y						30,000ya
Idaho—															
Boise	48,860d			48,860d											
Lewiston										7,500y	7,500y				
Moscow								50,000y							
Pocatello															123,000ya
Sandpoint	$80,000 to be spent in paving.														0.75ma
Wallace				18,000y											
Illinois—															
Alton							13,685f								
Aurora	80,000y						16,000y								
Belleville						$30,000	$12,000	$75,000							
Bloomington							58,000y								
Cairo			100,000y												
Canton							1,400y								
Casey							4,118y								
Charleston							15,000y								

City	Asphalt	Asphalt Concrete	Asphalt Macadam	Bitulithic	Bituminous Concrete	Bituminous Macadam	Brick	Cement Concrete	Granite	Gravel	Macadam	Oiled Macadam	Sandstone	Wood Block	Others.
Chicago Heights							57,554y								
Collinsville							15,777y								
Danville							4m								
Decatur															
Dixon							12,500y								
E. Moline							40,000y								
E. St. Louis							4.42m	1.00m							
Elgin					55,591y	43,000y	41,744y								
Evanston	All streets north of Foster and east of Ridge avenue.														
Freeport					20,000y		80,000y	8,000y			2,000y				
Galesburg							90,000y								
Galva							26,250y								
Greenville							5,300y								
Harvey							123,000y								
Hillsboro							17,565y								
Jerseyville							5,000y								
Joliet	40,000y					30,000y	20,000y								
Kankakee							30,000y								
Lake Forest							32,000g								
Mattoon							15,000y								
Moline	25,000y	8,000y					66,000y								
Monmouth							120 to 30 b								
Mt. Carmel							30,000y								
Mt. Vernon							40,000y								
Murphysboro						46,000y	13,000y								
Normal							20,000y								
Oak Park	43,623y	130,061y					15,924y								
Pana							34,320y								
Paris							20,000y								
Peoria	15,000y	2,000y					150,000y								
Quincy					2m		2½m					3m			
Rantoul							2¼m								
Rockford							62,690y				50,375y				
Silvis							7b								
Springfield							100,000y							57,0001	
Streator							¾m								
Taylorville							41,622y	4,362y							
Urbana							20,000y								
Waukegan		10,000y						7,400y							
White Hall							80,000y								
Indiana—															
Anderson							½m	3m							
Bloomington							18,000y								
Bloomfield							7b								
Bluffton	47,000y														
Ft. Wayne	40,000y	15,000y					26,000y	5,000y							
Frankfort							14,500y								
Gary			25,000y				20,000y	6,000y			30,000y				
Greencastle											6m				
Huntington						350y	600y								

Indianapolis	100,000d				100,000d		100,000d							100,000d gal. oil	
Jeffersonville											3m				50,000
Lafayette								½m		¼m					
Laporte							22,000y								
Logansport							10,000y	probably							
Michigan City	4,000f						9,000f								
New Albany	Cannot give any information.														
Noblesville															1.2a
Portland							5b								
Richmond							13,000y								
South Bend							25,000y								
Terre Haute							10-15m	8-10m							
Vincennes							20,000y								
Iowa—															
Algona							30,000y								
Atlantic															60b
Bloomfield					15,000y			1,100y							
Boone	61,000d	61,000d					61,000d	61,000d							
Chariton							10b								
Cherokee		42,500d					42,500d	42,500d							
Clarinda								30,000y							
Clinton							30,000y	20,000y							
Corning							15,000y								
Cresco								24,000y							
Davenport	15,000y						30,000y								
Ft. Dodge		45,000y												25,000y	
Indianola	44,100d	44,100d		44,100d				44,100d							
Iowa City				21b			4b								
Keokuk							6,000y	2,100y			2,300y				
Leon		8,000d		8,000d			8,000d								
Marshalltown							4,000y								
Marion							2b								
Mason City															2ma
Missouri Valley							24,850y								
Monticello								20,000yv							
Muscatine		10,000y		10,000y				8,000y							
Nevada		21,000d					21,000d	21,000d							
Oskaloosa							1m								
Pella				37,710y											
Perry								10m							
Sac City	3pd	3pd		3pd	3pdv		3pd	3pd							
Sioux City							1m	15m							
Tama															10ba
Traer	18,570d						18,570d	18,570d							
Waterloo	27,000y						5,200y	5,200y							
Waukon							21,100y								
Webster							29,141d	29,141d							
Winterset		29,141d			29,141d			1,800y							
Kansas—															
Abilene					20,000y										
Arkansas City	35,000y														
Atchison							4,000y	6,000y							
Chanute							18,000y								
El Dorado					2,700y										
Ft. Scott							20,000y								
Hutchinson							20,000y								
Independence							6b								
Junction City					50,000y										

City	Asphalt	Asphalt Concrete	Asphalt Macadam	Bitulithic	Bituminous Concrete	Bituminous Macadam	Brick	Cement Concrete	Granite	Gravel	Macadam	Oiled Macadam	Sandstone	Wood Block	Others,
Lawrence		20,000y					20,000y	7,000y							
Leavenworth							13,650y	5,750y							
Manhattan					63,000										
McPherson					37,000y										
Ottawa						9,966y	7,888y								
Pittsburg							52,250y	5,840y							30,000ya
Salina															30,000ya
Topeka		27b					17b								
Wichita			1m				2m								
Winfield							32,000y								
Kentucky—															
Covington	12,000y					6,000y		10,000y	8,000y					3,000y	
Dayton					4,000y										
Highland						8,000y									
Hopkinsville				10,000y											
Lexington	4m						½m								
Louisville	100,000y				15,000y		85,000y		20,000y					10,000y	
Middlesboro					200,000y										
Morganfield							3m								
Paducah	None.														
Louisiana—															
Lake Charles		33,000y					63,000y								
Maine—															
Calais						4,200y									
Lewiston						11,000y									
Portland					6,5001	7,648y		1,390y	4,514y	3,309y					
Maryland—															
Baltimore	352,000y						176,000y		44,000y					8,800y	
Cumberland	Can give nothing definite now.														
Frederick								1,500y			5,100y				
Hagerstown									6,222y						
Pocomoke City								12,000y							
Westminster											8,500y				
Massachusetts—															
Adams								3,330y							
Andover						15,000y			4,000y		6,700y				
Boston	$500,000 voted for suburban street improvements.														
Brookline						0					0	0		8,000y	
Everett	Appropriations not yet made.														
Fall River	$213,500 for street improvements.														
Gloucester	None.														
Greenfield	2,000y						2,000y			3m	1m				
Lawrence	Estimate not made yet.														
Lowell						25,000y		10,000y	25,000y	40,000y					
Lynn								43,500y							
Medford	Not yet decided. Will be very little														

Somerville	$40,000 for road work.														
Southbridge						8,000y				8,000y				7,300y	
Springfield				18,000y	25,000y	130,000y	2,000y	9,000y	6,000y	7,000y	15,000y			25,000y	
Taunton	Estimates not made yet.														
Waltham						9,165y					5,890y				
Webster	None.														
Westfield					20,000y										
Woburn	None.														
Michigan—															
Allegan	$10,000 bonds for paving voted.														
Alpena		12,000y													
Ann Arbor								25,000y							
Battle Creek		14,600y				46,300y		2,000y							
Bay City	None.														
Eaton Rapids							3p								
Flint	40,000y						40,000y	8,644y		6,000y					
Grand Rapids					25,000y		40,000y	6,000y		50,000y					
Grosse Pointe														0.75m	
Hamtramck								4m							
Hillsdale					1,6501										
Holland			10,000y												
Ishpeming	None.														
Kalamazoo					19,000y		14,000y								
Lansing					15,000y										
Marquette			4,0001									7,0001			
Menominee											5,300y				
Muskegon			5bd					5bd							
Pontiac		3m													
Saginaw	2m														
Sturgis							18,000y								
Minnesota—															
Bemidji								17,000y							
Crookston	6,527yw														4½ma
Eveleth														13,000y	
Faribault								1,000y						26,500y	
Mankato			d			d		20,000y							
Minneapolis		25,000y			25,000y		15,000y	50,000y						175,000y	
New Ulm										2b					
Owatonna										4m				8,500y	
Red Wing							700y	7,200y	2,000y					7,200y	
Rochester					13,000y									13,000y	
St. Cloud								9,000y							
St. Paul	23,588y				8,780y		20,000y	3,000y					8,690y	242,027y	
Stillwater															6ba
Winona							5,578yd	5,578yd							
Virginia	None.														
Mississippi—															
Hattiesburg	None.														
Natchez	None.														
Missouri—															
Boonville							15,000y	14,000y							
Cameron							2,020y	6,178y							
Cape Girardeau								65,000y							
Clinton				13,000											
Columbia								7,015y							
Desoto								4,320y			12,110y				
Hannibal			10,000y	2,000y			2,000y	40,000y							
Jefferson City					4m										

City	Asphalt	Asphalt Concrete	Asphalt Macadam	Bitulithic	Bituminous Concrete	Bituminous Macadam	Brick	Cement Concrete	Granite	Gravel	Macadam	Oiled Macadam	Sandstone	Wood Block	Others,
Joplin		2m												1m	
Kansas City		9m	4.5m				4m	15m					2.5m	4m	
Kirksville	16,500y						5,000y	18,000y							
Kirkwood															4ma
Mexico							4,200y								
Nevada							6,000y								
Palmyra						6,000y									
Poplar Bluff					40,000										
St. Joseph	5b														
St. Louis		2p		2p			18p				9p	2p			
Sedalia		15,000y					20,000y								
Springfield		39,000y						67,000y							
Trenton							500y	14,000y							
Webb City										21,000yq					
Montana—															
Anaconda															22,000ya
Billings															50,500ya
Bozeman				50,000											
Butte				24,300y				5,500y							
Great Falls				83,000y				3,119y							
Helena				32,000y			40,000y								
Missoula				70,000y											
Nebraska—															
Fremont							11,000y								
Havelock							10,000y								
Lincoln	20,000y	70,000y					10,000y	2,000y							
Norfolk					30,000y						5,000y				
South Omaha					70,500y	13,200l	42,300y	14,100y							
New Hampshire—															
Laconia						5,000y									
New Jersey—															
Atlantic City							30,620d		30,620d					30,620d	
Bayonne	3m														
Bloomfield	1m		1m						2m						
Bridgeton										15,000y					
Camden	12,000y						1,000y		50,000y						
Elizabeth					5.5m		6.0m		4.0m						
Long Branch										50,000y					
Metuchen											8,000y				
Millville							500y			5m					
Newark	75,000y			10,000y			50,000y		145,000y					75,500y	
New Brunswick	$50,000 for paving.														
Passaic	1.13m		0.13m												
Plainfield						¼m									
Rutherford						0.05m	30,000y								
Summit					3,000y						10,000y				
Trenton	10,000y				40,000y		8,000y								
Ventnor City	1,000y														

Westfield											14,000y				
West Hoboken															2,000yr
West New York	10,000y	9,000y			9,000y										
New Mexico—															
Albuquerque	None.														
Roswell		3p													
New York—															
Albany	$400,000 street improvement work.														
Amsterdam							38,150y								
Binghamton				6,000y			10,000y	15,000y						1,600y	
Buffalo	245,336y						31,343y						11,198y		
Carthage						2,400f			½m						
Charlotte				¼m			½m								
Corning							26,034y								
Cortland						1,500l	2,100l					2,000l			
Dunkirk	14,134y	3,581y					15,500y	3,800y							
Elmira							5,250								
Fulton								30,400y	8,800y						
Gloversville					2,850y			3,720y							
Hornell							3,800y								
Hudson							6,148l								
Ithaca	None.														
Jamestown	1,400y						25,000y								
Johnstown	4,000y			1.54m		8,000y						10,000y			
Little Falls			5,000y	15,000y			4,000y								
Lockport	14,233y						13,065y								
Massena							35,000y								
Middletown							5,000y								
New York—															
Manhattan	327,000y								225,000y					120,000y	
Brooklyn	606,800y								180,954y					17,000y	5,700ys
Queens	20,000y	24,200y		5,500y					37,000y					14,000y	
Richmond					17,900y		600y		12,900yt						
Niagara Falls															250,000ya
North Tonawanda							6,600y								
Norwich							16,000y								
Ogdenburgh							30,490y								
Olean							30,000y								
Oneonta							1,000l								
Ossining	1.10m						1.0m								
Oswego							18,350y								
Plattsburgh						10,000y	9,000y								
Poughkeepsie	½m		½m				1m								
Saratoga Springs				5,000y				2m			2m			Hassam—6,100y	
Schenectady					100,000y				5,000y						
Syracuse	21,290y					11,000y	61,380y		21,790y						
Troy	6,000y			22,560y			32,190y		21,400y—relaid						
Utica	30,000y	1,700y		44,000y											
Watertown							10,000y	30,000y			10,000y	18m			
North Carolina—															
Asheville				30,000y											
Durham						20,000y									
Greensboro					20,000y					30,000y					
Monroe											4,000l				
Winston-Salem	None.														
North Dakota—															
Fargo	None.														
Minot										2m					
Williston										2m					

City	Asphalt	Asphalt Concrete	Asphalt Macadam	Bitulithic	Bituminous Concrete	Bituminous Macadam	Brick	Cement Concrete	Granite	Gravel	Macadam	Oiled Macadam	Sandstone	Wood Block	Others,
Ohio—															
Ada							1,350l								
Akron							15m							1m	
Alliance							1m								
Andover								14,900yl							
Ashtabula															
Bellefontaine							4,300y								
Belle Valley							10b								
Bucyrus	10,000y						3b								
Cambridge							15,000y								
Canton	13,830y						13.3m								
Chillicothe							5,100y								
Cincinnati	81,000y					38,730y	95,045y		83,131y	29,800y	2,680y			58,560y	1,370yu
Cleveland					33,564y		366,000y	5,000y					104,425y		
Dayton							70,000y							16,000y	
Delaware	6,000y						15,000y							6,000y	
Delphos							20,000y								
East Liverpool							14,821y								
Findlay							1¼m								¼ma
Fostoria	7,000y						10,000y								
Fremont							12,000y								
Galion															1.1a
Greenville							3,740y								
Ironton							3m	½m							
Lancaster							10m								
Lebanon							20,000y								
Lima					4,032y		9,252y								
Logan							1p								
Lorain		38,000y					1,200y								
Mansfield							1½m								
Marion	11,650y						19,000y								
Massillon						2,500f	45,000y			4,000y					
Middletown	1m					3m									
Mt. Vernon								9,300y							
Newark							16,000y								
Newton Falls	Several blocks.														
Norwood				5,000y				20,000y	1,000y					10,000y	
Painesville							26,400y								
Portsmouth								3m							
St. Marys							15,000y								
St. Paris	$30,000 worth of paving.														
Sandusky	12,000y						20,000y	7,000y							
Steubenville							2m								
Tiffin							2m								
Urbana	22,000d						22,000d	22,000d						22,000d	
Versailles							10,000y								
Warren							5m								
Willoughby							5,[illegible]50y								
Zanesville	Plans for extensive paving.														
Oklahoma—															
Lawton											8,800y				

McAlester	1.1m														
Oklahoma City	50,000y														
Okmulgee					5m		0								
Tulsa	5m	1½m													
Oregon—															
Astoria				45,000d			15,000d	45,000d						45,000d	
Eugene				11,600y	12,044y										
McMinnville															100b
Portland	29,575l	27,500l		32,865lz		33,560lx	43,802y	34,195lz			3,190l		23,905l	12,000y	
Pennsylvania—															
Allentown	70,000y				30,000y		1,000y		1,800y						
Bradford							7,000y								
Butler							3,500y								
Carnegie							1,000y								
Catasauqua					2,500l										
Chester	Not yet outlined.														
Chambersburg							15,000y								
Clearfield							2,000y								
Connellsville							9,000y								
Corey							12,500y								
Dubois							17,000y	3,800y							
Farrell							2,200l								
Gallitzin							5,000y								
Grove City					8,000y		4,000y								
Hanover					12,000y										
Harrisburg	50,000y														
Hazelton					12,960y		1,500y				3-5m				
Homestead							1,000y								
Kane							Some.								
Kingston							10,000y								
Lancaster															
Lilly							10,000y								
McKees Rocks								6,500y	6,500y						
Meadville							4½m								
Monongahela									3,000y						
Nanticoke							1m								
Norristown									0						
North Braddock							2m								
Oil City	7,400y				4,000y		7,400y	3,800y							
Old Forge		1¾m									½m				
Philadelphia	$400,000 widening Main Traffic Ave., demolishing buildings, placing underground structure and paving.														
Pottstown							1,800y								
Rankin									1m						
Reading	$30,000 for paving.														
Scranton	94,596y								1,177y						
Sharpsville							12,000y								
Shenandoah	20,000y														
Wilkinsburg							½m								
Williamsport							25,000y								
Wilmerding	Several streets.														
York															4ma
Rhode Island—															
Pawtucket	No estimate.														
Providence	14,890y			36,230y											
Woonsocket			1m									1,000,000y			
South Carolina—															
Charleston	$140,000 to be expended.														
Columbia							½m	5,000y							2ma

City	Asphalt	Asphalt Concrete	Asphalt Macadam	Bitulithic	Bituminous Concrete	Bituminous Macadam	Brick	Cement Concrete	Granite	Gravel	Macadam	Oiled Macadam	Sandstone	Wood Block	Others,
Greenville	......	......	......	......	......	......	......	3,000y	......	......	......	......	......	......	......
Spartanburg	Several streets to cost $90,000.														
Sumter	......	......	......	......	......	......	5p	......	......	......	......	......	......	......	......
South Dakota—															
Pierre	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Sioux Falls	50,000yd	50,000yd	......	50,000yd	......	......	......	50,000yd	50,000yd	9,000y	......	......	......	......	......
Watertown	......	......	......	......	30,000y	......	......	2,830y	......	......	......	......	......	50,000yd	......
Tennessee—															
Chattanooga	$10,000 for paving from city funds.														
Clarksville	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Johnson City	......	16,552y	......	......	......	......	11,000y	......	......	......	......	......	......	......	......
Knoxville	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Memphis	20,855l	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Mt. Pleasant	......	......	......	......	20,000l	......	11,059l	14,710ll	......	34,522l	......	......	......	......	......
Nashville	$1,000,000 for paving.						......	......	......	3m	......	......	......	......	......
Texas—															
Abilene	......	......	......	......	7,335y	......	......	......	......	......	......	......	......	......	......
Austin	......	3,250y	......	16,269y	......	......	......	......	......	......	......	......	......	......	28,963y
Dallas	......	......	......	68,307y	7,335y	......	......	5,527y	......	......	......	......	......	......	......
Ft. Worth	......	......	......	......	29,000y	......	......	......	......	......	......	......	......	36,674y	28,963y
Galveston	......	......	......	......	......	......	29,000y	3,400y	......	......	......	......	......	......	......
Hallettsville	Extensive plans.		......	......	......	......	95,138y	19,683y	......	......	......	......	......	......	......
Houston	3½m	3½m	......	2m	......	......	......	......	......	......	......	......	......	......	86,399yn
Lufkin	8,930y	......	......	......	......	......	4m	1m	......	10m	......	......	......	14m	......
Marshall	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
McKinney	$200,000 for pavements, mostly asphalt.					15m	......	......	......	......	......	......	......	......	......
Mineral Wells	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Paris	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
San Antonio	......	......	......	......	12,000y	16,000y	......	6,500y	......	......	25,000y	......	......	......	100,000ya
Sulphur Springs	......	......	......	1p	......	......	100,000y	......	......	......	......	......	......	......	22,000y
Waco	......	......	......	80,000y	......	......	......	......	......	......	......	......	......	......	35,000a
Wichita Falls	......	......	......	......	......	......	12,000y	2,000l	......	20,000y	......	......	......	......	......
Utah—															
Ogden	1.87m	......	......	......	......	......	......	.58m	......	......	......	......	......	......	......
Salt Lake City	3m	......	......	2½m	......	......	......	1m	......	......	......	......	......	......	......
Vermont—															
Barre	......	......	......	......	......	5,000y	......	......	......	......	......	......	......	......	......
Burlington	......	......	......	......	......	4,176l	2,455l	......	......	......	......	......	......	......	......
Rutland	......	......	......	......	......	......	1m	......	2m	......	2m	......	......	......	......
Virginia—															
Danville	Estimates not made yet.														
Newport News	......	......	......	......	......	11,200y	......	......	......	......	......	......	......	......	......
Portsmouth	Not yet determined.										1,500l				
Pulaski	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Roanoke	......	......	......	......	½m	......	......	3,000y	......	......	......	......	......	......	......
Suffolk	......	......	......	......	......	......	......	6,000y	......	......	......	......	......	......	......

Washington—															
Aberdeen	12,000y							20,000y						3,000y	
Bellingham	2m														12ma
Centralia								20,000y							
Hoquiam										6b					
N. Yakima															1p
Port Angeles															12p
Pullman				28,000d	28,000d	5,000y									
Renton							9,000y								
Seattle	12m						6b								
Spokane	4m						¼m	¼m						½m	
South Bend								13,000y							
Tacoma	120,000d				120,000d			9,000y							
Vancouver				20,000y											2ma
Walla Walla				40,000y									0.25m		
W. Virginia—															
Bluefields						2p									
Charleston															153,850ya
Parkersburg							3½m								
Wisconsin—															
Appleton							6,000y	14,000y		2m		6m			3½ma
Ashland	600l														
Baraboo						6,000									
Beloit														60,000y	
Burlington								8,000							
Columbus															7,000a
Delavan					16,000y										
Depere								8,000y							
Eau Claire						12,000y		4,000y						1,800l	
Green Bay							1m	¼m							
Janesville			4,224y			3,000y	10,000y				7,026y				
Lacrosse			3,000y				5,000y								
Madison	30,000y	20,000y			30,000y		25,000y								
Marinette								10,000y							
Merrill							10,000d	10,000d			4,000y				
Milwaukee	$330,000 for street improvement.														
Neenah														3,800l	3,000la
Oconto											6,000y				
Oshkosh				2.75m			70,000y								
Racine	1bd	1bd					70,000yd								
Richland Center								4b							
Sheboygan							6,000y	75,000y					640y		
South Milwaukee								23,000y							
Superior	30,000		30,000y				35,000y	26,000y						30,000y	
Wausau						15,000y									
West Allis	0														
Wyoming—															
Cheyenne	Estimates not made yet.														

a—Kind not decided. b—Blocks of street. c—Asphalt or brick. d—Of one or more kinds marked with "d" on same line. e—Gravel and oil. f—square feet. g—Warrenite. h—Surface oiling and screenings on old water bound macadam. i—Cement concrete with oil and rock screenings surface. j—Boulevard and sea wall. k—Amiesite. l—Linear feet. m—Miles. n—Shell. o—Amount not yet determined. p—Contracts for paving streets. q—Shell and gravel. r—Trap rock. s—Slag blocks. t—Napped granite. u—Boulders. v—Dolarway. w—Westrumite. x—Bituminous gravel. y—Square yards. z—22,155 l. f. Hassam; 23,905 l. f. bitulithic redressing.

ROADS TO BE CONSTRUCTED DURING 1914.

City and County	Bitumen Concrete	Bitulithic	Bituminous Macadam	Brick	Cement Concrete	Gravel	Macadam	Others
Alabama—								
State, Statement not available until about May 1.								
Guntersville, Marshall........	......	......	......	......	......	5m	4m	......
Luverne, Crenshaw...........	......	......	......	......	......	......	......	10mc
Arkansas—								
Star City, Lincoln............	......	......	......	......	......	15md	15md	......
California—								
Bakersfield, Kern.............	$2,500,000 bonds voted; $60,000 on state highways.						......	116ma
Fairfield, Solano.............	......	......	......	......	11½m	......	......	......
Los Angeles, Los Angeles.....	......	......	$28,000	......	......	......	1m	......
Merced, Merced..............	......	......	......	......	14m	......	......	......
Oakland, Alameda............	5.1m	......	......	......	3.1m	......	......	......
Placerville, Eldorado.........	$100,000 on state highways				......	......	6.5m	......
Redwood City, San Mateo.....	$ 60,000 on state highways				4mu	......	......	......
Riverside Riverside..........	$1,125,000 bonds sold.							
San Bernardino, San Ber'dino	$30,000 on state highways.							
San Diego, San Diego.........	......	......	......	......	13.5m	......	......	......
San Jose, Santa Clara........	1.8mg	......	......	......	......	......	......	......
San Luis Obispo.:.........	$ 95,000 on state highways.							
Santa Cruz, Santa Cruz......	$110,000 on state highways.							
Ventura, Ventura.............	$165,000 on state highways				5.1m	......	......	......
Connecticut—								
Danbury, Fairfield...........	......	......	......	......	......	......	26,200	......
Ellington, Tolland............	......	......	......	......	......	1,8501	......	......
Franklin, Hartford...........	......	......	......	......	......	3,6501	......	......
Old Saybrook................	......	......	......	......	......	7201	......	......
Florida—								
St. Augustine, St. John's.....	......	......	64mg	64m	64m	......	......	......
Illinois—								
State	......	......	......	5,000,000 bricks		......	......	......
Burnt Prairie, White.........	......	......	......	......	5m	10m	......	......
Cambridge, Henry............	......	......	......	......	3m	......	......	......
Lincoln	......	......	......	......	8m	......	......	......
Morrison, Whiteside..........	......	......	......	......	2m	20m	......	......
Newton, Jasper...............	$72,000 for State Aid Roads.							
Polo, Ogle..................	......	......	......	4m	......	......	some	......
Pontiac, Livingston..........	......	......	......	......	4m	......	......	......
Savanna, Carroll.............	......	......	3m	......	......	......	2m	......
Springfield, Sangamon........	......	......	......	......	7m	......	......	......
Toledo, Cumberland..........	Impossible to give definite information.							
Vienna, Johnson.............	......	......	......	......	......	......	1m	......
Watseka, Iroquois............	......	......	2m	1m	5m	......	8m	......
Wyoming, Stark.............	......	......	......	......	1m	......	1m	......
Indiana—								
Bedford, Lawrenle............	......	......	......	......	......	......	25,0001	......
Bloomington, Monroe.........	......	......	......	......	......	......	3r	......
Bluffton, Wells...............	......	......	......	......	......	10,0001	80,0001	......
Boonville, Warrick............	......	......	......	......	......	......	25m	......
Brookville, Franklin..........	......	......	......	......	......	......	4.5m	......
Brownstown, Jackson.........	......	......	......	......	......	6r	4¼m	......
Connersville, Fayette..........	......	......	......	......	5,000y	7½m	4m	......
Crawfordsville, Montgomery..	......	......	......	2m	3m	20m	......	10ma
Dana, Vermillion.............	......	......	......	4-6m	4m	35-50m	......	......
Decatur, Adams..............	......	......	......	......	......	......	35m	......
Delphi, Carroll...............	......	......	......	......	......	1r	2¾m	......
Elkhart, Elkhart.............	......	......	......	......	3,0881	4½m	1r	......
Ft. Wayne, Allen.............	......	......	......	......	......	5r	2r	......
Fowler, Benton..............	......	......	......	......	......	20m	......	......
Franklin, Johnson............	......	......	......	......	......	25,0831	......	......
Frankfort	......	......	......	......	......	22m	......	......
Goshen, Elkhart	9m	......	......	......	3,0801	24m	......	......
Greencastle, Putnam..........	......	......	......	......	......	25,0001	......	......
Greensburg, Decatur..........	......	......	......	......	......	......	2m	......
Hagerstown, Waynetown......	......	......	3m	......	......	6m	......	......
Hartford City, Blackford.....	......	......	......	......	......	2r	1r	......
Indianapolis, Marion..........	......	......	......	......	......	1rd	1rd	......
Knox, Starke................	......	......	......	......	......	11m	......	......
Kokomo, Howard.............	......	......	......	38,7001d	......	58,286	40,0001	......
La Porte, La Porte...........	......	......	......	......	......	......	8m	......
Lawrenceburg, Dearborn......	......	......	......	3m	6,0001	......	20m	. ...
Madison, Jefferson...........	......	......	......	......	......	......	10m	......
Marion, Grant...............	......	......	......	......	......	$183,286	......	......
Martinsville, Morgan..........	......	......	......	......	......	2r	3½m	......
Montpelier, Blackford........	......	......	......	......	......	4m	......	......
Muncie, Delaware............	......	......	......	......	......	......	$13,000	......
New Albany, Floyd..........	......	......	......	......	......	2r	6m	......
Newport, Vermillion..........	......	......	......	2m	......	3r	5m	......
Nohlesville, Hamilton.........	......	......	......	......	......	some	......	......
Paoli, Orange................	......	......	......	......	......	2r	8,6761	......
Plymouth, Marshall..........	......	......	3m	20,487y	......	29m	12m	12mb
Portland, Jay................	......	......	......	......	......	......	4m	......
Rensselaer, Jasper...........	. ...	......	......	......	......	......	3m	.....
Rochester, Fultor.....	......	......	10m	2½m	......	some	......	.....
Rushville, Rush.	. ....	......	......	......	......	2m	......	.....

City and County	Bitumen Concrete	Bitulithic	Bituminous Macadam	Brick	Cement Concrete	Gravel	Macadam	Other
Salem, Washington						10m	20m	
Scipio, Jennings							2m	
Seymour, Jackson					½m	2m		
South Bend, St. Joseph					18m	9m		
Spencer, Owen					$14,000			
Sullivan, Sullivan							12,000l	
Terre Haute, Vigo				3m				
Tipton, Tipton				5m	5m	20m		
Valparaiso, Porter	$ 14,000 road bonds sold.							
Versailles, Ripley							10m	
Vincennes, Knox				5m	1m	25m		
Wabash, Wabash							2r	
Williamsport, Warren						34m	6m	
Winamac, Pulaski						30m		
Iowa—								
Dubuque, Dubuque							$90,000	
Washington, Washington				4,840y				
Kansas—								
Abilene, Dickinson								24mc
Chanute, Neosho							1m	
Eldorado, Butler	15b							
Kansas City, Wyandotte							3m	
McPherson, McPherson	37,000y							
Norton, Norton								2me
Pittsburg, Crawford							some	
Topeka, Shawnee					1m	7m		3ma
Troy, Doniphan					5m			
Wichita, Sedgewick							1m	
Kentucky—								
Ashland, Boyd					2 700l			
Benton, Marshall						50m		
Bowling Green, Warren						7.67m	15.9m	
Cynthiana, Harrison							20m	
Hodgenville, LaRue						10m		
Lancaster, Garrard	8,500d		8,500d				14,000y	
Mason, Grant							8m	
Louisiana—								
Lake Charles, Calcasieu	Materials worth $100,000 purchased for 28 miles of highways.							
Oberlin, Allen	$ 30,000 road bonds sold.							
Maine—								
Augusta, Kennebec			25m		5m	190m		
Maryland—								
State, partial	5md		64md	64md	110md	5md	110md	18md
Annapolis, Anne Arundel						4.1md	4.1md	
Chestertown, Kent						1.3md	1.3md	
Easton, Talbot							1m	
LaPlata, Charles						3.9md	3.9md	
Salisbury, Wicomico	6.7m					6.7md	6.7md	
Massachusetts—								
State (partial advertised)								14,000lo
Michigan—								
Central Lake, Antrim							4m	
Charlevoix						5m		
Crystal Falls, Iron								5mj
Detroit, Wayne					$500,000			
Jackson Jackson						25md	25md	
Pontiac, Oakland			3rd			3rd	3rd	
Minnesota—								
State					70m	600m	50m	
Ada, Norman						10m		
Bemidji						45.11m		
Carlton, Carlton						55m		
Duluth, St. Louis					$61,576d	10md	32md	
Mankato						16 397l		
Minneapolis, Hennepin						29,200l		
Mora, Kanabec							5r	
St. Paul, Ramsey					70m	600m	50m	
Virginia, St. Louis						1½m		
Walker, Cass							2.36m	
Winona, Winona					9m			
Mississippi—								
Greenwood, Leflore							21.5m	
Vicksburg, Warren								15m
Missouri—								
Columbia, Boone						12m		
Greenfield, Dade							10-12m	
Hillsboro, Jefferson						4m	11m	
Kansas City, Jackson							17-23	
Macon, Macon	1500 miles earth roads							
Poplar Bluffs, Butler						5m		
Rolla, Phelps						10m	5m	
St. Joseph, Buchanan			3m					10,000yf
Troy, Lincoln						20m		
Montana—								
Glendive, Dawson						20m		
Glasgow, Valley	30 miles of earth roads.							
Philipsburg, Granite						3m		

City and County	Bitumen Concrete	Bitulithic	Bituminous Macadam	Brick	Cement Concrete	Gravel	Macadam	Others
Nebraska—								
Seward, Seward	500 miles earth roads.							
Wahoo, Saunders	15 to 25 miles earth roads.							
New Jersey—								
Bridgeton, Cumberland	......	......	......	......	......	6m	......	......
Cedar Run, Ocean	......	......	......	......	......	12m	......	......
Flemington, Hunterdon	......	......	......	......	......	......	1r	......
Lumberton, Burlington	......	......	......	......	......	......	3mq	......
Netcong, Warren	......	......	......	......	......	......	7½m	......
Perth Amboy, Middlesex	3¾m	......	8m	......	......	3½m	......	......
Salem, Salem	......	......	......	......	......	13m	......	......
Somerville, Somerset	......	......	......	......	......	......	0.43m	......
Wenonah, Gloucester	3,900y	9,857y	7,000y	......	......	5,200cy	6,000t	......
New York—								
State (partial)	......	......	......	......	......	......	......	200m
Albion, Orleans	......	......	......	3m	19m	......	......	......
Auburn, Cayuga	......	......	10m	2m	......	20m	10m	......
Cortland, Cortland	......	......	......	¼m	......	......	10.4m	......
Fonda, Montgomery	......	......	......	1m	......	4m	3m	......
Herkimer, Herkimer	......	......	8.6mg	......	......	......	......	......
Ithaca, Tompkins	......	......	7.4m	3.00m	......	......	......	......
Lyons, Wayne	3m	......	22m	......	......	50m	20m	......
Malone, Franklin	......	......	25m	¼m	......	10m	20m	20ma
Montour Falls, Schuyler	......	......	20m	......	......	1m	......	......
Oswego, Oswego	......	......	......	¼m	7m	10m	8m	......
Owego, Tioga	......	......	9m	1⅝m	......	2m	......	100yh
Penn Yan, Yates	......	......	......	......	......	......	12m	......
Rochester, Monroe	......	......	......	3m	3½m	6m	39½m	4ma
Schenectady, Schenectady	......	......	......	......	7.87m	8m	2.0m	3mi
Warsaw, Wyoming	......	......	......	......	......	......	2.79m	......
Watertown, Jefferson	......	......	17.59m	0.24m	1.81m	......	30.85m	......
North Carolina—								
Tarboro, Edgecombe	$ 20,000 road bonds sold.							
Ohio—								
Bellaire, Belmont	1	......	10md	......	......	......	......	10mdgp
Bryan	......	......	......	......	......	......	3m	......
Cadiz, Harrison	......	......	......	1.4m	......	......	8m	......
Canton, Stark	......	......	......	70,400y	70,000y	......	......	......
Celina, Mercer	......	......	......	......	5m	......	15m	......
Chardon, Geauga	......	......	......	......	5m	......	......	......
Chillicothe, Ross	......	......	......	6md	6md	......	......	......
Cincinnati, Hamilton	......	......	......	......	......	5r	5m	......
Cleveland, Cuyahoga	......	......	......	86.15m	......	......	......	......
Columbus, Franklin	......	......	......	......	......	......	5r	......
Dayton, Montgomery	......	......	1m	8m	......	30m	......	......
Delaware, Delaware	......	......	......	1,000l	......	......	20m	......
Findlay, Hancock	......	......	......	......	......	......	60m	......
Georgetown, Brown	......	......	......	......	......	......	5m	......
Hillsboro, Highland	......	......	......	......	......	4m	4m	......
Jackson, Jackson	......	......	......	......	......	......	7m	......
Jefferson, Ashtabula	......	......	......	3½m	10m	......	......	......
London, Madison	......	......	......	......	......	......	2m	......
Napoleon, Henry	......	......	......	......	......	......	50m	......
Newark, Licking	......	......	......	......	13.83m	......	......	......
Nova, Ashland	......	......	4¾m	......	......	......	......	......
Painesville, Lake	......	......	......	2.6m	12.4m	......	......	......
Port Clinton, Ottawa	......	......	......	......	......	......	40m	......
Portsmouth, Scioto	......	......	......	......	......	......	6m	2.260l
St. Clairsville, Belmont	$450,000 bonds sold.							
Sandusky, Erie	......	......	......	10md	10md	......	......	......
Springfield, Clark	......	......	......	......	......	......	12m	......
Toledo, Lucas	$189,900 road bonds sold.							
Troy, Miami	......	......	......	......	......	......	11ma	......
Upper Sandusky, Wyandot	......	......	......	......	......	......	40m	......
Warren, Trumbull	......	......	......	21.7m	8m	......	25m	......
Waverly, Pike	......	......	......	......	......	......	10m	......
West Union, Adams	......	......	......	......	......	......	$85,000	......
Wooster, Wayne	......	......	......	......	......	......	2r	......
Youngstown, Mahoning	......	......	......	......	......	......	14,600ls	......
Zanesville, Muskingum	......	......	......	......	12m	......	2m	......
Oklahoma—								
Arnett, Ellis	......	......	......	......	......	4m	......	......
Buflalo, Harper	None							
Sayre, Beckham	......	......	......	......	......	......	......	10mc
Tahlequah, Cherokee	......	......	......	......	......	4m	3m	......
Pennsylvania—								
Scranton, Lackawanna	......	......	......	......	......	......	5½m	......
South Carolina—								
Florence, Florence	......	......	......	......	......	......	......	400mc
Marion, Marion	......	......	......	......	......	......	......	20mc
South Dakota—								
Plankinton, Aurora	......	......	......	......	......	......	15m	......
Tennessee—								
Alamo, Crockett	$ 30,000 bonds for bridges and levees authorized.							
Benton, Polk	$ 80,000 bonds for roads and bridges authorized.							
Camden, Benton	$200,000 bonds for roads and bridges authorized.							
Centerville, Hickman	$200,000 bonds for roads and bridges authorized.							
Charlotte, Dickson	$250,000 bonds for roads authorized.							

City and County	Bitumen Concrete	Bitulithic	Bituminous Macadam	Brick	Cement Concrete	Gravel	Macadam	Others
Chattanooga, Hamilton	$ 50,000 bonds for roads authorized.							
Cleveland, Bradley	1½-mill tax for roads authorized.							
Covington, Tipton	$ 75,000 bonds for roads and bridges authorized.							
Dandridge, Jefferson	$125,000 bonds for macadam roads authorized.							
Dyersburg, Dyer	$ 76,000 bonds for bridge and levee authorized.							
Erwin, Unicoi	$ 50,000 bonds for roads authorized.							
Gainesboro, Jackson	$100,000 bonds for roads and bridges authorized.							
Greeneville, Greene	$500,000 bonds for macadam roads authorized.							
Huntingdon, Carroll	$250,000 bonds for roads and bridges authorized.							
Loudon, Loudon	$160,000 bonds for roads and bridges authorized.							
McMinnville, Warren	$100,000 bonds for roads authorized.							
Memphis, Shelby	$600,000 bonds for roads and bridges authorized.							
Nashville, Davidson	$695,000 bonds for roads sold.							
Pulaski, Giles	$100,000 bonds to purchase toll pikes and road machinery.							
Sevierville, Sevier	$185,000 bonds for macadam roads authorized.							
Tazewell, Claiborne	$400,000 bonds for macadam roads and bridges authorized.							
Texas—								
Bastrop, Bastrop	$ 30,000 bonds voted.							
Beaumont, Jefferson								1.7mn
Belton, Bell						6m		
Cameron, Milam	$100,000 bonds voted.							
Falfurrias, Brooks	$ 34,000 bonds voted.							
Ft. Worth, Tarrant	About $800,000 in completion of highway system.							
Galveston, Galveston						2.8mq		
Hillsboro, Hill	$150,000 bonds voted.							
Kaufman, Kaufman	$250,000 bonds voted.					20mq		
Marshall, Harrison	$300,000 bonds voted.							
McKinney, Collin	$390,000 bonds voted.							
Palo Pinto, Palo Pinto	$100,000 bonds voted.							
Post, Garza	$ 60,000 bonds voted.							
San Marcos, Hays	$ 50,000 bonda voted.							
Waco, McLennan	$1,075,000 bonds voted.							
Virginia—								
Buckingham, Buckingham						834m		
Charlotte, Charlotte							3m	
Lebanon							20m	
Manassas, Prince William							3m	
Richmond, Henrico	$500,000 for improveemnts.							
Staunton, Augusta			6mg					
Tazewell, Tazewell							17m	
Washington, Rappannock							9½m	
Washington—								
Asotin, Asotin					1m			
Colville, Stevens						17½m		
Davenport, Lincoln							2m	
Ellensburg, Kittitas						20m		
Everett, Snohomish					4m	5m		
Kalama, Cowlitz							4m	
Olympia, Thurston						12m		
Port Townsend, Jefferson						6m		
Seattle, King				54,000y				
Shelton, Mason						10m		10mj
Tacoma, Pierce		4.26m		1rd				1rdng
Mt. Vernon, Skagit					2½m			
Vancouver, Clarke		2½md			2½md	66mb		
Waterville, Douglas						5m	4m	
Wenatchee, Chelan						20m		
West Virginia—								
Charlestown, Jefferson							10m	
Fairmont, Manon							18m	
Huntington, Cabell				82,130y				
Marlinton, Pocahontas							2½m	1ma
Martinsburg, Berkeley				15,000y			18m	5ma
Wisconsin—								
Baraboo, Sauk					2m	4m	25m	
Durand, Pepin							2½m	
Eagle River, Vilas	$35,000 for earth roads.							
Elkhorn, Walworth						5m	7m	6ma
Ft. Atkinson, Jefferson						16,100l	44,180l	
Gotham, Richland						2m	5m	
Grand Rapids					2m	6m		
Janesville, Rock						20m	2m	5mk
Milwaukee, Milwaukee					35m			3mn
Nelson, Buffalo					½m	½m	4m	20mj
New Lisbon, Juneau							12m	
Oshkosh, Winnebago					3,000l	8m	10m	2ma
Princeton, Green Lake						2m	6m	2mj
Sparta, Monroe					1m		17m	7ma
Superior, Douglas							6m	

a—Oiled macadam. b—Stone and gravel. c—Sand clay. cy—Cubic yards. d—Of one or more of those on same line marked "d." e—1 mile shale, 1 mile clay. f—Surface treatment with tar or oil. g—Asphalt macadam. h—Wooden block. i—Sand-clay-cinders. j—Earth road. k—Rubble and gravel. l—linear feet. m—Miles. n—asphalt. o—Sand and oil. p—Glutrin surface treatment. q—Shell. r—roads. s—Slag macadam. t—Tons. u—Bituminous top. y—Square yards.

STREET GRADING IN CITIES.

The following are reported amounts of street grading which is not done in connection with street paving:

Alabama—
Bessemer: None.

Arkansas—
Pine Bluff: 5 miles.

California—
Eureka: 5 miles.

Colorado—
Colorado Springs: 10 miles.

Connecticut—
Ansonia: ½ mile.
Hartford: 2 miles.
Naugatuck: 1 mile.
Torrington: ½ mile.

Illinois—
Cairo: 40,000 cu. yds.
Peoria: 10,000 cu. yds.
Springfield: 3 miles.

Indiana—
Anderson: 3 miles.
Logansport: None.

Iowa—
Mason City: 2 miles.
Muscatine: 20,000 cu. yds.

Kansas—
Atchison: 1.2 miles.
Ft. Scott: 2 miles.

Kentucky—
Paducah: None.

Massachusetts—
Southbridge: 3 miles.
Springfield: $10,000.
Webster: $2,500.

Michigan—
Pontiac: 10 miles.

Minnesota—
St. Paul: 15 miles.
Stillwater: None.

Mississippi—
Hattiesburg: 9.3 miles.

Missouri—
Hannibal: 2 miles.
Kansas City: 30 miles.

Montana—
Butte: 130,000 cu. yds.
Great Falls: 3 miles.
Helena: 25,000 cu. yds.
Missoula: $10,000.

Nebraska—
Lincoln: 100,000 yds.

New Jersey—
Bayonne: ¼ mile.
New Brunswick: Small amount.
West New York: 2 miles.

New York—
Binghamton: 4 miles.
Buffalo: 14,379 lin. ft.
Johnstown: 1.5 miles.
Plattsburg: 1 mile.
Queens Boro: 560,000 cu. yds.
Richmond: 590 cu. yds.
Utica: 1:5 miles.

North Carolina—
Asheville: 2 miles.
Durham: 17,000 cu. yds.

Ohio—
Akron: ½ mile.
Canton: 72,652 cu. yds.
Cincinnati: 18 miles.
Sandusky: 10,000 cu. yds.
Steubenville: 40,000 yds.
Tiffin: None.

Oklahoma—
Chickasha: None.
Oklahoma City: 100,000 cu. yds.

Pennsylvania—
Farrell, Boro of: ½ mile.
Lebanon: None unless by special appropriation.
McKees Rocks: 6,000 cu. yds.
Oil City: ½ mile.
Old Forge, Boro of: 1¾ miles.

Rhode Island—
Pawtucket: Uncertain.

Tennessee—
Nashville: $59,660.00.

Utah—
Ogden: 4.0 miles.

Washington—
Aberdeen: 450,000 cu. yds. dredging.
Seattle: 20 miles.
Walla Walla: 1½ miles.

Wisconsin—
Ashland: 2 miles.
Green Bay: 1¼ miles.
LaCrosse: None.
Sheboygan: Nothing definite.
Superior: Not determined yet.
Wausau: About 2 miles.

ROAD GRADING IN COUNTIES

The following are reported amounts of road grading not in connection with placing of any of the kinds of surfacing included in the tables of road paving. In some cases apparently the usual working of the roads is reported as road grading:

Alabama—
Guntersville, Marshall County: 25 miles.

Illinois—
Morrison, Whitesides County: 40 miles.
Newton, Jasper County: 100 miles.
Pontiac, Livingston County: 300 miles.
Savanna, Carroll County: 4 miles.
Springfield, Sangamon County: 1,500 miles.
Vienna, Johnson County: 400 miles.
Wyoming, Stark County: 400 miles.

Indiana—
Crawfordsville, Montgomery County: 500 miles to be kept in repair.
Dana, Vermillion County: 100 to 350 miles.
Hagerstown, Wayne County: 1 mile.
LaGrange, Lagrange County: 350 miles.
Noblesville, Hamilton County, 650 miles.
Salem, Washington County: 150 miles macadam roads to be regraded.

Iowa—
Carroll, Carroll County: 4 miles.
Storm Lake, Buena Vista County: 13 miles.

Kansas—
Abilene, Dickinson County: 100 miles.
Chanute, Neosho County: 15 miles.
El Dorado, Butler County, 100 miles regrading, 150 miles new road.
Emporia, Lyon County: 20 miles.
Goodland, Sherman County: 30 to 35 miles.
Iola, Allen County: $56,000 to be expended.
Jetmore, Hodgeman County, 135 miles.
McPherson, McPherson County: 72 miles.
Norton, Norton County: 46 miles.
Pittsburg, Crawford County: 200 miles.
Russell, Russell County: 75 miles.

Santa Fe, Haskell County: 24 miles
Topeka, Shawnee County: 200 miles.
Westmoreland, Pottawatomie County: 205 miles.
Wichita, Sedgwick County: 75 to 100 miles.
Yates Center, Woodson County: 70 miles.

Kentucky—
Ashland, Boyd County: 2 miles.
Benton, Marshall County: 350 miles.
Bowling Green, Warren County: Graded roads, 31.75 miles.
Macadam, 28.00 miles.
Repairing, 29.00 miles.
arth roads, 432.00 miles.
Hodgenville, La Rue County: 250 miles.
Lancaster, Garrard County: 7,000 cu. yds.
Mason, Grant County: 8 miles.
$16,000 for repairs.

Missouri—
Charleston, Mississippi County: $12,000 will be expended.
Greenfield, Dade County: Number of miles indefinite.
Hillsboro, Jefferson County: 45 miles.
Kansas City, Jackson County: 32 miles.
Macon, Macon County: 1,500 miles.
Poplar Bluff, Butler County: 25 miles.
Rolla, Phelps County: 20 miles.
St. Joseph, Buchanan County: 300,000 yds.
Sikeston, Scott County: 200 miles.
Troy, Lincoln County: 20 miles.

Minnesota—
St. Paul: 800 miles.

Montana—
Glendive, Davison County: 20 miles.
Glasgow, Valley County: 30 miles.

Nebraska—
Fremont, Dodge County: 25 miles.
Seward, Seward County: 500 miles.
Wahoo, Saunders County: 15-25 miles.

New Jersey—
Netcong, Warren County: 80,000 cu. yds.
Salem, Salem County: 13 miles.
Somerville, Somerset County: 16,382 cu. yds.
Wenonah, Gloucester County: 22,000 cu. yds.

New York—
Auburn, Cayuga County: 800 miles.
Cortland, Cortland County: 300 miles.
Fonda, Montgomery County: 120 miles.
Lyons, Wayne County: 75 miles.
Montour Falls, Schuyler County: 300 miles.
Oswego, Oswego County: 15 miles.
Penn Yan, Yates County: 40 miles turnpiking.
Rochester, Monroe County: 52 miles.
Schenectady, Schenectady County: 150 miles.
Waterloo, Seneca County: 100 miles.

Ohio—
Cadiz, Harrison County: 8 miles.
Celina, Mercer County 20 miles.
Chardon, Geauga County: 5 miles.
Delaware, Delaware County: 20 miles.
Hillsboro, Highland County: 1½ miles (contract let).
Jefferson, Ashtabula County: 6,000 cu.yds.
Napoleon, Henry County: 50 miles.
Sandusky, Erie County: 10 miles.
Upper Sandusky, Wyandotte County: 40 miles.
Waverly, Pike County: 10 miles.

Oklahoma—
Beaver, Beaver County: Considering grading 20 miles.
Buffalo, Harper County: Impossible to give estimate.
Coalgate, Coal County: 25 miles.
Fairview, Major County: 25,000 cu. yds.
Hobart, Kiowa County: No estimate.
Sayre, Beckham County: 100 miles.
Tahlequah, Cherokee County: 25 miles.
Tulsa, Tulsa County: 2 roads.
Woodward, Woodward County: 25 miles.

Virginia—
Buckingham, Buckingham County: 8¾ miles.
Lebanon, Russell County: 10 miles.
Manassas, Prince William County: 10-20 miles.
Staunton, Augusta County: 5 miles.
Tazewell, Tazewell County: 15 miles.

Washington—
Asotin, Asotin County: 5 miles.
Colville, Stevens County: 92 miles.
Ellensburg, Kittitas County: 40 miles.
Everett, Snohomish County: 30 miles.
Olympia, Thurston County: 33.4 miles.
Port Angeles, Clallain County: 35 miles.
Port Townsend, Jefferson County: 20 miles.
Seattle, King County: 75 miles.
Mt. Vernon, Skagit County: 10 miles.
Waterville, Douglas County: 18 miles.
Wenatchee, Chelan County: 20 miles.

Wisconsin—
Baraboo, Sauk County: 30 miles.
Danbury, Burnett County: $10,000 will be expended.
Elkhorn: Walworth County: 1 mile.
Ft. Atkinson, Jefferson County: 53,660 l.
Gotham, Richland County: 5 miles.
Grand Rapids, Wood County: 40 miles.
Milwaukee, Milwaukee County: 35 miles.
Newald, Forest County: 25 miles.
Oshkosh, Winnebago County: 20 miles.
Rice Lake, Barron County: $38,000 will be expended.
Sparta, Monroe County: 20 miles.
Superior, Douglas County: 28½ miles.

West Virginia—
Huntington: 12 miles (convict labor).
Martinton, Pocahontas County: 2 miles.
Proctor, Wetzel County: 115 miles.
Webster Springs, Webster County: 1 mile.

SIDEWALKS IN CITIES

Nearly all the sidewalks reported are of cement, but there is a showing of several other kinds.

Alabama—
Bessemer: None.
Gadsden: Cement, 5,500 sq. yds.
Selma: Cement, 2 miles.

Arizona—
Argenta: Cement, 2 miles.

Arkansas—
Ft. Smith: Cement, about 4 miles.
Little Rock: Cement, 5 miles.
Pine Bluff: Cement, 3 miles (private construction).

California—
Eureka: Cement, 1,500 ft. long, 12-in. wide. Wood, 7½ miles.
Los Angeles: 100 miles (public).
Oakland: Cement, 25 miles.
Redlands: Cement, 1 mile.
San Francisco: Several miles.
San Jose: Cement, 10 miles.

Colorado—
Colorado Springs: Cement, 5 miles.
Pueblo: 1 mile—both public and private.

Connecticut—
Ansonia: Tar concrete, 1 mile.
Hartford: Cement (private).
Stone (private).
Naugatuck: Cement, 2,000 sq. yds.

Torrington: Cement, 3,000 ft.
Tar concrete, 1,000 ft.
Willimantic: About $40,000 to be expended.

Florida—
St. Petersburg: 2 miles.

Georgia—
Brunswick: Tile, 2,000 sq. yds.
Macon: No estimate can be made.

Illinois—
Alton: Cement, 2 miles.
Belleville: Cement, $10,000.
Cairo: Cement, 10,000 sq. yds.
Canton: Brick, ½ mile.
Cement, ¾ mile.
Chicago Heights: Cement, 2 miles (private).
East St. Louis: Cement, 5.0 miles.
Freeport: Cement, 1½ miles.
Galesburg: Cement, $2,910.
Joliet: Cement, 4 miles.
Mattoon: Cement, 10,000 sq. ft.
Moline: Cement, 10 miles.
Park Ridge: Cement, several streets.
Peoria: Cement, 12 miles (private).
Quincy: Cement, 5-6 miles.
Rock Island: Cement, 5 miles.
Streator: No estimates made.
Waukegan: Cement, 7,000 ft.

Indiana—
Corydon: Cement, 2,265 sq. ft.
Ft. Wayne: Cement, 264,000 sq. ft.
Gary: Cement, 50,000 sq. yds.
Jeffersonville: Cement, about 6 miles.
Lafayette: Cement, 3,000 lin. ft.
Logansport: All work done by property owners.
Michigan City: Cement, 2,000 ft.
Richmond: Cement, 56,000 sq. ft.
South Bend: Cement, 10,000 sq. ft.
Terre Haute: Cement, 10 miles.

Iowa—
Clinton: Cement, 100,000 sq. ft.
Creston: $5,861.
Ft. Dodge: Cement, 10,000 lin. ft., 5-inch wide.
Marshalltown: Cement, about 5,000 lin. ft.
Mason City: Cement, 3 miles.
Muscatine: Cement, 4 miles.
Sioux City: Cement, 10 miles.

Kansas—
Atchison: Brick, 1,000.
Cement, 25,000.
Ft. Scott: Cement, 2 miles.
Hutchinson: Cement, 10 miles.
Independence: Cement, 4 blocks.
Pittsburg: Brick, 2 miles.
Topeka: Contract not let until about June 1.
Wichita: Cement:, 150,000 sq. ft.

Kentucky—
Covington: Cement, 6 miles.
Lexington: Cement, 1 mile.
Louisville: Cement, 36,000 sq. yds.
Paducah: Cement, amount not decided.

Louisiana—
Breaux Bridge: Cement, all principal streets.
DeQuincy: Cement, 82,000 sq. ft.
Lafayette: Cement, 24 miles.
Lake Charles: Cement, 1,000 yds.
Morgan City: $32,000.

Maine—
Lewiston: As called for.

Massachusetts—
Brookline: $24,500, kind not determined.
Fall River: $32,000, kind not determined.
Greenfield: Cement, 3,000 sq. yds.
Tar concrete, lin. ft.
Somerville: About $40,000.
Southbridge: Cement, 2,000 sq. yds. (public).
Webster: Cement, $5,000.
Westfield: Cement, 4,000 sq. yds.
Worcester: $15,000.00.

Michigan—
Alpena: Cement, ½ to ¾ mile.
Ann Arbor: Cement, 1 mile (private).
Bay City: Cement, 300,000 sq. ft.
Battle Creek: Cement, 300,000 sq. ft.
Flint: Cement, 130,000 sq. ft.
Holland: Cement, 1 mile.
Kalamazoo: Built by property owners.
Marquette: Cement, ½ mile.
Pontiac: Cement, 5 miles.
Saginaw: Cement, 10 miles.

Minnesota—
Minneapolis: Cement, 30 miles.
St. Cloud: Cement, 1,500 sq. yds. (public).
St. Paul: Cement, 75,000 lin. ft.
Stillwater: Cement, about 1 mile (public).
Virginia: Cement, 2 miles (private).
Wood, 1 mile.

Mississippi—
Vicksburg: Cement, 2 miles.

Missouri—
Hannibal: Cement, 8 miles, 4-ft. wide (public).
Jefferson: No estimate.
Joplin: Cement, 5 miles.
Kansas City: Cement, 36 miles.
Sedalia: Cement, 3 miles (public).
Springfield: Cement, 27,000.
Webb City: Cement, 15,000 sq. ft.

Montana—
Billings: Cement, 100,000 sq. ft.
Butte: Cement, Contract, 7 miles; private, 3 miles.
Great Falls: 400,000 sq. ft.
Helena: Cement, 200,000 sq. ft.
Missoula: Cement, 5 miles.

Nebraska—
Lincoln: Cement, 10 miles.

New Jersey—
Bayonne: Cement, 5,000 lin. ft.
Stone, 5,000 lin. ft.
Bloomfield: Cement, 2 miles.
Stone, 2 miles.
Elizabeth: Stone, 12 miles.
Irvington: Cement, one street.
New Brunswick: Cement, small amount.
Passaic: Cement, 1,500 lin. ft. (public).
Plainfield: Cement, 1 mile (private).
Trenton: All private work.
West New York: Cement and stone, 1.5 miles.

New Mexico—
Albuquerque: Cement, 3,000 ft.

New York—
Binghamton: Cement, 4 miles.
Buffalo: Cement, 18 miles (public).
Charlotte: Cement, ¼ mile.
Cortland: Cement, ½ mile.
Dunkirk: Cement, 9,000 sq. yds.
Elmira: Cement, 20,000 ft. (private).
Fulton: Cement, 10,000 sq. ft.
Gloversville: Cement, 8,000 ft.
Hudson: Cement, ½ mile (private).
Jamestown: Cement, 5 miles.
Johnstown: Brick, 2 miles (private).
Cement, 4 miles (public).
Little Falls: Cement, 2 miles (private).
New Rochelle: Council proposition.
Niagara Falls: Cement, 10 miles.
North Tonawanda: Cement, 3 miles.
Ossining: Estimates not made yet.
Plattsburg: Cement, 4,000 ft.
Poughkeepsie: Cement, 1 mile.
Queens Boro: Cement, 1 mile.
Stone, 32,000.
Richmond: Cement, 3,300 sq. ft.
Stone, 2,100 sq. ft. (new); 7,880 sq. ft. (relaid).
Saratoga Springs: Cement, some.
Troy: Cement, 9,000 sq. ft.
Utica: Cement, 2.5 miles.
Watertown: Cement, 5 miles.

North Carolina—
Asheville: Cement, 20,000 sq. yds.
Durham: Impossible to make tstimate at this time.
Winston-Salem: Cement, 25,000 sq. yds. (public).

North Dakota—
Grand Forks: Cement, 2 miles.

Ohio—
Akron: Cement, 30 miles.
Alliance: Cement, 1 mile.
Cambridge: Cement, 18,000 ft. (private, semi-public).
Canton: Cement, 46,590 sq. ft.
Stone, 146,240.
Chillicothe: Cement, 16,000 sq. ft.
Cincinnati: 200,000 sq. ft. (public).
Findlay: Cement, ½ mile (public); 3 miles (private).
Ironton: Cement, 5 miles.
Lancaster: Cement, ½ mile.
Lorain: Stone, 10,000 sq. ft.
Mansfield: Stone, 3 miles.
Massillon: Cement, 2 miles (private).
Middletown: Cement, 3 miles.
Sandusky: Brick, 300 sq. ft.
Cement, 15,000 sq. ft.
Stone, 4,000 sq. ft.
Steubenville: Cement, 5 miles.
Tiffin: None.
Toledo: Usual amount.
Warren: Cement, 1½ miles.
Stone, 1½ miles.

Oklahoma—
Oklahoma City: Cement, 6,000 lin. ft.
Shawnee: Cement, 2,500 ft.
Tulsa: Cement, 15,000 ft.

Pennsylvania—
Carnegie, Boro of: Cement, about 2,000 ft.
DuBois: Brick, 8,000 lin. ft.
Cement, 5,000 lin. ft.
Farrell, Boro of: Stone, about 1,000 lin. ft.
Hazleton: Cement, 4,000 sq yds (private).
Tar concrete, 8,000 sq. yds. (private).
Lebanon: None.
McKees Rocks: Cement, 100,000 sq. ft. (private).
Cement, 2 miles (private).
Nanticoke: Cement, 2 miles (private).
Oil City: Brick and cement, about 2 miles.
Wilkinsburg: Cement, ½ mile (private).
York: Cement, 65,000 sq. ft.

Rhode Island—
Pawtucket: Cement, amount indefinite.
Woonsocket: Tar concrete, 2,000 sq. yds.

South Carolina—
Columbia: Cement, 5 miles.
Greenville: 5,000 sq. yds.

Tennessee—
Nashville: $14,362.99.

Utah—
Ogden: Cement, 26,400 lin. ft. 6 ft wide (public).
Salt Lake: Cement, 20 miles.

Vermont—
Barre: Cement, 3,000 sq. yds.
Rutland: Tar concrete, 1 mile.
Stone, 2 miles.

Virginia—
Roanoke: Granolithic.

Washington—
Aberdeen: 15,000 sq. yds.
Bellingham: Cement, 2 miles.
Everett: Wood, 1 street.
Seattle: Cement, 43 miles.
Wood, 1 mile.
Walla Walla: Cement, 20,000 sq. ft.

West Virginia—
Charleston: Cement, 10,000 sq. yds.
Parkersburg: Cement, 20,000 sq. yds.

Wisconsin—
Appleton: Cement, about 4 miles, 5 ft. wide.
Beloit: Cement, 1 mile.
Fond du Lac: Cement, about 6 miles (private).
Green Bay: Cement, 4 miles (private).
Jasonville: Cement, 1.5 miles.
LaCrosse: Cement, about 2 miles (private).
Madison: 4 miles.
Oshkosh: Cement, about 14 miles (private).
Sheboygan: Cement, 100,000 sq. ft.
Superior: Cement, 10 miles (public).

SIDEWALKS IN COUNTY WORK

Naturally there are few sidewalks on country roads, but a few are reported.

Illinois—
Wyoming, Stark County: 1 mile.

Indiana—
Connersville, Fayette County: 15,000 sq. ft.

Kansas—
El Dorado, Butler County: 1 mile.
Goodland, Sherman County: 2,300 to 2,500 cement.
Russell, Russell County: 1½ mile cement.
Troy, Doniphan County: Considerable.

Kentucky—
Lancaster, Garrard County: 5,000 sq. ft. cement.

New Jersey—
Cedar Run, Ocean County: 700 ft.

New York—
Lyons, Wayne County: 5,820 ft. cement.
Rochester, Monroe County: 5 miles cement.

Ohio—
Hillsboro, Highland County: Small amount.

Oklahoma—
Arnett, Ellis County: 1,000 ft. cement.
Coalgate, Coal County: 3 miles cement.

Washington—
Asotin, Asotin County: 1,000 ft. cement, 5 ft. wide (public).

West Virginia—
Martinsburg, Berkeley County: 3,000 sq. yds. cement.
Proctor, Wetzel County: 1,200 sq. yds. brick.
Webster Springs, Webster County: 1,000 ft. cement.

CURB AND GUTTER IN CITIES

Alabama—
Bessemer: None.
Gadsden: Concrete curb and gutter, 20,000 lin. ft.
Selma: Concrete curb, 2 miles.

Arkansas—
Argenta: Concrete curb and gutter, about 2 miles.
Ft. Smith: Concrte curb and gutter, 11 miles.
Little Rock: Concrete curb, 15 miles.
Concrete curb and gutter, 6 miles.
Pine Bluff: Concrete curb and gutter, 20,000 ft.

California—
Los Angeles: Granite block and cement concrete gutter, 101.4 miles.
Concrete curb, 81.5 miles.
Oakland: Brick gutter, 2 miles.
Cobble gutter, 2 miles.

Concrete curb, 12 miles.
Concrete gutter, 26 miles.
Wood curb, 18 miles.
Redlands: Cement gutter, 1 mile.
Granite curb, 1 mile.
San Jose: Concrete curb and gutter, 10 miles.
Santa Barbara: Concrete curb and gutter, 6 miles.
Vallejo: Concrete curb, 10 miles.

Colorado—
Colorado Springs: Concrete curb and gutter, 2 miles.
Pueblo: Concrete curb, 6,000 ft.

Connecticut—
Ansonia: Cobble gutter, 1½ miles.
Granite curb, 1½ miles.
Hartford: Concrete curb, about 3 miles.
Granite curb, about 1½ miles.
Meriden: Indefinite.
Naugatuck: Cobble gutter, 1 mile.
Granite curb, ¾ mile.
Torrington: Concrete curb and gutter, 3,000 ft.

Georgia—
Brunswick: Concrete curb, 2,000 lin. ft.
Macon: No estimate.

Illinois—
Alton: Concrete curb, 2 miles.
Concrete curb and gutter, 5 miles.
Limestone curb, 1,500 ft.
Aurora: Concrete curb and gutter, 8 to 10 miles.
Belleville: Concrete curb and gutter, $20,000.
Sandstone curb, $700.
Cairo: Concrete curb and gutter, 80,000 ft.
Limestone curb, 500 ft.
Canton: Concrete curb and gutter, 800 ft.
Chicago Heights: Concrete curb, 33,074 6 lin. ft.
East St. Louis: Concrete curb, .5 miles.
Granite curb, .75 miles.
Sandstone curb, 7.5 miles.
Freeport: Concrete curb, 20,000 ft.
Concrete curb and gutter, 10,000 ft.
Sandstone curb, 10,000 ft.
Galesburg: Concrete curb, 38,750 lin. ft.
Joliet: Concrete curb and gutter, 10,000 lin. ft.
Moline: Concrete curb, 48,000 ft.
Concrete curb and gutter, 18,700 ft.
Oak Park: Concrete curb and gutter, 118,-215 lin. ft.
Peoria: Concrete curb, 10 miles.
Quincy: Brick gutter, 3 miles.
Concrete curb and gutter, 2½ miles.
Sandstone curb, 3 miles.
Springfield: Sandstone curb, 57,000 lin. ft.
Streator: Sandstone curb, 2,500 ft.
Waukegan: Concrete curb, 3,300 ft.
Concrete curb and gutter, 7,000 ft.

Indiana—
Ft. Wayne: Concrete curb and gutter, 7,000 lin. ft.
Sandstone curb, 47,000 lin. ft
Gary: Concrete curb, 50,000 lin. ft.
Concrete curb and gutter, 25,000 lin. ft.
Indianapolis: 3 streets.
Jeffersonville: Brick gutter, about 6 miles.
Limestone curb, about 6 miles.
Lafayette: Concrete curb and gutter, 6,000 lin. ft.
LaPorte: Concrete curb and gutter, 2 miles.
Logansport: None.
Michigan City: Concrete curb, 6 000 ft.
Concrete curb and gutter, 8,000 ft.
Richmond: Concrete curb and gutter, 5,700 ft.
Terre Haute: Concrete curb, 10-15 miles

Iowa—
Algona: 27,537 lin. ft. curb.
Davenport: Concrete curb and gutter, 25,000 ft.
Ft. Dodge: Concrete curb and gutter, 25,000 ft.
Indianola: Concrete curb and gutter, 32,-000 lin. ft.
Marshalltown: Concrete curb, 800 ft.
Mason City: Concrete curb, about 20 miles.
Muscatine: Concrete curb and gutter, 2 miles.
Sioux City: Concrete curb, 10 miles.
Concrete curb and gutter, 10 miles.

Kansas—
Atchison: Concrete curb, 6,000 ft.
Ft. Scott: Concrete curb and gutter, 11,000 ft.
Hutchinson: Concrete curb, 3 miles.
Concrete curb and gutter, 3 miles.
Independence: Concrete curb and gutter, 12 blocks.
Pittsburg: Concrete curb and gutter, 43,000 ft.

Kentucky—
Covington: Brick gutter, 5 000 ft.
Concrete curb and gutter, 10,000 ft.
Limestone curb, 20,00 ft.
Louisville: Brick gutter, 60,000 lin. ft.
Limestone curb, 12,000 lin. ft.
Marginal curb, 5,000 lin. ft.
Paducah: Concrete gutter and granite curb, amount indefinite.

Louisiana—
DeQuincy: Concrete curb, 114,480 lin. ft.
Lake Charles: Concrete curb, 3,000 lin. ft.
Concrete curb and gutter, 3 miles.

Maine—
Lewiston: As called for.

Maryland—
Frederick: Concrete curb and gutter, 8,435 ft.

Massachusetts—
Brookline: $24,500 appropriated.
Gloucester: None.
Somerville: $40 000 appropriated.
Southbridge: Concrete curb and gutter, 1,500 lin. ft.
Westfield: Concrete curb, 2,000 ft.

Michigan—
Alpena: Concrete curb, 7,000 lin. ft.
Ann Arbor: Concrete curb, 1 mile.
Bay City: None.
Battle Creek: Concrete curb and gutter, 15,000 lin. ft.
Flint: Concrete curb and gutter, 43,000 lin. ft.
Marginal curb, 1,000 lin. ft.
Holland: Concrete curb and gutter, 5,000 ft.
Marquette: Concrete curb, 4,000 lin. ft.
Menominee: Concrete curb and gutter, 2,500 ft.
Pontiac: Concrete curb and gutter, 3 miles.
Saginaw: Brick gutter, 4 miles.
Concrete curb, 4 miles.

Minnesota—
Duluth: Indefinite.
Minneapolis: Concrete curb and gutter, 75 miles.
St. Cloud: Concrete curb, 30,000 ft
St. Paul: Concrete curb, 87,754 lin. ft.
Stillwater: Concrete curb, about ½ mile.
Virginia: None.

Mississippi—
Vicksburg: None.

Missouri—
Hannibal: Concrete curb and gutter, 3 miles.
Jefferson: Concrete curb and gutter, 8 miles.
Joplin: Concrete curb, 5 miles.
Kansas City: Concrete curb and gutter, 3½ miles.
Concrete curb, 36 miles.
Sedalia: Concrete curb, 2 miles.
Concrete curb and gutter, 1 mile.
Springfield: Concrete curb, 47,000 lin. ft.
Limestone curb, 20,000 lin. ft.

Webb City: Concrete curb and gutter, 10,000 lin. ft.

Montana—
Billings: Concrete curb, 3-4 miles.
Concrete gutter, 16,100 lin. ft.
Street parking and boulevarding, 12 miles.
Great Falls: 50,000 lin. ft. concrete curb.
Helena: Concrete curb, 50,000 lin. ft.

Nebraska—
Fremont, Dodge County: 10 blocks concrete curb.
Lincoln: Brick gutter, 4,000 ft.
Concrete curb, 15,000 ft.
Concrete curb and gutter, 25,000 ft.

New Hampshire—
Laconia: Granite curb, 1,000 ft.

New Jersey—
Bayonne: Concrete curb, 3-4 miles.
Concrete curb and gutter, ½ mile.
Bluestone curb, 2 miles.
Bloomfield: Concrete curb, 2 miles.
Concrete curb and gutter, 2 miles.
Bluestone curb, 5 miles.
Passaic: Concrete curb and gutter, 1,500 lin. ft. (public).
Plainfield: Concrete curb, ½ mile.
Concrete curb and gutter, ½ mile.
West New York: Marginal curb, 1,200 ft.
Bluestone curb, 3,000 ft.

New York—
Amsterdam: Granite curb, 18,000 lin. ft.
Binghamton: Concrete curb, 6 miles.
Charlotte: Granite curb, 1 mile.
Cortland: Concrete curb and gutter, 3,000 ft.
Sandstone curb, 4,000 ft.
Dunkirk: Concrete curb and gutter, 12,000 ft.
Elmira: Sandstone curb, 2 miles.
Fulton: Concrete curb and gutter, 15,000 lin. ft.
Sandstone curb, 1,000 lin. ft.
Marginal curb, 600 lin. ft.
Gloversville: Cobble gutter, 2,500 ft.
Concrete curb, 1,500 ft.
Hornell: Concrete curb and gutter, 3,300 lin. ft.
Jamestown: Concrete curb and gutter, 2 miles.
Johnstown: Concrete curb, 17,000 ft.
Granite curb, 5,000 ft.
Marginal curb, 1,000 ft.
Little Falls: Concrete curb, 3,000 lin. ft.
Sandstone curb, 6,000 lin. ft.
New Rochelle: Council proposition.
Niagara Falls: Sandstone curb, 10 miles.
North Tonawanda: None.
Ossining: No estimates made yet.
Plattsburg: Concrete curb and gutter, 5,000 ft.
Poughkeepsie: Concrete curb and gutter, ½ mile.
Bluestone curb, 1½ miles.
Queens Boro: Cobble gutter, 3,000 ft.
Concrete curb, 14,200 ft.
Bluestone curb, 3,200 ft.
Richmond: Brick gutter, 999 sq. ft.
Belgian block gutter, 1,830 sq. yds.
Concrete curb, 506 lin. ft.
Granite curb, 72 lin. ft.
Limestone curb, 8,650 lin. ft.
Second-hand granite gutter, 2,050 sq. yds.
Troy: Concrete curb, 17,500 lin. ft.
Granite curb, 750 lin. ft.
Utica: Concrete curb and gutter, 11,000 lin. ft.
Sandstone curb, 11,000 lin. ft.
Watertown: Concrete curb and gutter, 1½ miles.

North Carolina—
Asheville: Granite, 12,000 lin. ft.
Durham: Concrete curb and gutter, 17,000 ft.
Winston-Salem: Granite curb, 5-10 miles.

North Dakota—
Grand Forks: Concrete curb, 4 miles.

Ohio—
Akron: Concrete curb and gutter, 15 miles.
Sandstone curb, 15 miles.
Ashtabula: Concrete curb and gutter, 2,800 lin. ft.
Cambridge: Concrete curb and sandstone curb, 12,000 ft.
Canton: Concrete curb, 9,250 lin. ft.
Sandstone curb, 35,160 lin. ft.
Chillicothe: Concrete curb, 3,500 ft.
Cincinnati: Concrete curb, 38,280 lin. ft.
Concrete curb and gutter, 700 lin. ft.
Granite curb, 80,000 lin. ft.
Findlay: Sandstone curb, 1 mile.
Lancaster: Sandstone curb, 2 miles.
Mansfield: Concrete curb and gutter, 1,000 ft.
Massillon: Brick gutter, 2,000 ft.
Concrete curb and gutter, 10,000 ft.
Sandstone curb, 8,000 ft.
Marginal curb, 1,650 ft.
Middletown: Concrete curb and gutter, 3 miles.
Sandusky: Concrete curb, 6,000 lin. ft.
Concrete curb and gutter, 8,000 lin. ft.
Sandstone curb, 5,000 lin. ft.
Steubenville: Concrete curb and gutter, 4 miles.
Sandstone curb, 1,000 lin. ft.
Tiffin: None.
Warren: Concrete curb, 1 mile.
Sandstone curb, 3 miles.

Oklahoma—
Chickasha: None.
Oklahoma City: Concrete curb, 10,000 ft.

Pennsylvania—
Bradford: Concrete curb and gutter, 2,200 ft.
DuBois: Concrete curb, 16,000 lin. ft.
Marginal curb, 400 lin. ft.
Farrell, Boro of: Sandstone curb, about 1,100 ft.
Hazleton: Cobble gutter, 5,000 lin. ft. (private).
McKees Rocks: Concrete curb, 4,000 lin. ft.
Meadville: Concrete curb and gutter, 39,000 lin. ft.
Marginal curb, 3,000 lin. ft.
North Braddock: Concrete curb and gutter, about 4 miles.
Oil City: Concrete curb and gutter, 38,000 ft.
Old Forge, Boro of: Concrete curb, 1 mile.
Wilkinsburg: Concrete curb and gutter, 10,000 ft.
York: Concrete curb and gutter, 8 miles.

Rhode Island—
Pawtucket: Indefinite.
Woonsocket: Cobble gutter, 8,000-10,000 lin. ft.
Granite curb, 8,000-10,000 lin. ft.

South Carolina—
Columbia: Concrete curb, 5 miles.

Tennessee—
Nashville: $40,000 to be expended.

Texas—
Marshall: Concrete curb and gutter, 5 miles.

Utah—
Ogden: Concrete curb and gutter, 13,200 lin. ft. (public).
Salt Lake City: Concrete curb and gutter, 22 miles.

Vermont—
Barre: Granite curb, 1,500 ft.

Washington—
Aberdeen: Concrete curb, 10,000 lin. ft.
Concrete gutter, 10,000 lin. ft.
Bellingham: Concrete curb and gutter, 2 miles.
Everett: 1 street.
Seattle: Brick gutter, 18 miles.
Cobble gutter, 20 miles.
Granite curb, 2 miles.
Walla Walla: Concrete curb and concrete curb and gutter, 4 miles.

West Virginia—
Charleston: Concrete curb, 78,620 ft.
Concrete curb and gutter, 4,600 ft.
Parkersburg: Concrete curb, 25,000 ft.

Wisconsin—
Appleton: Concrete curb and gutter, 6,000 ft.
Beloit: Concrete curb and gutter, ½ mile.
Eau Claire: Concrete curb and gutter, about 3,000 lin. ft.
Fond du Lac: Concrete curb and gutter, 30,000 ft.
Janesville: Concrete curb, 23,801 ft.
LaCrosse: Concrete curb and gutter, 3,600 lin. ft.
Madison: Concrete curb and gutter, 5 miles.
Sheboygan: Concrete curb and gutter, 50,000 lin. ft.
Limestone curb, 800 lin. ft.
Superior: Concrete curb and gutter, 10,000 ft.
Granite curb, 25,000 ft.
Wausau: Concrete curb and gutter, about 4,000 feet.

CURB AND GUTTER ON COUNTY ROADS

Illinois—
Watseka, Iroquois County: 2 miles concrete curb.
4 miles concrete curb and gutter.

Indiana—
Connersville, Fayette County: 2,000 lin. ft. concrete curb and gutter.
Plymouth, Marshall County: 2,000 ft. concrete curb.

Kansas—
Goodland, Sherman County: 1,000 to 2,000 ft. concrete curb.
500 ft. concrete curb and gutter.
McPherson, McPherson County: 26,000 ft. concrete curb and gutter.
Russell, Russell County: ¼ mile concrete curb.

New Jersey—
Cedar Run, Ocean County: 1,400 ft. concrete curb.
Wenonah, Gloucester County: 20,000 sq. ft. concrete gutter.

New York—
Cortland, Cortland County: 3,000 ft. concrete curb and gutter.
Fonda, Montgomery County: 1 mile granite curb.
Ithaca, Tompkins County: 2,000 ft. concrete curb.
Lyons, Wayne County: 2,900 ft. cobble gutter.
500 ft. concrete curb.

Ohio—
Canton, Starke County: 42,240 lin. ft. concrete curb.
Sandusky, Erie County: 20 miles concrete curb.
Warren, Trumbull County: Indefinite.

Oklahoma—
Arnett, Ellis County: 1,000 ft. concrete curb.
Coalgate, Coal County: 3 miles concrete curb and gutter.
Sayre, Beckham County: 1,000 ft. cobble gutter.

West Virginia—
Huntington, Cabell County: 31,600 lin. ft. concrete curb.
31,600 lin. ft. concrete curb and gutter.
Martinsburg, Berkeley County: 1,000 ft. concrete curb.
1,500 ft. concrete curb and gutter.

SEWER CONSTRUCTION

Alabama—
Bessemer: None.
Gadsden: Vitrified pipe, 41,000 lin. ft.
Manholes, 40; outlets, 2.

Arizona—
Tempe: Vitrified pipe system to cost $33,000.

Arkansas—
Argenta: Large storm and sanitary sewer now being perfected; too soon to give exact measurements.
Ft. Smith: Concrete pipe, 8 miles.
Manholes, 100.

California—
Alturas: Sewer system with septic tanks.
El Centro and Imperial: Outfall sewer, 30-inch, to cost $100,000.
Eureka: Vitrified pipe, 5 miles, 6 to 10-inch inclusive.
Manholes, 10.
Hanford: System to cost $75,000.
Los Angeles: 15 miles storm sewer including monolithic and reinforced concrete and vitrified pipe.
100 miles vitrified pipe and 200 manholes for sanitary sewers.
Oakland: Vitrified pipe, 10 miles.
Manholes, 125; catchbasins, 50.
Reedley: Sewer system, $28,000.
San Francisco: Mile rock tunnel outlet for 2 districts, $193,314.
San Jose: Reinforced concrete, 1 mile.
Vitrified pipe, 1 mile.
Santa Barbara: Vitrified pipe, 3 miles.
Manholes, 30.
Vallejo: Vitrified pipe, 10,000 ft. 10 to 24-inch.

Colorado—
Colorado Springs: Vitrified pipe, 1 mile 8 to 30-inch.
Manholes, 10.
Pueblo: Vitrified pipe, 7,000 ft. 8-inch.

Connecticut—
Ansonia: Vitrified pipe, 8,000 ft. 8 to 12-inch.
Manholes, 35.
Danbury: Vitrified pipe, 8,000 ft. 8, 10, 12, 15, 18-inch.
Manholes, about 40; catchbasins, 7.
Hartford: Two large sewers contemplated.
Meriden: $4,500 appropriated for 8-in. vitrified pipe, manholes, flush tanks, etc.
Naugatuck: Vitrified pipe, ½ mile.
Manholes, 5; catchbasins, 20.
New Britain: Is selling $55,000 sewer bonds.
Torrington: Vitrified block, 2,200 ft. 39-inch.
Vitrified pipe, 3,000 ft. 8 to 18 in.
Manholes, 20; catchbasins, 20.
Willimantic: $5,000 to $7,000 appropriated for sewers.

Georgia—
Augusta: Reinforced concrete, 5,510 ft. 30 to 66-in.
Vitrified pipe, 4,045 ft., 12 to 24-in.
Manholes, 19, 12 to 24-in.; catchbasins, 54.
Brunswick: Vitrified pipe, 2½ miles.
Flush tanks, 4.
Jackson: Sewer system, $14,000.
Macon: None.

Idaho—
Lewiston: Vitrified pipe, concrete pipe, 8 to 10-in., 26,000 ft.

Illinois—

Alton: 1,662 ft. 6-in. house connections, 973 ft. 8-in. pipe, 419 ft. 10-in. pipe, 1,206 ft. 12-in. pipe, 800 ft. 15-in. pipe, 13 manholes, 18 catchbasins, 2 inlets, one lamp hole.

Sanitary Sewer District No. 2, 32,400 lin. ft. 6-in. house connections, 38,730 lin. ft. 8-in. pipe, 11,140 lin. ft. 10-in. pipe, 1,160 lin. ft. 10-in. pipe, 6,500 lin. ft. 12-in. pipe, 4,503 lin. ft. 15-in. pipe, 1,460 lin. ft. 12-in. cast iron pipe, 1,430 lin. ft. 16-in. cast iron pipe, and 144 manholes, 21 flush tanks and 18,400 lin. ft. repaving trenches.

Belleville: $160,000 to be spent on sewer construction.

Cairo: Vitrified pipe, 20,000 ft.; manholes, 50; catchbasins, 200.

Canton: Vitrified pipe, 3,000 ft.; manholes, 10.

Centralia: Vitrified pipe, 8,580 ft., 8 to 12-in.; 20 manholes.

Chicago: Bids asked for a number of streets.

Chicago Heights: Brick, concrete, plain, concrete block, 1,933 ft. 84-in., 3,700 ft. 60-in, 2,270 ft. 54-in., 653 ft. 48-in., 1,600 ft. 42-in., 3,320 ft., 36-in., 2,000 ft. 30-in., 1,252 cu. yds. concrete reinforced. Vitrified block and pipe, 11,140 ft. 24-in., 1,325 ft. 20-in., 14,529 ft. 18-in., 15,670 ft. 15-in., 6,837 ft. 12-in., 660 ft. 10-in., 48,410 ft. 8-in., 37,880 ft. 6-in.

Manholes, 490; catchbasins, 432.

East Moline: Sewer in Watertown addition.

East St. Louis: Concrete, plain and reinforced 5.7 miles. Vitrified pipe, 5.5 miles.

Freeport: Vitrified pipe, 3 miles.

Manholes, 40; catchbasins, 30.

Galesburg: Vitrified pipe, 2,000 ft. 12-in.

Joliet: Vitrified pipe, about 3 miles.

Lockport: Sewer system to cost $80,000.

Mattoon: Vitrified pipe, about 2 miles.

Moline: Vitrified pipe, 11 miles.

Peoria: Two sewer systems. About 40 miles of sewer from 8-in. pipe to 8½ ft. brick.

Plano: Sewer system, $35,000.

Quincy: Brick, 1 mile; vitrified pipe, 1½ mile.

Rankin: Storm and sanitary sewer system to cost $24,340.

Rockford: Small sewers in 16 streets.

Springfield: Brick, 10,800 lin. ft.; vitrified pipe, 10,000 lin. ft., 18-in.

Manholes, 60.

Indiana—

Angola: Two systems to cost $43,000.

Anderson: Vitrified pipe, ½mile, 8 to 12-in.

Manholes, 5 to 10; catchbasins, 10 to 20.

Ft. Wayne: Vitrified pipe, 20,600 lin. ft. 12, 15, 18-in.

Manholes, 60; catchbasins, 18.

Gary: Concrete, plain, 1,375 ft. 60-in., 1,000 ft. 54-in., 675 ft. 48-in., 675 ft. 42-in.

Vitrified pipe, 3,753 ft. 27-in., 3,000 ft. 18-in., 4,000 ft. 12-in., 1,000 ft. 8-in., 3,000 ft. 24-in., 3,500 ft. 15-in., 3,500 ft. 10-in.

Manholes, 70; catchbasins, 50.

Huntington: Vitrified block, 500 ft.

Vitrified pipe, 10,000 ft.

Indianapolis: Local sewers 4 streets, Pogues run improvement, $800,000.

Main sewer concrete, 12 to 48-in.

Lafayette: Vitrified pipe, 5,000 ft.

Manholes, 5; catchbasins, 20.

LaPorte: Vitrified pipe, 1,600 ft. 18-in., 1,800 ft. 15-in., 600 ft. 10-in.

Logansport: Concrete, reinforced, 7,540 lin. ft. 24, 30, 36-in.

Vitrified pipe, 12,000 lin. ft.

Manholes, 65; catchbasins, 40; outlets, 6.

Michigan City: Concrete, reinforced 7,500 ft. of brick 9 ft. to 3 ft. 6 in.

Muncie: Sewer in one street.

Peru: Sewers in various streets.

Richmond: Concrete, reinforced concrete pipe, vitrified block and vitrified pipe, 3 miles of 8 to 54-inch diameter.

South Bend: Vitrified pipe 5,000 ft. 8, 10, 12, 14, 18-in.

Terre Haute: Vitrified pipe, 3 to 5 miles.

Vincennes: Storm sewer system 9 miles, $48,000.

Winchester: Combined storm and sanitary sewer.

Iowa—

Clinton: Considering completion of District No. 3.

Davenport: Vitrified pipe, 6-mile lateral from 6 to 18-in.

Des Moines: Sewer on 1 street.

Ft. Dodge: Vitrified pipe, 2 miles.

Guthrie Center: System to cost $40,000.

Indianola: Storm sewer, 1,200 ft. 8 to 24-in. with 72 catchbasins.

Kingsley: Sanitary system, 8 to 12-in. vitrified pipe.

Marshalltown: Vitrified pipe 1½ miles.

Manholes, 20.

Mason City: Vitrified pipe 1 mile 36-in.

Montezuma: East side system, $12,000.

Muscatine: Vitrified pipe, 2 miles.

Sheffield: $12,000 sewer bonds sold.

Sioux City: Vitrified block, 5 miles.

Vitrified pipe, 20 miles.

Manholes, 100; catchbasins, 400.

Kansas—

Atchison: Vitrified pipe, 6,000 ft. 8 to 10-inch.

Manholes, 20.

Council Grove: Lateral, 23,800 ft.

Dodge City: $13,964.

Ft. Scott: Vitrified pipe, 3 miles.

Manholes, 50.

Hutchinson: Concrete, plain, 1½ miles 30-inch.

Independence: Storm sewer, 6,000 ft., probably vitrified brick.

Pittsburg: Vitrified pipe, 2 miles 8-in.

Manholes, 25.

Salina: Sewer in 1 street, $13,000.

Topeka: Three sewers, contract for one has been let; contracts for other two will be let later.

Kentucky—

Covington: Concrete, plain, 1,100 ft. 7x9 ft.

Vitrified block, 2,500 ft.

Vitrified pipe, 5,000 ft.

Manholes, 60.

Catchbasins, 180.

Lexington: Vitrified pipe, possibly 2 miles.

Louisville: Concrete, reinforced, 3,000 ft.

Concrete pipe, 10,000 ft.

Vitrified pipe, 40,000 ft.

Manholes, 75; catchbasins, 450.

Paducah: Nothing definite yet. Plans preparing for sewer district No. 3 to cost about $200,000.

Louisiana—

Lake Charles: Vitrified pipe, 6 miles.

Manholes, 75; catchbasins, 250.

Maine—

Lewiston: Brick, 400 ft. 48-in.

Vitrified pipe, 3,000 to 4,000 ft.

Waterville: Manholes and catchbasins as needed.

Some 60-in. reinforced concrete pipe and vitrified pipe.

Maryland—

Baltimore: 8 to 15-in., 13,350 ft.

Frederick: Brick, 2,110 ft.

Vitrified block, 1,860 ft.

Vitrified pipe, 7,600 ft.

Manholes, 40; catchbasins, 20.

Mt. Rainier: Vitrified pipe, 8.5 mi., 8 to 15-in.

Massachusetts—

Brookline: Indefinite.

Fall River: $190,000 to be expended.

Greenfield: Vitrified pipe, 2,000 lin. ft.

Manholes, 12; catchbasins, 12.

Somerville: About $25,000 to be expended.

Southbridge: Vitrified pipe 1 mile 8-in.
Manholes, 20.
Springfield: $46,000 to be expended.
Taunton: $15,000 to be expended for sewer construction.
Webster: $2,000 to be expended.
Westfield: Vitrified pipe, 7,000 ft.

Michigan—
Alpena: Indefinite.
Ann Arbor: Vitrified pipe 2 miles 8-in.
Manholes, 30.
Bay City: Concrete pipe, 3,000 ft.
Vitrified pipe, 12,000 ft.
Manholes, 50.
Detroit: Is selling $1,160,000 of sewer bonds.
Flint: Vitrified block, 1 mile.
Vitrified pipe, 4 miles.
Manholes, 200; catchbasins, 200.
Grand Rapids: Bond issue of $50,000 proposed.
Holland: Vitrified pipe, 5,000 ft.
Ishpeming: Vitrified pipe, about 4,000 lin. ft. 24-in.
Manholes, 8; catchbasins, 4; outlets, 1.
Kalamazoo: Vitrified pipe, 26,000 ft.
Marquette: Vitrified pipe, 1,200 ft. 8-in.
Menominee: Vitrified pipe, 3,000 ft.
Manholes, 6; catchbasins, 7.
Pontiac: Vitrified pipe, about 4 miles 8-in.
Saginaw: Concrete pipe, 4 miles, mostly 12-in.
Zeeland: Sewer system to cost about $15,000.

Minneosta—
Cuyuna: Sewer system, $20,000.
Duluth: 6 or 7 miles concrete and vitrified pipe, all sizes.
Kelliher: 2,900 ft. 8-in.
Mankato: Storm sewer on 2 streets.
Minneapolis: Concrete, reinforced 5 miles.
Vitrified pipe, 20 miles.
Ortonville: Sewer system, $12,000.
St. Cloud: Vitrified pipe, ¾ mile.
St. Paul: 40 miles of sewer system, 9 to 78-in.
Stillwater: Vitrified pipe, ¾ mile.
Winona: Vitrified pipe, ¾ mile 6 and 8-in.
Manholes, 24.

Mississippi—
Vicksburg: None.

Missouri—
Chillicothe: One sewer, $5,000.
Hannibal: Concrete, plain, 4,000 ft.
Vitrified pipe, 70,000 lin. ft.
Jefferson: Vitrified pipe, 20,000 ft. 6, 8, 10-in.
Joplin: Concrete, reinforced, 2 miles.
Poplar Bluff: Sanitary sewers in District No. 4, 32,627 ft. 6 to 18-in. pipe; 38 manholes.
Sedalia: Vitrified pipe, 1¾ miles 15-in.
Manholes, 10.
Springfield: Vitrified pipe, 12 miles.
Manholes, 225.
St. Louis: $65,000.
Webb City: Vitrified pipe, 2,000 ft. 8 and 10-in.
Manholes, 6.

Montana—
Billings: Vitrified pipe, 12,000 lin. ft.
Manholes, 25; catchbasins, 15.
Butte: Concrete, reinforced, 400 lin. ft.
Concrete pipe, vitrified block, vitrified pipe, 9,000 lin. ft. 8-in. for sanitary sewer.
Manholes, 35.
Catchbasins, 15.
Great Falls: Reinforced concrete, 7,000 lin. ft. 4-ft.
Vitrified pipe, 5,660 lin. ft. 9-in., 690 lin. ft. 8-in.
Manholes and flush tanks, 40; catchbasins, 60.
Missoula: Vitrified block, 5,800 ft. 28-in.
Vitrified pipe, 8,200 ft. 20-in.

Nebraska—
Bancroft: Complete sanitary system, $19,200.
Lincoln: Vitrified pipe, 3 miles 8-in.
Manholes, 40.
Catchbasins, 40.
Scotts Bluff: Sewer laterals, $16,000.
Wayne: Sanitary sewers, 4,000 ft. 8-in.

New Hampshire—
Laconia: Vitrified pipe, 3,000 ft.

New Jersey—
Bayonne: Vitrified pipe, 1 mile.
Manholes, about 120 ft. apart.
Catchbasins, 30.
Bloomfield: Vitrified pipe, 5 miles.
Manholes, 50; catchbasins, 10.
Elizabeth: Brick, 0.5 miles.
Vitrified pipe, 7 miles.
Millville: Brick, 2,400 ft. 30-in., or
Vitrified pipe, 2,400 ft. 30-in.
Vitrified pipe, 1,300 ft. 24-in.
Manholes, 13.
Catchbasins, 35 with inlet pipes.
New Brunswick: Small amount.
Passaic: Vitrified pipe, 3,600 lin. ft. 8-in. diam.
Manholes, 12; flush tanks, 2.
Pitman: Sewer system to cost $100,000.
Plainfield: Cast iron, 0.17 miles 16-in.
Vitrified pipe, 1.3 miles 27-in.
Manholes, 20.
Trenton: $150,000 to be expended.
West New York: Vitrified pipe, 1,000 ft. 12-in.

New Mexico—
Albuquerque: None.

New York—
Albany: Intercepting sewer to cost about $310,000.
Amsterdam: Granite curb, 18,000 lin. ft.
Binghamton: Vitrified pipe, 4 miles 8 to 15-in.
Buffalo: Brick, 550 ft. 45-in., 280 ft. 42-in., 280 ft. 39-in., 285 ft. 33-in., 900 ft. 27-in.
Vitrified pipe, 1,500 ft. 24-in., 1,200 ft. 20-in., 3,000 ft. 18-in., 5,000 ft. 15-in., 5,000 ft. 12-in., 10,000 ft. 10-in.
Manholes, 150.
Charlotte: Vitrified pipe, 1½ miles 12 to 15-in.
Manholes, 6.
Cortland: Vitrified pipe, 1,500 ft. 8-in.
Dunkirk: Vitrified pipe, 8,000 lin. ft. 8 to 15-in.
Manholes, 30; catchbasins, 60.
Elmira: Vitrified pipe, about 13,000 ft.
Fairport: Intercepting sewer, $6,500, 600 ft. 8 to 18-in.
Fulton: Vitrified pipe, 2,500 lin. ft. 6 to 8-in.
Manholes, 6; catchbasins, 12; outlets, 18.
Goshen: Plans approved by State Board.
Gloversville: Vitrified pipe, 440, 15-in., 320 ft. 12-in.
Manholes, 3; catchbasins, 8; outlets, 2.
Hornell: Vitrified pipe, 1,800 ft. 24 in., 2,500 ft. 15-in., 5,000 ft. 8-in.
Manholes, 20; catchbasins, 10; outlets, 1.
Jamestown: Vitrified pipe, 2 or 3 miles.
Johnstown: Vitrified pipe, 1 mile 8-in.
Manholes, 10; catchbasins, 2.
Middletown: Vitrified pipe, 24-in.
New Rochelle: Council proposition.
New York City—Brooklyn: Two districts, to cost $160,000.
Niagara Falls: Concrete pipe, 3,000 ft.
Vitrified pipe, 8 miles.
Manholes, 200.
Catchbasins, 100.
Northport: Sewer system to cost $70,000.
North Tonawanda: Vitrified pipe, ½ mile.
Ossining: Concrete, reinforced, 5,530 ft. 5 to 6 ft. diameter.
Vitrified pipe, 184 ft. 8-in., 977 ft. 12-in., 244 ft. 15-in., 2,234 ft. 18-in., 1,911 ft. 21-in., 921 ft. 24-in., 778 ft. 36-in.
Plattsburg: Vitrified pipe, 2,500 ft. of 10-in.

Manholes, 10.
Catchbasins, 50.
Saratoga Springs: Vitrified pipe, some.
Troy: Vitrified pipe, 10,000 ft.
Manholes, 300.
Catchbasins, 125.
Utica: Vitrified pipe, 5,000 lin. ft. 8 to 15-in.
Manholes, 20; catchbasins, 45.
Wappingers Falls: Plans for sewer system approved by State Board to cost $75,000.
Waterloo: $25,000 sewer bonds sold.
Watertown: Vitrified pipe, 2 miles.

North Carolina—
Asheville: Vitrified pipe, 10,000 ft.
Manholes, 25 or 30.
Catchbasins, 25 or 30.
Durham: Vitrified pipe, 20,000 ft. 8 to 12-in.
Mooresville: Sanitary sewer, 9 miles.

North Dakota—
Grand Forks: Vitrified pipe, 1 mile.
Manholes, 10; catchbasins, 6.

Ohio—
Akron: Vitrified pipe, 2,000 ft. 8-in., 500 ft. 10-in.
Manholes, 12; catchbasins, 6.
Ashtabula: Vitrified pipe, 1,400 ft. 8-in.
Manholes, 4.
Cambridge: Vitrified pipe, 4,000 ft.
Manholes, 15; catchbasins, 15.
Canton: Vitrified pipe, 4.1 miles.
Manholes, 80; catchbasins, 100.
Chillicothe: Vitrified pipe, 670 ft. 20, 15, 12-in. laterals.
Manholes, 2; catchbasins, 9.
Cincinnati: Brick or concrete, plain, 41,900 lin. ft.
Vitrified pipe, 59,000 lin. ft.
Other types, 11,320 lin. ft.
Columbus: Storm sewer, $30,000.
Dayton: System for District No. 6.
East Liverpool: Vitrified pipe, ½ mile 8-in.
Findlay: Vitrified pipe, 2 miles 10 to 24-in.
Manholes, 51; catchbasins, 112.
Hamilton: Sanitary sewers in 2 districts.
Kenmore: Sewer system $70,000.
Lancaster: Vitrified pipe, 1 mile.
Lorain: Sanitary sewer, 3 streets.
Lowellville: Storm sewers in several streets.
Mansfield: Vitrified pipe, 2 miles.
Manholes, 25; catchbasins, 50.
Marion: Sanitary and storm sewers in 2 streets.
Massillon: Vitrified pipe, 1 mile.
Manholes, 20; catchbasins, 18.
Middletown: Vitrified pipe, 1 mile.
Mt. Vernon: Vitrified pipe, 6,200 ft. 12 to 24-in.; concrete vitrified pipe or segment tile, 2,700 ft. 30-in., 32 catchbasins, 17 manholes; 3,600 ft. sanitary vitrified pipe, 6 to 15-in.
St. Bernard: Sanitary sewer in 1 street.
Sandusky: Brick, 7,000 lin. ft. 36-in.
Concrete, plain, 4,000 lin. ft. 36-in.
Reinforced concrete, 1,000 lin. ft. 36-in.
Vitrified block, 4,000 lin. ft. 30-in.
Vitrified pipe, 10,000 lin. ft. 12 to 24-in.
Manholes, 125; catchbasins, 200.
Steubenville: Vitrified pipe, 1 mile.
Manholes, 30; catchbasins, 60.
Swanton: District No. 1.
Tiffin: Tile, ½ mile.
Toledo: Usual amount.
Urbana: Storm sewer, 2,865 ft. 12 and 15-in.
Warren: Brick, 2,500 ft.

Oregon—
Beaverton: Sanitary and storm sewer systems.
Portland: Sewer in one street, $5,000.
St. Johns: Sewer system.

Oklahoma—
Atoka: Sewer system, 7½ miles of pipe.
Oklahoma City: Vitrified pipe, 2,000 ft.
Shawnee: Vitrified pipe, 3,000 ft.
Tulsa: Vitrified pipe, 10,000 ft. 8-in.

Pennsylvania—
Bradford: Vitrified pipe, 6,400 ft. 8 to 12-in.
Manholes, 17; catchbasins, 4.
DuBois: Vitrified pipe, 6,000 lin. ft. 8-in.
Manholes, 25.
Harrisburg: Will spend $85,000 on sewers this year.
Lebanon: Vitrified pipe, 61,000 ft. 6 to 15-in.
McKees Rocks: Concrete curb, 4,000 lin. ft.
Meadville: Vitrified pipe, 3,000 lin. ft. 8-in.
Manholes, 5; catchbasins, 10.
Nanticoke: $100,000 to be expended.
North Braddock: Vitrified pipe, about 1 mile.
Manholes, 20.
Oil City: Vitrified pipe, 6,000 ft. mostly 6 in. some 10 to 12-in.
Manholes, 4; catchbasins, 75; outlets, 5.
Scranton: Two district systems to cost $136,000.
Sunbury: East End Sewer Co. to build intercepting sewers.
West Chester: Brick, 7 miles.
Vitrified pipe laterals, 8 to 12-in., 20,000 ft.
Wilkinsburg: Brick, 1,000 ft. 4½-ft.
York: 3 miles, kind to be determined later.

Rhode Island—
Woonsocket: Vitrified pipe, 1 mile 8-in.

South Carolina—
Charleston: $20,000 to be expended.

South Dakota—
Aberdeen: Several miles of stone sewer to be constructed.

Tennessee—
Chattanooga: Sewers in 11th ward, $13,000.
Greenville: Sanitary sewer system.
Memphis: Intercepting sewers, 13,000 ft. 6 to 16-ft. circular and rectangular part in tunnel.
Nashville: Brick, $191,520.59.
Vitrified pipe, $40,000.

Texas—
Galveston: $150,000 water and sewer extension bonds sold.
Houston: Sanitary, in several streets.
San Antonio: Storm sewers 1 street, $4,000.

Utah—
Ogden: Vitrified pipe, 18,000 lin. ft. 8-in. (public).
Manholes, 60.
Salt Lake City: Storm sewers, 1 mile.
Concrete pipe, 3 to 30-in.
Vitrified pipe, $1,500,000.
Main outlet sewer, $270,000.

Vermont—
Barre: Vitrified pipe, 2,000 ft.
Rutland: Concrete, plain, 1 mile.

Virginia—
Roanoke: Storm drains and sewers, 8 to 24-in. pipe, 2 streets.

Washington—
Aberdeen: Vitrified pipe, 1,600 lin. ft.
Manholes, 30; catchbasins, 30.
Bellingham: Concrete pipe, vitrified block, vitrified pipe, 3 miles, with manholes and catchbasins.
Bremerton: 8 to 12 in. concrete pipe sewers in 5 streets.
Centralia: Trunk and branches, 2 miles, estimate $150,000.
Seattle: Brick, 0.25 miles.
Concrete, reinforced, 5 miles.
Vitrified pipe, 20 miles.
Manholes, 500.
Catchbasins, 750.
Walla Walla: Vitrified pipe, 1½ miles.
Manholes, 25.

West Virginia—
Charleston: Brick or segment block, 500 ft. 72-in., 2,000 ft. 60-in., 1,300 ft. 54-in., 3,500 ft. 48-in., 4,400 ft. 36-in., 1,000 ft. 30-in.
Vitrified pipe, 4,400 ft., 24-in., 1,600 ft. 20-in., 400 ft. 18-in., 1,400 ft. 15-in., 6,600 ft. 12-in., 3,300 ft. 10-in., 3,400 ft. 8-in.
Manholes, 75; catchbasins, 100; outlets, 3.
Parkersburg: Vitrified pipe, 1,000 ft.

Wisconsin—
Appleton: Vitrified block, ½ mile.
Ashland: Vitrified pipe, 7,400 ft.
Beloit: Vitrified pipe, 1½ miles 8 and 10-in.
Chilton: Sewer system, $30,000.
Eau Claire: 1 mile of sewer.
Fond du Lac: Vitrified pipe, 3 miles.
Green Bay: Vitrified pipe, 3,000 ft.
Janesville: About 1 mile of storm sewers, 18 to 36-in.
Madison: Monroe street district, 7 miles 6 to 18-in. vitrified pipe, and 2 miles 24-in. cast iron pipe; 18 miles in whole city.
Merrill: Reinforced concrete, 3,000 ft. of 48-in.
Milwaukee: $550,000 to be expended.
Oshkosh: 1 mile of sewer.
Racine: 4 laterals.
Sheboygan: Vitrified pipe, 5,000 lin. ft.
Manholes, 25; catchbasins, 50.
Superior: Vitrified block, 1 mile.
Vitrified pipe, 3 miles.
Manholes, 30; catchbasins, 32.
Wausau: Vitrified pipe, 1 mile.
Manholes, 20; catchbasins, 32.

DRAINS FOR COUNTY ROADS

Illinois—
Savanna, Carroll County: 2 miles 4-in. vitrified pipe.
Catchbasins, 3, 3-ft.
Springfield, Sangamon County: Vitrified pipe, 1 mile.
Wyoming, Stark County: Tile, 5 miles 6-in.

Indiana—
Knox, Starke County: 3 sewers across Gold ditch.
LaGrange, LaGrange County: 1 dredge ditch, 30 miles, including laterals.

Kansas—
Eldorado, Butler County: Two small stretches of vitrified pipe, and surface drainage.
Goodland, Sherman County: 800 to 1,000 ft. concrete pipe.
Norton, Norton County: Concrete, reinforced, 11 3x5x20 ft.
Wichita, Sedgwick County: Several small tiling projects.

Kentucky—
Ashland, Boyd County: Vitrified pipe, 2,000 ft. 12 and 16-in.
Hodgenville, LaRue County: Concrete, reinforced, 6 6 to 20-ft. arches.

Missouri—
Bethany, Harrison County: $8,000 to $10,000 to be expended.
Greenfield, 3 10-ft. culverts.
forced, 3 10-ft. culverts.
Hillsboro, Jefferson County: Concrete, plain 30.
Vitrified pipe, 15.
St. Joseph, Buchanan County: 4,000 ft. 18 to 36-in. concrete pipe.
Sikeston, Scott County: Cast iron pipe, 14 to 20-in.

New Jersey—
Wenonah, Gloucester County: Vitrified pipe, 6,800 lin. ft. 4-in.
Manholes, 1.
Catchbasins, 1; outlets, 1.

New York—
Medina, Orleans County: Catchbasins, 25.
Ithaca, Tompkins County: Concrete, reinforced, 30.
Lyons, Wayne County: Cast iron, plain, 30.
Concrete, reinforced, 50.
Concrete pipe, 40 ft.
Malone, Franklin County: Concrete, reinforced, 2,000 ft.
Vitrified pipe, 10,000 ft.
Montour Falls, Schuyler County: Concrete pipe 2,500 ft. 10, 15, 20-in.
Watertown, Jefferson County: Concrete, reinforced 400.

Ohio—
Painesville, Lake County: Vitrified pipe, 3 miles, 10 and 12-in.

Oklahoma—
Coalgate, Coal County: Vitrified pipe, 4 miles.
Manholes, 20.
Catchbasins, 100.
Tahlequah, Cherokee County: Concrete plain, 100 miscellaneous sizes.

Virginia—
Manassas, Prince William County: Concrete pipe, 75 to 100 ft.

Washington—
Everett, Snohomish County: Indefinite.
Shelton, Mason County: Concrete pipe, 1,000 ft. 4 to 12-in.

West Virginia—
Martinsburg, Berkeley County: Vitrified pipe, 3,000 ft.
Manholes, 5.
Catchbasins, 6.

Wisconsin—
Gotham, Richland County: Concrete, plain, 10, 22 ft. long and varying in opening from 18x18 in. to 4x6 ft.
Grand Rapids, Wood County: Concrete, plain, 90 from 18x18 in. up to a 6-ft. span; all 22-ft. roadway.

SEWAGE DISPOSAL PLANTS

Alabama—
Bessemer: None.
Gadsden: None.

Arkansas—
Argenta: None.
Ft. Smith: Pumps, 2.
Pumping stations, 1.

California—
Alturas: Septic tanks proposed.
El Centro and Imperial: Septic tanks to cost $20,000.
Los Angeles: Settling tanks, 1.
Pumping stations, 1.
San Jose: Septic tanks, 1.
Filters, 2.

Colorado—
Pueblo: None.

Connecticut—
Greenwich: Sewage disposal plant contemplated.

Florida—
Jacksonville: None.

Wauchula: Bids asked for water and sewerage systems.

Georgia—
Brunswick: Pumps, 1, centrifugal.
Macon: None.

Illinois—
Belleville: Septic tanks, $15,000.
Decatur: Sewage disposal plant urged.
Moline: Settling tanks, 2, Imhoff.
Pumps, 2, centrifugal.
Pumping stations, 1.
Quincy: None.

Indiana—
Ft. Wayne: Pumps, 1.
Pumping stations, 1.
Logansport: None.
South Bend: None.

Iowa—
Davenport: None.
Mason City: Septic tanks, 1.
Sioux City: Pumps, 2.
Pumping stations, 1.

Kansas—
Ft. Scott: Septic tanks, 1.

Kentucky—
Louisville: None.
Paducah: None.

Maryland—
Mt. Rainier: Sewage disposal plant and 2 automatic sewage lifts.

Massachusetts—
Brookline: None.
Somerville: None.
Springfield: None.
Worcester: $59,000 for purification.

Michigan—
Bay City: None.
Grand Rapids: Plant costing about $500,-000 to be built as soon as possible.

Minnesota—
Kelleher: Sewage disposal plant to be constructed.
St. Paul: $3,000 to be expended.
Stillwater: None.
Virginia: $45,000 to be expended.

Mississippi:
Vicksburg: None.

Missouri—
Jefferson: None.
Poplar Bluff: Sewage disposal plant.
Sedalia: Septic tanks, 1.
Filters, 5.

New Jersey—
Millville: 1 pump for tidal chamber.
New hypochlorite plaint.
Trenton: None.

New York—
Albany: $30,000 to be expended.
Amsterdam: None.
Corning: Must build $70,000 plant.
Dunkirk: None.
Fairport: Sewage disposal plant will be constructed.
Middletown: $100,000 to be expended for Imhoff tanks.
Rochester: Bids submitted average about $400,000.
Utica: 1 plant being considered.
Waterloo: Sewage disposal plant to be conestructed, cost $25,000.

North Carolina—
Durham: Settling tanks, 1 Imhoff tank and sand filters; estimated cost $40,000.

Ohio—
Akron: Plans for a complete plant are now on file. Approximate cost, $375,000.
Bucyrus: Is selling bonds for site for sewage disposal plant.
Chillicothe: None.
Dayton: Plans under way for sewage disposal plant.
Mansfield: Settling tanks, 1.
Septic tanks, 4.
Filters, 5 beds, 1 acre.
Massillon: None.
Sandusky: Settling tanks, 2.
Septic tanks, 2.
Pumps, 2.
Pumping stations, 1.
Tiffin: None.
Urbana: Bids for plant called for.

Oklahoma—
Oklahoma City: Indefinite. Subject under consideration.

Oregon—
Beaverton: Septic tank proposed.

Pennsylvania—
Farrel, Boro of: 1 plant has been ordered built.
Lebanon: None.
Nanticoke: Later on may adopt sewage disposal plant.
Norristown: Plant to cost $55,000.
West Chester: Settling tanks, 2.
Filters, 2.
Wilkinsburg: None.

Rhode Island—
Pawtucket: None.
Woonsocket: Filters, 1.

Utah—
Salt Lake City: Pumping station, 1, cost $25,000.

Wisconsin—
Chilton: Plans in preparation for sewerage and sewage disposal system to cost $30,000.
Green Bay: None.
Milwaukee: $100,000 has been appropriated as the preliminary step for a sewage disposal plant, filters, tanks, etc., to cost $10,000,000 to $15,000,000.

WATER WORKS IMPROVEMENTS

Alabama—
Bessemer: None.
Clanton: Will vote on water works construction.
Gadsden: Meters, 400.

Arizona—
Wickenburg: Bids asked for water works system, 11,600 ft. 2, 4 and 6-in. c. i. and galv. pipe, gasoline engine and centrifugal pump, 13 hydrants, gate valves, well, pump house, 100,000-gal. reinforced concrete tank.

Arkansas—
Argenta: None.
Ft. Smith: Mains, c. i., 1,400 16-in., 1,320 12-in., 3,960 8-in., 10,500, 6-in.
Meters, 300.

California—
Santa Barbara: Dam, $120,000.
Vallejo: Mains, c. i., 5,000 ft. 4 and 6-in.
Meters, 600.

Colorado—
Colorado Springs: Mains, c. i., extensions.
Lamar: Mains, 2 miles, to cost $17,000.
Walsenburg: Water works system will cost $23,000.
Williamsburg: Water works construction, $21,000.

Connecticut—
Hartford: Reservoirs, 6.
Mains, c. i., 180 miles $1\frac{1}{2}$ to 30-in.
Meriden: Will continue work on the Broad Brook addition to water supply, consisting of storage reservoir, 1,000,000,000 capacity, distributing reservoir 5,000,000 capacity, with pumps, pipe lines, etc.
Willimantic: Mains, about 4,000 ft. 6 to 8-in.

Florida—
Jacksonville: Remodeling pumping station and sub-station.
Wauchula: Bids asked for water and sewerage systems.

Georgia—
Brunswick: None.

Illinois—
Aurora: Pumps, 1 turbine.
Wells, 1 12-in., 2,200 ft. deep.
Byron: Bids asked on extensions, $4,000.
Canton: Mains, c. i., 5,000 ft.
Chicago: Boilers, 5 320-h.p., stokers, etc.
Mains, 4 to 12-in.
Deerfield: System costing $12,000 under construction.
East Moline: Water mains to be laid in one district.
Joliet: Pumps, 1 1,000,000,000-gal. triplex electric driven.
Wells, 1 artesian well.
Reservoirs, 1 4,000,000-gal., concrete.
Mains, 3 miles 6 and 8-in.
Mattoon: Pumps, electric driven 40-h.p., centrifugal.
Moline: Pumps, 1 10,000,000-gal.
Mains, c. i., 15 miles 4 to 24-in.
Meter, 24-in. station.
Oak Park: Mains, 5,380 lin. ft. 6-in. Service pipes, 2,500 lin. ft. ¾-in.
Piper City: Is building water system to cost $15,000.
Princeville: 50,000-gal. tank; deep well and centrifugal pumps and gasoline engines. 50,000-gal. underground reservoir.
Rock Island: Additions to number of meters and new 10,000,000-gal. pump.
Springfield: Wells, 9.
Waukegan: Mains, c. i., 2,100 ft. 6-in.

Indiana—
Anderson: Mains, 1½ miles. c. i., 6-in.
Ft. Wayne: Mains c. i., 24,000 lin. ft. 6 and 8-in.
Meters, 220.
Lafayette: Pump, 1 (already purchased).
Mains, c. i., ½ mile 6-in.
Laporte: Buildings, 1.
Wells, 1.
Reservoirs, 1.
Mains, c. i., 1 mile.
Logansport: Filter plants, $80,000 plants now being constructed.
Mains, c. i., 1,000-ft. extensions.
Michigan City: Boilers, 1.
Pumps, 1 10,000,000-gal.
Buildings, additions.
Intake, 1.

Iowa—
Cedar Rapids: Bonds voted for dam. $125,000.
Chelsea: 155 tons pipe and specials; tank, tower, pump, oil engine; hydrants, valves; wells, pump station.
Ft. Dodge: Mains, c. i., 2 miles.
Harlan: Mains, 3,000 ft.
Marshalltown: Mains, c. i., 1 mile distribution.
Meters, 75.
Mason City: Mains, c. i., 1 mile distribution.
Mitchellville: Constructing water works system.
Muscatine: Mains, c. i., 3 miles for supply.
Sheffield: $16,000 water bonds sold.
Sioux City: Reservoirs, 2.
Mains, c. i., 10 miles.
Woodbine: Complete water works system, with 100,000-gal. tank.

Kansas—
Arkansas City: Plans made for improvements and extensions to cost $87,000.
Council Grove: Boiler, 80-h.p. 2 gravity filters.
Derby: Proposes to construct water works system.
Esbon: Will build water and light plant.
Ft. Scott: Mains, c. i., 1 mile.
Jetmore: Is building water works plant.
Larned: Will vote on water and light plant.
Lawrence: Boilers, 2.
Pumps, 2.
Buildings, 8.
Settling basins, 2.
Filter plants, 1.
Wells, 4.
Manhattan: Improvements to cost $10,000.
Nickerson: Will vote shortly on water works system.
Pittsburg: Compressor for air lift.

Kentucky—
Carlisle: Dam, motors and pumps, pipe, tank and tower, complete system.

Louisiana—
Ville Platte: Is building water system to cost about $20,000.

Maryland—
Baltimore: Filtration plant of which mechanical equipment costs $160,000.
Mt. Rainier: Mains, 8.5 miles 4 to 10-in.; pumping station; reservoir; 150,000-gal. water tower; 3 artesian wells.

Massachusetts—
Boston: 3,750 tons 6 to 20-in. c. i. pipe and specials.
Brookline: Mains, c. i., 4,000 ft. 10-in., 2,000 ft. 8-in., 4,000 ft. 6-in., all distribution.
Service pipe, 175, cement lined.
Meters, 200.
Webster: Reservoir, $50,000 will probably be expended.
Westfield: Meters, 100.
Winfield: Mains, c. i., 6,000 ft. 6-in.
Worcester: Mains, steel, construction, $25,000.
Maintenance, $90,000.

Michigan—
Ann Arbor: Mains, c. i., 1 mile 6-in.
Detroit: $500,000 bonds sold.
Grand Rapids: Extensions to mains to cost $35,000.
Pontiac: Pumps, 8,000,000 gal.
Wells, 1.
Service pipes, 300.
Meters, 400.
Saginaw: Boilers, 2, 300-h.p.
Pumps, 3 centrifugal low lift (35-ft.) 10,000,000-gal. daily capacity.
Buildings, 1 pumping station, 90x100 ft.
Settling basins, 3,000,000-gal. capacity.
Filter plants, 6 mechanical filters, 25,000,000-gals. capacity.
Reservoir, 1 filtered water, 2,000,000-gal. capacity.
Intakes, 9,000 ft. 48-in.
Mains, supply, 16, 20, 24-in.; 2 river crossings, each about 600 ft. long.

Minnesota—
Albert Lea: Pumps, 1 and 20-h.p. motor.
Buildings, reinforced concrete pump station.
Reservoir, 75,000-gal. tank.
Intake, from lake.
Mains, 12,000 ft. c. i., 4 to 10-in. and hydrants.
Baudette: Boiler, engine, dynamo, stack, etc.
Excelsior: Mains, 12,800 ft. 4 to 8-in., c. i. and universal pipe; tanks, towers, pump and station.
Hibbing: Considering water supply projects to cost $650,000 and $950,000.
Minneapolis: Filter plants, $200,000 to be expended.
Mains, c. i., 15 miles, 1½ mile of which is distribution; steel, 3 miles.
St. Cloud: Pumps, 1,500-gal. electric centrifugal for fire pressure; estimated cost, $2,000.
St. Paul: Pumps, small centrifugal with motor.
Buildings, warehouse, garage and barn.
Wells, probably 2.
Reservoirs, plans for 2.
Conduits, plans for 54-in.
Mains, c. i., 10 miles, 30 to 6-in.

Service pipe, 2,000 ft.
Meters, 3,000.
Stillwater: Mains, c. i., 1 mile 6-in.

Mississippi—
Tunica: Bids asked for municipal water works, 50,000-gal. tank, etc.
Vicksburg: $100,000 will be expended for plant.

Missouri—
Hannibal: Mains, c. i., 20, 10, 8, 6-in. $150,000 to be expended.

Montana—
Columbus: Constructing water works with filter, reservoir, 8-in. supply main and distribution system.
Great Falls: Intake, 500 ft. of 36-in. c. i. pipe.
Red Lodge: Is selling $300,000 water works bonds.

Nebraska—
Dorchester: Will build water system costing $13,000.
Gering: Will build water system.
Lincoln: Wells, 2.
Mains, 5 miles.
Meters, 500.
Niobrara: Is building water system to cost $12,000.
Scotts Bluff: Main extensions, $3,000.

New Jersey—
Allendale: Bids asked for water works system.
Bayonne: Mains, c. i., 2 miles 8-in.
Bloomfield: Mains, c. i., 3 miles 6 and 8-in.
Meters, 100.
Garfield: Extensions to mains, 4½ miles.
New Brunswick: Reservoirs, stand pipe, $20,000.
Mains, c. i., extensions to distribution.

New York—
Amsterdam: Meters, 100 ⅝ and ¾-in.
Arkport: Mains, 3 miles 4 to 10-in. c. i.; 38 hydrants; 18 valves; reservoir and dam, $20,000.
Brighton: Water works system under construction; 4 miles 6-in. c. i. pipe, hydrants and valves.
Buffalo: Will install hypochlorite plant and concrete reservoir, $100,000.
Charlotte: Mains, 1 mile 4-in. distribution.
Service pipes, 75.
Meters, 75.
Cobleskill: Mechanical pressure filter.
Cortland: Pumps, 1.
Buildings, 1.
Mains, c. i., 1,500 ft. 16-in., 1,500 ft. 12-in.
Fulton: Boilers, 2.
Pumps, 1.
Hudson: Pumps, 1 1,500,000-gal.
Johnstown: Intake, 1 10-6 ft.
Conduits, 1 mile 6-in. c. i.
Niagara Falls: Mains, 5 miles 30 to 6-in.
Service pipe, 3 miles.
Meters, 200.
North Tonawanda: Mains, c. i., 1 mile.
Plattsburg: Reservoir, 70,000,000-gal. capacity.
Poughkeepsie: Mains, c. i., ½ mile, mostly 8-in. distribution.
Rochester: Mains, 8 miles 37 or 39-in. c. l., lock bar and welded steel or riveted steel or w. i. pipe.
Sidney: Water works system to cost $125,000, 10 miles 8 and 10-in. wood stave pipe line.
Wappingers Falls: Plans for $75,000 water and sewerage system.
Williamson: Is constructing water system to cost $28,000; 8 miles 6 to 10-in. c. i. pipe, filters, concrete reservoir, pumping station.

North Carolina—
Asheville: Mains, c. i., 5,000 ft. 4 to 10-in.
Meters, 300.

North Dakota—
Williston: Filter plant, stand pipe and electric pump.

Ohio—
Akron: 3 150-h.p. boilers, economizer, etc.; 2,677 tons pipe and specials, 8 gate valves, etc.
Bucyrus: $180,000 bonds to be sold.
Cambridge: Water works system contemplated.
Canton: Mains, c. i., 5 miles distribution.
Chillicothe: None:
Cincinnati: Selling $450,000 water works bonds.
Cleveland: Bids asked for water purification plant.
Dayton: Additional pumps and machinery.
Elyria: Meters, 200, 5 to 8-in.
Lorain: Boilers, 2.
Middletown: Mains, c. i., 3,000 ft. 12 and 16-in.
Painesville: Is selling $30,000 water purification bonds.
Portsmouth: Boilers, 2.
Pumps, 4.
Buildings, 1.
Settling basins, 2.
Filter plants, 1.
Wells, 2.
Reservoirs, 1.
Intakes, 1.
Conduits, c. i. pipe.
Mains, c. i., 36-in.
Sandusky: Intakes, 1,200 lin. ft. 36-in. and 48-in. c. i.
Mains, c. i., 5,000 lin. ft. 6 to 12-in.
Service pipes, 4,000 lin. ft. ⅝-in.
Meters, 1,000 ⅝-in.
Steubenville: Mains, c. i., 2 miles.
Filtration plant.
Service pipes, 500 ft. ¾-in.
Toledo: Extensions and improvements of mains, $250,000.
High pressure pumping station.

Oklahoma—
Chickasha: Pumps, 4.
Morris: Will vote on $42,000 bonds for water supply.
Shawnee: Mains, c. i., 3 miles.
Tulsa: Reservoirs, 10,000,000-gal.

Pennsylvania—
DuBois: Mains, c. i., 1,800 ft. 8-in., 900 ft. 12-in. supply.
Meters, 65.
Franklin: Meters provided by vote of the council.
Lebanon: None.
McKees Rocks: Wells, number of private wells.
Vitrified pipe, 600 lin. ft., small.
Oil City: Mains, c. i., 3,000 ft. 6-in.

Rhode Island—
Central Falls: Propose 16-in. main, costing $14,000.

South Carolina—
Camden: Water works plant under construction, $87,000.
Ft. Mill: Water supply system, including 120,000-gal. stand pipe, $15,000.

South Dakota—
Davis: Water works, to cost $7,500, will be built.
Huron: Filter plant, to cost about $19,500.

Tennessee—
Jackson: $35,000 water works bonds sold.
Nashville: $121,984.99 will be expended.
Quanah: $20,000 voted for improvements.
St. Elmo: Water plant under consideration, to cost $20,000.

Texas—
Aransas Pass: Water works and electric light plant, to cost $30,000.
Galveston: $150,000 water and sewer extension bonds sold.
Killien: Water works system under construction.
Wills Point: Water system, to cost $24,000, under consideration.

Utah—
Ogden: Pipe, steel, 5,000 ft. 6-in.
Salt Lake City: Reservoirs, 2, 280,000,000-gal.

Conduits, concrete, ½ mile.
Mains, c. i., 5 miles 12-in.. and 20-in., 12 miles 6-in.

Vermont—
Rutland: Intakes, about 1 mile.

Washington—
Aberdeen: Reservoir, 7,250,000 gal. capacity; mains, 1,000 ft. 12-in., 1,800 ft. 6-in. c. i., 3,500 ft. steel, 1,000 ft., wood stave.
Bellingham: Wells, 2.
Conduits, 1,800 ft. 3x5 ft.
Mains, c. i., 1 mile, 12, 10, 8-in.
Wood, 1 mile 6 and 4-in.
Service pipes, 3 miles ½ and 1-in.
Pullman: Extensions and additions to tanks and pumps, $20,000.
Seattle: Mains, c. i., 20 miles.
Walla Walla: Meters, 200.
Warden: Water works system; tower, tank, etc.

West Virginia—
Charleston: Mains, several miles, various sizes.
Wheeling: Rapid sand filtration plant, $240,000, and storage reservoir, $398,000, recommended.

Wisconsin—
Chilton: Plans under way for water works system to cost $35,000.
Eau Claire: Wells, 1, 12-in.
Fond du Lac: Mains, c. i., ½ mile distribution.
Madison: 1 well; 30,000 ft. c. i. pipe; 300 meters.
Milwaukee: Boilers, 2, 300-h.p.; water tube, Swift stokers, weighing devices; foundation for new pump and pump well.
Pump, 1, 12,000,000-gal. capacity.
Intakes, lake crib.
Conduits, 9 ft.
Mains, c. i., 12 miles 6 to 16-in.
Sheboygan: Pumps, 2.
Buildings, 2.
Mains, c. i., 15,000 ft. 4 to 20-in. distribution.
Two Rivers: Intake from Lake Michigan to cost $40,000.

LIGHTING IMPROVEMENTS

Alabama—
Bessemer: None.

California—
Eureka: Lamps and posts, 50 posts, 4 lamps each (private).
Mill Valley: Considering municipal gas plant.
Redlands: 2 miles of ornamental lighting.

Colorado—
Colorado Springs: Ornamental lighting, ½ mile.
Pueblo: None.

Connecticut—
Hartford: Ornamental lighting, 140 double light standards, 113 single light standards.
Lamps, 400 nitrogen lamps, 300 c. p.
Naugatuck: Ornamental lighting, 1 dozen.

Florida—
Jacksonville: 100-115 v multiple type, 75-100 w street series 4.3 to 4.5 amp. lamps.

Georgia—
Brunswick: None.

Idaho—
Boise: 232 c. i. poles; 232 luminous arc lamps.

Illinois—
Barry: Municipal lighting plant under consideration.
Belleville: Ornamental lighting, $10,000.
Lamps, arc.
Chicago: 5,000 additional arc lamps to be installed; 40,000 ft. conduit; asks bids on complete light and power system in 22d St., pump station.
Elgin: Additions to machinery in electric light plant, $162,000.
Oak Park: Ornamental lighting under consideration.
Quincy: None.
Springfield: 1 turbo generator.
Sterling: Boulevard lighting system.
Sullivan: Ornamental lights about court house square.
Waukegan: Ornamental lighting, seven blocks.

Indiana—
Anderson: Ornamental lighting, about 1 mile electroliers.
Elkhart: Bids wanted for lighting city on several differing plans.
Ft. Wayne: Municipal plant improvements, $75,000.
Huntington: New power house required; 2,500-k.w. generators.
Indianapolis: New street lighting contract for 10 years will be let Apr. 20.
Logansport: Indefinite.
Richmond: Ornamental lighting.

Iowa:
Allison: Municipal lighting plant under consideration.
Mason City: Engines, 2.
Dynamos and motors, 2.
Wire, pole line.

Kansas—
Atchison: Poles, 82 c. i.
Lamps, 60, 100-watt.
Ft. Scott: Lamps, 12, 2,000 c. p.
Independence: Dynamos, steam turbine, 15 k. w.
Jetmore: Water and light plant under construction.
Larned: Municipal light and water plant will be voted in April.
Leroy: Municipal lighting plant, 60 lights.
Pittsburg: Ornamental lighting, 26 blocks.

Kentucky—
Paducah: $16,500 for improvements to municipal lighting plant.

Louisiana—
Eunice: Will build electric light plant.
Lake Charles: Poles, wood creosoted.
Mains, 10-in.

Maryland—
Baltimore: Iron gas lamp posts, 500 more ornamental lamps to cost $30,000.

Maine—
Waterville: New gas plant and mains in all streets.

Massachusetts—
Seekonk: Ornamental lights to cost $500.
Westfield: Boilers, engines, dynamos and motors to furnish 600 k. w.

Michigan—
Grand Rapids: New generator and additional ornamental lighting to cost $15,000.

Minnesota—
Baudette: Machinery for electric light and water plant.
Luverne: Ornamental lighting on Main street.
St. Paul: Ornamental lighting, about 50 lamps; $25,000 will be expended.

Missouri—
Grand City: Ornamental lights in business district.
Joplin: Boilers, 1.
Engines, 1.

Montana—
Butte: Ornamental lighting, 306 magnetite arcs.
Great Falls: 80, 5-cluster posts, ornamental lighting.
Helena: 675 electroliers, series tungsten and nitrogen lamps.

Nebraska—
Lincoln: Dynamos and motors, 1.

New Jersey—
Trenton: None.

New York—
Amsterdam: None.
Bath: Bonds for municipal light plant voted, $50,000.
Cortland: Mains, 2,000 ft. 12-in. steel.
Fulton: Lamps, 400 mazda tungsten.
Hudson: Ornamental lighting, 3 parks to be lighted.
Johnstown: Ornamental lighting, 6 private.
Newark Valley: Municipal light plant, 35 to 50 k. w. outfit.
Saratoga Springs: Contemplate doing considerable work.
Spencerport: Has voted $16,000 for electric lighting plant.
Utica: Poles, 15 wooden.
Ornamental lighting, 30 ornamental poles.
West Sayville: Street lighting district to be established.

North Carolina—
High Point: Considering municipal street lighting system.
Madison: Considering electric light plans.
Wilson: Improvements to electric power plant.

North Dakota—
Fordville: Contemplates electric light and water plant.
Portland: Bonds voted for electric light plant to be built this year.
Sheldon: Street lighting system under consideration.

Ohio—
Akron: Electric light, extension of "White Way" system.
Cambridge: Some improvements.
Chillicothe: None.
Mansfield: Ornamental lighting, a new system.
Orrville: Electric light plant equipment bonds for sale, $13,500.
Tiffin: None.

Pennsylvania—
DuBois: Lamps and kind, 10 arc.
South Bethlehem: Municipal lighting plant is urged.

South Carolina—
Lake City: Municipal electric light plant under construction.

South Dakota—
Aberdeen: Ornamental lighting, to be extended.

Tennessee—
Nashville: Ornamental lighting, $43,650 to be expended.

Texas—
Austin: 100 c. i. poles; 100 series tungsten lamps.
Houston: Considering municipal light and power plant.

Utah—
Salt Lake City: Poles, steel and wood.
Lamps, 100 additional arc.

Vermont—
Rutland: Ornamental lighting, 1 mile.

Virginia—
Kenbridge: Lighting system under consideration.

West Virginia—
Charleston: Ornamental lighting, 1 "White Way," 54 large standards.

Wisconsin—
Appleton: Some additional lights.
Juneau: Electric light transmission line and distributing system, $9,000.
LaCrosse: None.
Milwaukee: About $400,000 to be expended.
Wausau: Ornamental lighting, 10 blocks.

BRIDGES AND BUILDINGS IN CITIES

Alabama—
Bessemer: None.
Gadsden: Bridges, concrete, 2.
Huntsville: city hall.
Mobile: Reinforced concrete culvert 4x12x-2,000 ft.; also bridge.

Arkansas—
Argenta: City hall, 1, estimated cost $75,-000.
Heber Springs: Court house, $61,400.
Hot Springs: Remodeling court house, $40,000.
Pigott: Jail.

California—
Bakersfield: Jail for Kern Co., $150,000.
Eureka: None.
Los Angeles: Concrete bridge, 1; subways, 2 tunnels.
Oakland: City hall to be completed; 7 school buildings under construction.
Oceanside: City hall to cost $75,000.
San Diego: Municipal stadium, $50,000.
San Jose: Concrete bridges, 2.
Santa Barbara: Steel girder, stone arch and concrete bridges, $75,000 to be expended.
Santa Cruz: 3-arch concrete bridge, $16,-000.

Colorado—
Boulder: Concrete bridges, 4.
Colorado Springes: Concrete arch bridge, 1.
Denver: Viaduct, bonds sold, $260,000.
Ft. Morgan: 210-ft. 7-span reinforced concrete bridge.
Pueblo: None.

Connecticut—
Hartford: Stone arch bridge, 1, $9,500.
Meriden: None.
Naugatuck: Concrete bridge, 1.

Delaware—
Georgetown: $30,000.
Wilmington: Swimming pool.

Florida—
Bartow: Jail to cost $70,000.
Jacksonville: Concrete bridges, 2, cost $2,100 and $1,800; viaducts, 1.

Georgia—
Macon: Fireproof buildings, estimated cost $10,000.

Illinois—
Belleville: Concrete bridges, 2; cost $12,-000; library, $40,000.
Chicago: Monroe St. bridge; Torrence Ave., W. Lake St., Jackson Blvd.
East St. Louis: Steel girder bridges, 2; concrete bridges, 1.
Edwardsville: County court house, $194,-000.
Freeport: $10,000 for repairing.
Galesburg: Concrete bridges, 2.
Springfield: Subway, 1.
Watseka: Reinforced concrete bridge, $2,700.

Indiana—
Anderson: Concrete bridge, 1 56 ft. by 16 ft.
Crawfordsville: Addition to court house to cost $50,000.
Ft. Wayne: School building, $150,000; subway, 2.

Iowa—
Davenport: City building, 1, cost $5,000.
Eagle Grove: City hall and fire station.
Ft. Dodge: Steel girder bridge, 1, 100-ft. span; city hall, $100,000; viaducts, 700-ft. steel.
Marshalltown: Viaducts, 1 R. R., 1,200-ft.
Mason City: Concrte bridges, 2.
Muscatine: $12,000 for arch bridge; city hall, $90,000.
Rock Rapids: Court house.
Sioux City: Concrete bridges, 2.
Tama: City hall.

Kansas—
Atchison: Concrete bridges, 2, costs $2,800 and $8,000.
Horton: city hall, $15,000.
Topeka: Market house contemplated, and fire station.
Wichita: Concrete bridge, 1, 200 ft. long.

Kentucky—
Louisville: Concrete bridges, 1, 40-ft. arch.
Taylorsville: Court house, $30,000.

Louisiana—
DeRidder: Court house.
Lake Charles: Concrete bridges, 4.

Massachusetts—
Boston: Steel Granite Ave. bridge, $30,000; Winthrop Ave., bridge, $60,000.
Greenfield: Concrete bridge, 1, 100-ft. span.
Haverhill: Hospital, $75,000.
Southbridge: 1 high school building.
Springfield: Steel girder bridges, 3, cost $560,000; concrete bridge, 1, cost $4,500.
Westfield: Concrete bridge, 1, 110-ft. span.
Worcester: $2,000 appropriated for bridges.

Michigan—
Battle Creek: Concrete steel girder bridges, 4.
Bessemer: Addition to court house, $65,000.
Detroit: Municipal hospital appropriation, of $1,125,000 asked.
Grand Rapids: Concrete bridge to cost $138,000.
Kalamazoo: Concrete bridge, 1.
Marquette: Steel girder bridge, 2.
St. Joseph: City hall, $30,000.

Minnesota—
Little Falls: Jail, $30,000.
Luverne: 6 reinforced concrete bridges, 22-ft. to 40-ft. span.
Minneapolis: Concrete bridges, $900,000; viaducts, grade elimination, $5,000,000.
St. Paul: 4 steel span bridges; concrete bridges, 7; public library, estimated cost $1,000,000 (started); 2 new floors on bridges (steel).
Staples: City jail.
Stillwater: Concrete bridges, 1, 140 ft.; jail and armory.

Missouri—
Kansas City: 23d St. viaduct, $500,000.
Kirkwood: City hall, fire station and jail, $15,000.

Montana—
Deer Lodge: 2 steel bridges.
Great Falls: 1 concrete subway 60 ft. by 700 ft.

Mississippi—
Meridian: Municipal building to cost $150,000; school buildings to cost $50,000.
Vicksburg: Concrete bridge, probably 1.

Missouri—
Hannibal: Concrete bridges, 3; workhouse $10,000.
Jefferson: Concrete bridges, 2.
Joplin: Concrete bridges, 1; city hall, library, auditorium, school, market; viaducts, 1.
Webb City: Concrete bridge, 1; library, 1.

Montana—
Butte: City buildings, city stables and shops (corrugated iron).
Missoula: Concrete bridge, 1, $10,000.

Nebraska—
Cambridge: Reinforced concrete bridge, $18,000.
Lincoln: Concrete bridges, $10,000 to be expended.

New Jersey—
Bayonne: City hall will probably be started.
Bloomfield: City hall.
Camden: Bridge over Newton Creek, $62,000.
Millvill: City vault.
Newark: Bond issue of $125,000 for city hospital extensions recommended.
Center market, $670,000.
West New York: City hall, 1, $75,000.

New York—
Amsterdam: Steel girder bridge, 1, 432 ft. long.
Binghamton: Steel girder bridge, 1, 60-ft. span; high school building, $500,000.
Charlotte: Steel girder bridges, 1, $175,000; city hall, 1.
Cortland: City buildings, new fire station, 1 school building.
Fulton: Concrete bridges, 3 reinforced crete.
Gloversville: Concrete bridges, 3.
Hamell: Concrete bridges, 1.
Johnstown: Concrete bridges, 2.
Little Falls: City hall, $100,000.
Ogdenburg: Concrete steel arch bridge over Oswegatchie river.
Poughkeepsie: Steel girder bridge, 1, 56-ft. span; new jail.

New York—
Troy: City buildings, 1, central station house.
Utica: Steel girder bridges, 1; school building; subways, $60,000 to be expended.
Watertown: Concrete bridges, 1, 58-ft. span.
Yonkers: $40,000 city hall bonds and $20,000 public building bonds sold.

North Carolina—
Asheville: $25,000 to be expended for schools.
Concord: New jail and remodeling court house.
Durham: Probably municipal court with lock-up and armory, $20,000.
Winston-Salem: Iron bridge, $31,000.

North Dakota—
Langdon: County jail.
Sanborn: City hall, $8,000.

Ohio—
Akron: Steel girder bridges, 1; 1 engine house, 2 schools and 1 market house.
Alliance: City buildings, 1 school house (contract let); city hall, $75,000; hospital, $50,000.
Subways, 1, $40,000.
Ashtabula: Bridge, $73,000; subway, $341,000.
Public comfort station.
Cincinnati: Concrete bridges, 4; city buildings, 1; viaducts, 3, reinforced concrete; subways, 8 miles; elevated tracks.
Coshocton: 2 steel bridges, $31,000.
East Liverpool: Concrete culvert, 100 ft. long.
Massillon: Concrete bridges, 4 beam bridges; high school, $250,000; viaducts, 1, 1,000 ft. by 20 ft. roadway.
Norwood: City hall, $100,000.

Oklahoma—
Hobart: 9 steel or concrete bridges.

McAllister: 140-ft. bridge.
Tulsa: Auditorium, $10,000; subways, 2, $25,000.

Oregon—
Portland: 8 bridges to cost $77,000.

Pennsylvania—
Allentown: New court house, $250,000.
Bridgeville: Municipal building.
Carnegie: Steel girder bridge, 1 small one, 50-ft. space.
Clanon: Bridge, 300-ft. span.
DuBois: Concrete bridge, 1 20-ft. span.
Ebensburg: 3 reinforced concrete bridges, each 100-ft. length.
Harrisburg: Bridge over Pennsylvania R. R., $23,000.
McKees Rocks: Steel girder bridge, 1; school, fireproof structure.
Meadville: City buildings to be remodeled.
Patton: $10,000 municipal hall bonds sold.
Philadelphia: Administration building, Bd. of Education, $350,000.
South Bethlehem: Bridge, $95,000 appropriated.
Warren: Concrete bridge, 2 250-ft. spans, $95,000.

South Carolina—
Yorkville: Court house, $70,000.

South Dakota—
Aberdeen: City hall, jail and fire station now under construction.
Flandreau: Court house.

Tennessee—
Chattanooga: $500,000 bridge proposed.
Nashville: $13,794.52 is to be expended.

Texas—
Houston: 1 steel bridge, $25,000; 5 concrete bridges, $45,000, $165,000, $138,000, $128,000, $30,000.
City hall annex, $150,000; jail, $50,000.
Kingsville: Court house, jail and hospital.
Seguin: Concrete bridge, $5,600.
Waco: Will rebuild suspension bridge over Brazos river, at cost of $52,000.

Utah—
Salt Lake City: Viaducts, 1 (private).

Vermont—
Rutland: Concrete bridge, 1 small bridge.

Virginia—
Fairfax: 2 20-ft. and 1 30-ft. concrete bridges.

Washington—
Aberdeen: 1 steel bascule bridge.
City hall and library to cost $20,000.
Walla Walla: County court house to cost $150,000.

West Virginia—
Charleston: Steel girder bridge ,1; library, 3 schools, 1 market.

Wisconsin—
Appleton: Isolation hospital and addition to poorhouse.
Eau Claire: Concrete bridge, 4-span concrete arch, $65,000 (contract let); subways, under Omaha tracks, $100,000.
Green Bay: Strauss trunion bascule bridge to cost $17,000.
LaCrosse: Viaducts, 1.
Madison: 1 concrete bridge.
Milwaukee: $150,000 bascule bridge, $16,000 for abutments, $250,000 for central police station, $100,000 for isolation hospital, $50,000 for a sanitarium, $60,000 for natatorium, $150,000 for public markets, $375,000 for concrete arch viaduct connecting Wright street and Bradford avenue.
Superior: Indefinite; will vote on $100,000 municipal auditorium.

COUNTY ROAD BRIDGES

Alabama—
Bay Minette, Baldwin Co.: Bridge over Aiken creek.

Arizona—
Wilkenburg, Maricopa Co.: Reinforced concrete bridge, $10,000.

Arkansas—
Murphysboro, Pike Co.: 5 steel bridges, $19,000.
Pine Bluff, Jefferson Co.: Steel bridge over Arkansas river, $625,000.

California—
Rio Dell, Humboldt Co.: Steel bridge, $50,000.
San Diego, San Diego Co.: 2 steel bridges, $18,000.

Idaho—
Lewiston, Nez Perce Co.: 2 bridges over Potlatch creek.

Illinois—
Cambridge, Henry Co.: Steel bridge, 120-ft. span; 4 concrete bridges, 12 to 60-ft. spans.
Effingham, Effingham Co.: 2 reinforced concrete bridges.
Morrison, Whiteside Co.: Steel truss bridge; concrete bridges, 10.
Newton, Jasper Co.: Concrete bridges; number indefinite.
Polo, Ogle Co.: Steel girder bridges, a few; concrete bridges, several.
Pontiac, Livingston Co.: Steel bridges, 2; concrete bridges, 10.
Savanna, Carroll Co.: Concrete bridges, 1, 35-ft. span.
Springfield, Sangamon Co.: Subways, 1.
Watseka, Iroquois Co.: Concrete bridges, 3, 20 to 55 ft.
Wyoming, Stark Co.: Concrete bridges, 10.

Indiana—
Anderson, Madison Co.: 2 reinforced concrete, 1 steel bridge.
Bloomington, Monroe Co.: 1 bridge.
Boonville, Warrick Co.: 11 bridges.
Brookville, Franklin Co.: 7 bridges, 325 to 425 ft. length, and repairs to others, $120,000.
Connersville, Fayette Co.: 10 concrete bridges, 12 to 35-ft. span, mostly Luten trusses.
Corydon, Harrison Co.: 1 bridge.
Crown Point, Lake Co.: 10 bridges.
Dana, Vermillion Co.: Steel girder bridges, 10 to 15, 50 to 60 ft.
Greenfield, Hancock Co.: 1 bridge.
Hagerstown, Wayne Co.: Repairing steel girder and concrete bridges.
Indianapolis, Marion Co.: Concrete bridge of 875 ft. length.
Lafayette, Tippecanoe Co.: $68,000 bridge bonds to be sold.
Lagrange, Lagrange Co.: Steel and concrete bridges, 5.
Newcastle, Henry Co.: Several bridges, $14,000.
Noblesville, Hamilton Co.: 8 concrete bridges.
Peru, Miami Co.: $47,000 bridge bonds to be sold.
Plymouth, Marshall Co.: Steel girder bridges; concrete bridges, 15.
Portland, Jay Co.: 24 new bridges.
Rochester, Fulton Co.: 4 bridges.
Salem, Washington Co.: several bridges, 70, 18, 60, 60, 2-60, 70, 50-ft. spans.
Shelbyville, Shelby Co.: 1 bridge.
South Bend, St. Joseph Co.: Concreto bridges, 1.
Versailles, Ripley Co.: Steel girder, 1; stone arch, 1.

Wabash, Wabash Co.: Bridge over Eel river.
Winamac, Pulaski Co.: Concrete bridges, 28.

Iowa—
Denison, Crawford Co.: 25 reinforced concrete bridges and culverts.
Estherville, Emmet Co.: 5 reinforced concrete arch spans, 8 to 60 ft.
Ida Grove, Ida Co.: Bridges and culverts, $26,000.
Knoxville, Marion Co.: 92 bridges and culverts, $57,000.
Mason City, Cerro Gordo Co.: 19 concrete bridges.
Sibley, Osceola Co.: 108 reinforced concrete bridges and culverts.
Sioux City, Woodbury Co.: 6 steel trusses, 40 to 60-ft. spans, concrete floors; 31 county bridgeh.
Tipton, Cedar Co.: 70-ft. steel span bridge and smaller, $17,000.

Kansas—
Abilene, Dickinson Co.: Concrete bridges, 2 double arch, 180-ft. span.
Chanute, Neosho Co.: Concrete bridges, 20 from 2-ft. to 20-ft. spans.
El Dorado, Butler Co.: Stone arch, 2, 1 36-ft. and 1 20-ft.; concrete bridges, 6.
Emporia, Lyon Co.: Concrete arches, 5; steel girder, 1 40-ft. span; concrete bridges, 40.
Goodland, Sherman Co.: Concrete bridges, 1 or 2.
Kansas City, Wyandotte Co.: Steel truss, 3.
Mankato, Jewell Co.: Steel girder, 3; concrete, reinforced, 5.
Norton, Norton Co.: Steel girder, 1, 16-ft.x32-ft.; concrete bridges, 4, 16-ft.x 20-ft.
Pittsburg, Crawford Co.: Steel and concrete, 6.
Russell, Russell Co.: Steel girder, 5, $2,000; stone arch, 8, $800; concrete, 3, $600, small.
Topeka, Shawnee Co.: 1 90-ft. concrete arch and 3 steel or concrete.
Troy, Doniphan Co.: Concrete culverts, 1 to 5.
Wichita, Sedgwick Co.: $50,000 will be expended; mostly concrete or steel and concrete.
Yates Center, Woodson Co.: Concrete bridges, 30.

Kentucky—
Benton, Marshall Co.: Steel girder, 2 or more.
Henderson, Henderson Co.: 110-ft. span bridge.
Hodgenville, LaRue Co.: Steel girder; concrete bridge.

Louisiana—
Plaquemine, Iberville Par.: Bridge across Bayou Plaquemine considered.

Maine—
Skowhegan, Somerset Co.: Steel bridge, 200-ft. length.

Maryland—
Annapolis, Anne Arundel Co.: Highway bridge with draw span.
Easton, Talbot Co.: Bridges, 2, concrete, $37,000, 500 and 300-ft. length.

Massachusetts—
Salem, Essex Co.: Reinforced concrete bridge, 180-ft. length.

Michigan—
State Highway Comr., Lansing: 10 bridges, 32 to 150-ft. length.

Minnesota—
Aitkin, Aitkin Co.: 5 county bridges.
International Falls, Koochiching Co.: Steel bridge.
New Ulm: Reinforced concrete bridge over Big Cottonwood river.
Winona: 3 reinforced concrete bridges, 23 to 90-ft. length.

Mississippi—
Natchez, Adams Co.: 9 steel bridges.

Missouri—
Bethany, Harrison Co.: Steel truss, 3; steel girder, 18; concrete, 5.
Charleston, Mississippi Co.: 15 steel bridges with wood floors.
Columbia, Boone Co.: Steel girders, 20.
Hillsboro, Jefferson Co.: Steel truss, 1; concrete culverts, 40.
Independence, Jackson Co.: Reinforced concrete arch bridge, 140 ft. long; 40x 20-ft. concrete girder bridge; 54-ft. concrete arch bridge; concrete double arch, 150 ft. length, $15,000.
Macon, Macon Co.: Steel girders, 30; concrete culverts, 100.
Poplar Bluff, Butler Co.: Steel girders, 5.
Rolla, Phelps Co.: Steel girder, 1, 100-ft. span; concrete bridge, 1, 80-ft.
St. Joseph, Buchanan Co.: Concrete bridges, 50.
Sikeston, Scott Co.: Concrete bridges, 6 to 8, 10-ft. arch.
Troy, Lincoln Co.: Steel girders, 10; concrete, 25.

Montana—
Glasgow, Valley Co.: 1 steel girder, 4 concrete bridges.
Missoula, Missoula Co.: 80-ft. concrete arch bridge.

Nebraska—
Beaver City, Furnas Co.: Steel or concrete bridge, $18,000.
Clay Center, Clay Co.: 6 bridges.
Fremont, Dodge Co.: Steel girders, about 10.
Nebraska City, Otoe Co.: $28,000 to $34,000 to be expended.
North Platte: Concrete girder of 23 to 33-ft. spans or concrete arch of 14 to 50-ft. spans.
Omaha: 240-ft. span steel bridge.
St. Paul, Howard Co.: 2 304-ft. or 5 145-ft. steel spans.
Seward, Seward Co.: Steel girders, 3; concrete culverts, 70.
Wahoo, Saunders Co.: Steel girders, 6 or 8; concrete, 10 or 12; mostly culverts.

New Jersey—
Cedar Run, Ocean Co.: Concrete bridges, 3.
Netcong, Warren Co.: Concrete bridges, 2 or 3.
Somerville, Somerset Co.: Concrete bridges, 6, 50-ft. arches.
Wenonah, Gloucester Co.: Steel girder, 1, encased in concrete, 90-ft. spans; concrete bridges, 7.

New York—
Auburn, Cayuga Co.: Concrete bridges, 2, 40-ft. span.
Charlotte, Monroe Co.: Steel girder bridge.
Cortland, Cortland Co.: Concrete bridges, 12.
Fonda, Montgomery Co.: Concrete bridges, 6; culverts, 100.
Herkimer, Herkimer Co.: Concrete bridges, $67,500 to be expended.
Ithaca, Tompkins Co.: Concrete bridges, 12, over 20 ft.
Lyons, Wayne Co.: Concrete bridges, 20.
Malone, Franklin Co.: Concrete bridges, 25.
Penn Yan, Yates Co.: Steel girder, 1, with concrete floor; concrete bridges, 50, under 5 ft.
Rochester, Monroe Co.: Steel girders, 2; concrete bridges and culverts, 90; viaduct, 1; subways, 2.
Schenectady, Schenectady Co.: Steel girder, 1, 60-ft. span; stone arches, 3, 15-ft. span; concrete bridges, 2, 24 and 18 ft.
Watertown, Jefferson Co.: Concrete bridges, 40.
White Plains, Westchester Co.: Bascule bridge.

North Carolina—
Wentworth, Rockingham Co.: Bridge over Dan river near Draper.

North Dakota—

Stanton, Mercer Co.: 3 steel bridges, 40 to 120 ft., 5 4-ft. steel culverts.

Ohio—

Akron, Summit Co.: 3 bridge spans.
Bryan, Williams Co.: Steel trusses, 4; concrete culverts, 20.
Cadiz, Harrison Co.: Steel girders, 2; concrete bridges, several.
Canton, Stark Co.: Steel girder, 1, 80-ft. span.
Celina, Mercer Co.: Steel girders, 6; concrete, 30.
Cincinnati, Hamilton Co.: Concrete bridge.
Cleveland, Cuyahoga Co.: Bridge on Bookpart road.
Columbus, Franklin Co.: 3 reinforced concrete arches, $120,000; several small bridges.
Coshocton, Coshocton Co.: Rebuilding 2 bridges, $65,000.
Dayton, Montgomery Co.: 2 80-ft. reinforced concrete arches; 6 steel girder bridges.
Delaware, Delaware Co.: Steel trusses, 8, 210 ft. each.
Georgetown, Brown Co.: Concrete bridge, 10 small.
Hamilton, Butler Co.: 200-ft. span steel or concrete bridge, $20,000 or more.
512-ft. span, steel or concrete bridge, in Hamilton, $150,000, and viaduct, $300,-000, in Middletown.
Hillsboro, Highland Co.: Steel girders, 5, 32 ft.; 1 truss bridge, 45 ft.
Jefferson, Ashtabula Co.: Steel girders, 3; concrete bridges, 4.
Mt. Vernon, Knox Co.: 4 bridges.
Napoleon, Henry Co.: Concrete bridges, 40.
Sandusky, Erie Co.: Steel girder, 1; concrete bridges, 20; subway, 1.
Sidney, Shelby Co.: Steel highway bridge.
Troy, Miami Co.: Concrete bridge, 1, to cost $100,000.
Warren, Trumbull Co.: 75 concrete and steel bridges.
Youngstown, Mahoning Co.: Bridge on McCartney road.
Zanesville, Muskingum Co.: Steel suspension bridge, 671-ft. span; steel trunion bridge, 700-ft. length; 4 steel bridges, 50 to 100-ft. spans.

Oklahoma—

Arnett, Ellis Co.: Steel girders, 17, contracted for; concrete culverts, 24.
Coalgate, Coal Co.: Steel girders, 6.
El Reno, Canadian Co.: 24 steel bridges.
Enid, Garfield Co.: Steel girders, 15; concrete bridges, 10.
Fairview, Major Co.: Steel girders, 6; concrete bridges, 2.
Hobart, Kiowa Co.: Steel bridges, 9; concrete bridge, 1.
Tahlequah, Cherokee Co.: $3,000 to be expended for stone arch bridges; $2,500 for concrete culverts.
Woodward, Woodward Co.: Concrete bridges, 6.

Pennsylvania—

Hooversville, Somerset Co.: 2 187-ft. steel spans encased in concrete.
Pittsburgh, Allegheny Co.: Steel bridge at McKees Rocks, $110,000.
Reading, Berks Co.: Concrete bridge at Monocacy, $30,000.
West Chester, Chester Co.: Bridge over Buck run.

South Carolina—

Florence, Florence Co.: $12,000 to be expended.
Marion, Marion Co.: Steel girder, 1; concrete bridges, 4.

South Dakota—

Clear Lake: All concrete bridges.
Leola: Galvanized steel culverts, 12 to 72-in. diameter.

Texas—

Angleton, Brazoria Co.: Steel drawspan over Bastrop bayou.
Franklin, Robertson Co.: Bridge at Sullivan Crossing, 550-ft. length.
Houston, Harris Co.: 1 bridge.
Somerville, Burleson Co.: 700-ft. steel bridge, $4,500.
Wharton, Wharton Co.: 2 bridges, $14,500.

Virginia—

Lebanon, Russell Co.: Steel girders, 2; concrete bridges, 10.
Manassas, Prince William Co.: Concrete bridge, 1.
Marion, Smyth Co.: Bridge 115.5-ft. length.
Richmond, Henrico Co.: $200,000 to be expended.
Staunton, Augusta Co.: Steel girders, 5; concrete, probably about 15 short spans.
Washington, Rappahannock Co.: Concrete bridges, 3.

Washington—

Concanully, Okanogan Co.: Bridge across Okanogan river.
Ellensburg, Kittitas Co.: Concrete bridges, 6,, 20 to 30-span.
Everett, Snohomish Co.: Steel bridges, 2; concrete bridge, 1.
Olympia, Thurston Co.: Steel girders, 5, 60 to 240-ft.
Seattle, King Co.: Steel bridges, 2; concrete bridges, 5.
Tacoma, Pierce Co.: Steel bridge at Burnett.
Vancouver, Clarke Co.: Steel girders, 6.
Waterville, Douglas Co.: Concrete bridges, 2, 6-ft. concrete arches.
Wenatchee, Chelan Co.: Concrete bridges, 2.

West Virginia—

Huntington, Cabell Co.: Steel girder, 1, 140-ft. span.
Martinton, Pocahontas Co.: Concrete bridge, 1, 20-ft. span.
Martinsburg, Berkeley Co.: Concrete bridges, 2.
Proctor, Wetzel Co.: Concrete bridges, 3.
Webster Springs, Webster Co.: Concrete bridges, reinforced, 2.

Wisconsin—

Baraboo, Sauk Co.: Steel girders, 4; concrete bridges, 10.
Durand, Pepin Co.: Concrete bridges, 2, 24x16 ft.
Elkhorn, Walworth Co.: Steel girders, 2, 80 and 90-ft. spans; concrete culverts, 40.
Gotham, Richland Co.: Steel girder, 1, 30-ft. span; concrete bridge, 1, 60-ft. span; 2 14-ft. spans.
Grand Rapids, Wood Co.: Steel-beams, 4; steel girders, 2; concrete, 3.
Janesville, Rock Co.: Steel girder, 1; concrete, 6.
LaCrosse, LaCrosse Co.: Bridge, $6,000.
New Lisbon, Juneau Co.: Steel girders, 12.
Oshkosh, Winnebago Co.: Concrete bridges, 3.
Rice Lake, Baron Co.: Concrete bridges, 5, $6,000.
Sparta, Monroe Co.: Steel girder, 1, 50-ft.; concrete bridges, 3, small.
Superior, Douglas Co.: Concrete bridge, 1.
Washburn, Bayfield Co.: 6 steel bridges.

Wyoming—

Rawlins, Caribou Co.: 140-ft. steel bridge, $9,000; 120-ft. steel bridge, $8,000.

GARBAGE DISPOSAL IMPROVEMENTS

Alabama—
Selma: Garbage wagons or carts, 10; horses, 10; cans, 500.

California—
Los Angeles: Plant, 1.
Oakland: Under consideration.
San Jose: Eighty-ton plant under consideration; garbage wagons or carts, 6.

Florida—
Key West: Constructing 30-ton incinerating plant.

Illinois—
Cairo: Considering incinerating plant. Garbage wagons or carts, 2.
Chicago: Municipal reduction plant under construction.
Joilet: Rebuilding garbage crematory.
Moline: Considering $2,500 incinerator.
Peoria: Garbage wagons or carts, 10; horses, 10.
Quincy: Plant is being considered.
Springfield: Plant, 1.

Indiana—
Ft. Wayne: $4,000 to be expended.
Logansport: Destructor plant is being considered.

Iowa—
Sioux City: Garbage wagons or carts, 5.

Kentucky—
Louisville: Horses, 99; tanks, 16 flushing tanks.

Massachusetts—
Brookline: Entire subject under consideration.
Springfield: $30,000 to be expended for additions to plants; garbage wagons or carts, 8; horses, 5.

Michigan—
Grand Rapids: Additional cars to cost $3,500.
Highland Park: Incinerator plant will be built, capacity 1 ton per hour.
Lansing: Considering municipal garbage plant.

Minnesota—
Duluth: General collecting system with carts is being considered in addition to the incinerator plant.

Missouri—
Hannibal: Garbage wagons or carts, 4.

New Jersey—
Bayonne: City is in need of reduction plant.
Millville: Incinerator, destructor, furnace, reduction plant, feeding provisions, dumps, dumping scows, etc., to be considered soon; cans, 18.
Plainfield: Garbage and refuse disposal under consideration.

New York—
New Rochelle: Contemplate building a plant.
Utica: New contract for garbage destruction to be let in October.

North Carolina—
Asheville: New plant just completed, and will likely purchase an electric truck for sanitary department.
Durham: 1 incinerator.

Ohio—
Akron: Plans approved for complete plant to cost $75,000.
Massillon: Possibility of a plant.
Sandusky: $15,000 incinerator plant.

Oklahoma—
Tulsa: $2,500 to improve incinerator.

Oregon—
Portland: $150,000 incinerator will be built.

Pennsylvania—
Carnegie: Some kind of disposal plant being considered.
Nanticoke: Possibility of building a plant.
North Braddock: Garbage wagons, 2.
West Chester: Garbage wagons, 2.

Tennessee—
Nashville: $34,826.00 to be expended.

Wisconsin—
LaCrosse: Possibility of building a plant.
Milwaukee: $1,100 to be expended for new boxes.
Sheboygan: Garbage wagon or cart, 1; horses, 2.

STREET SIGNS

Alabama—
Gadsden: 700 enamel street signs.

California—
Alameda: 300 street signs.
Oakland: 300 wooden signs.
Vallejo: 1,000 street signs.

Colorado—
Boulder: A number of metal signs.
Colorado Springs: 1,000 metal signs.

Connecticut—
Naugatuck: 50 metal street signs.

Illinois—
East St. Louis: 1,900 street signs.
Peoria: 400 enamel steel plates.
Waukegan: 435 street signs.

Indiana—
Ft. Wayne: Some are to be used.
Logansport: Over 2,000 street signs and about 3,000 house number plates to be changed.

Iowa—
Muscatine: 200 4-in. by 20-in. street signs and a number of plates.

Kansas—
Independence: 5,000 steel street signs.
Lawrence: 825 enamel street signs.

Kentucky—
Paducah: Various kinds of house number plates.

Massachusetts—
Brookline: $1,000 to be expended.

Michigan—
Ann Arbor: 200 metal street signs.
Grand Rapids: Additional signs to cost $250.

Minnesota—
Minneapolis: 1,000 4-way street signs.

New Jersey—
Bayonne: City in need of new street signs.
Bloomfield: 50 street signs.
Millville: 50 signs for the rural sections.
Trenton: 250 street signs.

North Carolina—
Asheville: Just placed 400 enamel street signs.

Ohio—
Akron: 3,400 blue and white enamel.
Bellefontaine: $600 bond issue for street signs and house numbers.
Canton: 6,000 enamel street signs on "Ton Can" metal.
Sandusky: 400 metal street signs and about half the city to be renumbered.

Oregon—
Portland. $5,000 to be expended.

Pennsylvania—
Lebanon: Complete street signs are to be placed.
McKees Rocks: A few street signs and about 200 brass plates.

Rhode Island—
Pawtucket: A few street signs.
Woonsocket: 500 wood painted street signs.

COUNTY ROAD SIGNS

Illinois—
Burnt Prairie, White Co.: About 100 road signs will be purchased soon.
Savanna, Carroll Co.: 100 metal boards.

Kansas—
Abilene, Dickinson Co.: Complete system of signs on 150 miles of county road.
Eldorado, Butler Co.: Painted board signs.
Russell, Russell Co.: Posts, hgt., 8 ft.; diam., 5-in., steel signs, enameled golden belt.
Wichita, Sedgwick Co.: Signs for about 100 miles of road.

Montana—
Glendive, Davison Co.: In need of signs.

Missouri—
Macon, Macon Co.; 200 state highway signs.
Sikeston, Scott Co.: About 125 signs.

New York—
Ithaca, Tompkins Co.: 6 concrete signs.
Lyons, Wayne Co.: 300 cast iron or steel road signs.
Penn Yan, Yates Co.: A number of concrete posts.
Rochester, Monroe Co.: A large number are to be placed.
Schenectady, Schenectady Co.: 50 sheet steel.
Woodward, Woodward Co.: 250 Goodrich guide sign boards.

Washington—
Port Townsend: Jefferson Co.: 2 dozen.
Wenatchee, Chelan Co.: Probably 100 plain painted board signs.

West Virginia—
Martinsburg, Berkley Co.: 200 cast iron 8-in. by 24-in. road signs.
Proctor, Wetzel Co.: 50 metal road signs.

FIRE DEPARTMENT ADDITIONS

Alabama—
Gadsden: 1,000 ft. hose, and are considering a new fire alarm system.
Selma: 1 chemical engine, 1 auto truck, 1 steam engine, 4,000 ft. hose, 1 chemical, 1 hook and ladder truck and 1 automobile for chief.

Arizona—
Tucson: Motor apparatus under consideration.

Arkansas—
Ft. Smith: 2,000 ft. hose, 2 pieces automobile apparatus.

California—
California: 2,000 ft. hose and 1 combination pumping and hose automobile.
Pomona: $15,000 to be expended.
Redlands: 80-h.p. 6-cylinder combination truck.
San Francisco: $450,000 appropriation recommended for motorizing dept.
San Jose: 3 buildings, 1 truck, 3 engines, 3 chemicals, 4 hose wagons, 24 horses, 1 chemical, 2 combinations; also some extensions.
Santa Monica: $30,000 appropriations asked for motor apparatus.
Vallejo: 1 combination hose and chemical.

Colorado—
Colorado Springs: 1,500 ft. hose, 1 hose and chemical truck.

Connecticut—
Ansonia: 1 chemical.
Hartford: 5,000 ft. hose; $125,000 asked for to be expended for new machines.
Naugatuck: 1 sweeper for street department; 500 ft. hose.
Torrington: 1 chemical truck.
Willimantic: Some new hose.

Georgia—
Brunswick: 1 auto engine and truck; 1 chief's auto.
Macon: 3,000 ft. of hose.

Illinois—
Aurora: Start rebuilding fire and police alarm system.
Belleville: 1 2,000-ft. building, 1 horse-drawn truck, 2 hose to be purchased, 2,000 ft. of hose.
Canton: 1 combination truck automobile.
Champaign: 2,300 ft. fire hose.
Chicago: 200,000 ft. fire alarm cable 5 to 50 pair, 550 tubular steel poles, 5,000 ft. chemical hose, 50,000 ft. fire hose.
Joilet: Motor fire engine, combination chemical and hose, motor drawn.
Oak Park: Hose to be purchased, automobile, engine, hose, chemical, ladder and combinations are under consideration.
Quincy: Auto for chief.
Rock Island: Combination chemical and hose car.
Springfield: 1 building, 2,000 ft. hose, 1 engine, 1 combination, new fire alarm system and 10 miles wire extension.
Streator: Probably 1 auto truck.

Indiana—
Ft. Wayne: 1,500 ft. of hose.
Gary: 1 chemical and 1 chief's car.
LaPorte: 1 engine is needed.
Logansport: $3,000 hose house; probably 1 ladder and 1 combination.
Richmond: Probably 1 ladder.
Vincennes: 500 ft. hose and 1 automobile.

Iowa—
Eagle Grove: Fire station.
Marshalltown: 1 Kissel truck.
Mason City: 1 triple combination 80 H. P. pumper, hose and chemical.
Muscatine: $4,000 truck.
Waterloo: 1 combination.

Kansas—
Atchison: 1,000 ft. of hose.
Hutchinson: Aerial truck.
Independence: 1 automobile apparatus, 1 engine and hose combination.
Topeka: 1 $18,000 station.
Wichita: 1 tractor engine, 1 tractor ladder, 1 supply truck.

Kentucky—
Clay: Complete fire equipment, chemical, hose, etc.
Louisville: 1 hose and ladder house, 1 engine, 1 auto truck, 85 ft. extension, electric motor, 10,000 ft. hose.
Paducah: 1 combination auto truck and pump, 1 chief's car.

Louisiana—
New Orleans: Motor pumping engine, 1 hose carriage, 1 motor water tower, motor chemical.

Maine—
Portland: Several pieces of omtor apparatus recommended.
Waterville: Hose to be purchased and signal system.

Maryland—
Baltimore: 4 chassis for fire wagons.

Massachusetts—
Danvers: Fire station and equipment recommended.
North Adams: Auto chemical and hose asked for.
Pittsfield: 1 motor apparatus.
Taunton: 1 piece of auto apparatus.
Worcester: $20,000 to be expended for automobile apparatus.

Michigan—
Battle Creek: 1 automobile apparatus.
Grand Rapids: Building additions and signal extension to cost $8,000.
Kinde: New fire apparatus.
Pontiac: 1 auto hose and chemical.

Minnesota—
Mankato: 1,000 ft. hose.
St. Paul: 8 horses, 1 automobile apparatus, 3,000 ft. of hose, 4 chiefs' cars.
Virginia: $4,000 to be expended.

Mississippi—
Jackson: 1 triple combination motor truck.

Missouri—
Hannibal: 1 automobile apparatus.
Joplin: 1 engine, 1 hose, 1 chemical, 1 ladder, 1 chief's car.

Montana—
Great Falls: 1 combination hose and chemical.
Helena: 1 engine.

Nebraska—
Lincoln: 1 combination.

Nevada—
Winnemucca: Considering purchase of hose cart.

New Hampshire—
Manchester: Appropriations asked of $30,000 for motorizing fire apparatus and $1,400 for fire alarm telegraph.

New Jersey—
Glen Ridge: Motor truck and ladder truck.
Millville: New city vault; 500 ft. of hose, 1 chemical and hose, new fire alarm system.
Plainfield: 1,000 ft. hose.

New Mexico—
Raton: Will purchase motor fire appartus.

New York—
Auburn: One piece motor apparatus.
Binghamton: 2,000 ft. hose, 1 motor tractor for truck.
Buffalo: Autos for battalion chiefs; tractors for 5 trucks.
Cortland: 1 fire station; 2 automobile apparatus.
Elmira: Probably 1 tractor.
Green Island: Fire alarm system; chemical.
Ithaca: 1 auto truck.
Johnstown: 1 chemical, hose and ladder auto truck.
Little Falls: 1 automobile apparatus; 2,000 ft. hose.
Manhattan: 7 motor-driven hose wagons.
Bronx: 2 5-ton motor-driven fire trucks.
North Tonawanda: 1 fire engine.
Utica: 2,000 ft. hose, 1 ladder, 1 combination, 7 new boxes.
Yonkers: $50,000 fire bureau equipment bonds sold.; auto hook and ladder truck; auto pumping engine.

North Carolina—
Asheville: Repairing of alarm system.

Ohio—
Alliance: $9,300 triple pumping piston type automobile apparatus.
Athens: New auto apparatus.
Bellefontaine: Additions to apparatus.
Cambridge: Probably combination fire truck, engine, hose.
Chillicothe: $22,000 for building and equipment.
Columbus: Additions to fire and police telegraph system.
Girard: Additions to hose.
Massillon: 1 squad wagon.
Middletown: 1 automobile apparatus.
Newport: Hose wagon.
Niles: Fire truck.
Sandusky: 1 central police and fire station.
Toledo: Motorization of fire department is under way to cost about $200,000.
Youngstown: Chassis for new ladder truck and water tower.

Oklahoma—
Chickasha: 500 ft. of hose.
Oklahoma City: Department is being moorized to suit tractors.
Shawnee: 1 automobile and engine.

Pennsylvania—
Allentown: 3 automobile apparatus; 10,000 ft. extensions.
DuBois: 1,500 lin. ft. of hose.
Gilbertsville: New fire apparatus.
Harrisburg: $25,000 available for motor apparatus.
Lebanon: 1,200 to 3,000 ft. of hose.
McKees Rocks: 2,000 ft. of hose; considerable automobile apparatus.
Meadville: Tractors for hook and ladder and hose; motor-driven combination hose and chemical; motor hook and ladder.
Nanticoke: 1 truck, horse drawn.
New Wilmington: Fire hose.
Oil City: 2 horses and 500 ft. of hose; $500 for extensions.
Old Forge: Probably 1 engine; full outfit of signal system and extensions.
Philadelphia: Purchase of apparatus to cost $8,870,000 recommended.
Pittsburg: 10,000 ft. fire hose.
Quakertown: Will purchase auto fire apparatus.
Scranton: 2 tractors for steam fire engines; 3 triple combinations; 2 combination chemicals; 1 aerial truck.
Sharon: 950 ft. hose.
West Chester: 3 automobile apparatus, pump and 2 chemicals; 1 combination.
Wilkes Barre: 3 tractors and 3 auto-combination wagons.

Rhode Island—
Providence: 3 fire trucks; fire boat.
Woonsocket: 1,000 ft. of hose; 1 auto truck.

South Dakota—
Aberdeen: Station and buildings; 1 combination.

Tennessee—
Nashville: $25,750 to be expended; motor driven fire engine.

Texas—
Houston: 2 fire stations, $30,000.
Waco: 5,000 ft. hose; motor pumping engine.

Utah—
Ogden: Motor combination chemical and hose.
Salt Lake City: 1 $7,500 substation: $10,000 apparatus for new station; 1 combination chemical, hose and pump, motor driven; 25 new alarm boxes.

Vermont—
Rutland: 1 chemical.

Washington—
Hoquiam: Combination hose and chemical.
Port Angeles: 1,000 ft $2\frac{1}{2}$-in. hose.
Seattle: 8,000 ft. $2\frac{1}{2}$-in. hose.
Spokane: 2,000 ft. $2\frac{1}{2}$-in. hose; 3 hose wagons; 1 ladder wagon; 1 combination chemical and hose; 1 chief's car; 10 fire alarm boxes.

Tacoma: Bids will be asked at once for new fire apparatus; $17,000 appropriated for apparatus and placing fire alarm wires underground.
Walla Walla: 1 Seagrave truck.

West Virginia—
Charleston: 1,000 ft. hose, 1 hose and chemical auto, 1 ladder, chassis or tractor; underground conduits.
Wellsburg: Auto fire truck.
Williamson: Hook and ladder wagon; more efficient fire alarm.

Wisconsin—
Appleton: 1 supply truck.
Ashland: 500 ft. hose.
Milwaukee: 2 buildings, $20,000; 10 horses, $3,000; $10,000 to be expended for hose; 1 engine, $10,000; 1 combination, $5,500.
Wausau: 1 automobile apparatus.

POLICE DEPARTMENT IMPROVEMENTS

Arkansas—
Argenta: 1 new patrol wagon.

California—
San Jose: Flashlight system; 2 horse-drawn patrol wagons; 1 patrol wagon.

Colorado—
Colorado Springs: Renewal of Gamewell system.

Connecticut—
Danbury: 1 auto patrol.
Naugatuck: Street telephones and police light system.

Illinois—
Cairo: 1 automobile.
Freeport: 1 combination ambulance and patrol wagon.
Joliet: 1 motor-driven fire engine, 1 combination motor-driven chemical and hose wagon.
Oak Park: Signal systems and extensions under consideration.

Indiana—
Gary: 6 motorcycles.
Lafayette: Signal systems and extensions for entire city.
Logansport: Repair of signal systems; patrol wagons and motorcycles.
Richmond: Possibly 1 automobile.

Iowa—
Mason City: 1 patrol wagon.
Waterloo: 1 patrol wagon and ambulance.

Kansas—
Ft. Scott: 1 patrol wagon.

Kentucky—
Lexington: 1 motorcycle.
Louisville: 2 auto patrols; 2 motorcycles; 25 bicycles; 1 ambulance for police and hospital.
Paducah: 1 auto for fire chief.

Massachusetts—
Southbridge: 1 police station.
Webster: Installing of signal systems and extensions.
Westfield: 1 automobile.

Michigan—
Battle Creek: Some building to be done this year.
Grand Rapids: Addition to department building, to cost $30,000.

Minnesota—
St. Paul: 1 automobile; 4 auto patrol wagons; 1 auto supply wagon; 2 5-ton auto trucks; 1 4-passenger and 1 2-passenger auto.

Missouri—
Hannibal: 1 auto patrol wagon.
Joplin: 1 patrol wagon.

Montana—
Great Falls: 1 automobile combination patrol wagon and ambulance.

Nebraska—
Lincoln: 1 car for chief.

New Jersey—
Newark: 12 motorcycles.
Plainfield: Patrol auto and ambulance being considered.
Trenton: $15,000 to be expended.

New York—
Binghamton: Signal systems and extensions in business district.
Charlotte: 1 building to cost $8,000.
Utica: 1 building; 6 new boxes; 1 motorcycle.

Ohio—
East Liverpool: 1 auto patrol.
Massillon: 1 patrol and ambulance; 1 squad wagon.
Middletown: 1 automobile.
Sandusky: 1 motorcycle.

Oklahoma—
Oklahoma City: 1 motor patrol wagon and 4 motorcycles.

Pennsylvania—
Allentown: 10,000 ft. signal systems and extensions.
Farrell: Considering police and fire telegraph system.
McKees Rocks: Buildings; jail extensions; considering signal systems and extensions and horse-drawn patrol wagons.
Nanticoke: Considering signal systems and extensions.
Old Forge: Complete outfit signal systems and extensions.

Rhode Island—
Woonsocket: 1 patrol; 1 ambulance.

Tennessee—
Knoxville: 1 auto patrol.
Nashville: $6,000 to be expended.

Texas—
Houston: 1 ambulance.

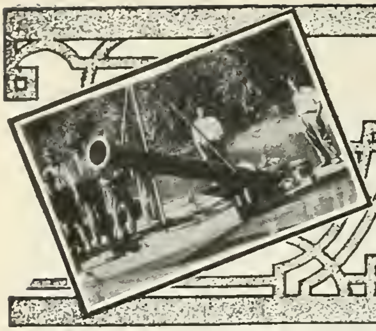
Utah—
Salt Lake City: 3 motorcycles.

Washington—
Aberdeen: 1 automobile patrol wagon.
Spokane: 10 boxes; 1 auto patrol; 2 motorcycles.

West Virginia—
Charleston: 1 signal system and extension; 1 patrol wagon; 1 motorcycle.

Wisconsin—
Appleton: 1 automobile; 1 auto patrol.
Milwaukee: $250,000 central police station.
Sheboygan: Auto patrol and ambulance combination.

(For information received too late for classification, see last page of editorial section.)



EDITORIAL

WHAT IS A POLITICIAN?

A correspondent in a confessedly facetious mood suggests that "a politician in an ordinary newspaper sense is one who accepts an office. The citizen who today declines the honor of representing his neighbors in local, state or national matters is a 'good man and true', but if he yields to their suggestions and his own pride and accepts a public position, he immediately becomes a 'politician.' Sometimes the word politician is used as synonymous with grafter, but not all public officers have yet been proven grafters so as to make the two terms synonymous.

Popular uses of the word politician are certainly confusing. In one case the securing of results by indirect methods involving the exercise of influences outside the line of operation is said to be using the arts of the politician. In another case he is one who works for the public good thru the medium of public office held himself or by some one whom he controls. By the common deterioration of words this use has degenerated to the third, wherein the term is applied to those who work for the benefit of the party or for the private good of themselves or their friends thru the medium of public office or control of public officials.

Scarcely any one of these uses should be applicable to one interested in the city's business. Here the principal concern is to do the business of the citizens which they cannot do for themselves, by wholesale and in the most efficient and economical manner possible. Evidently none of the definitions of politician given above have any necessary connection with the man who is doing his duty to the city in such an office, and the same is true of any other common definition of the term. Moreover, he should not be obliged to exercise the arts of the politician, but should be chosen without reference to his qualifications in this regard.

It is eminently true that there are differences concerning the policies to be followed in municipal matters and there is a need for the politician, using the word in the best sense, in setting forth and standing for such policies. But, the every day work of the city has nothing to do with such policies, aside from the effect thereon of the general policy adopted. This is the justification of the short ballot, the restriction of elections to the few intrusted with the carrying out of the policies approved by the voters. And it is the justification of the civil service or some method of securing and retaining in appointive offices of men competent to do the business of the city under such adopted policy, without fear of removal unless he becomes incompetent or neglectful or seriously at odds with the policy of his superior elected to carry out the will of the people.

In this sense the constant demand for the elimination of the politician, under any definition, from the every-day work of the city is made. The politician, in the best sense, is demanded in the mayoralty or the council or the commission. The politician in any sense has no place in a subordinate office. This is the basis for the popularity of the commission form of government, not because it belongs to that form of government more than to any other, but because its advocates are so strenuous in their assertions that it will be one of the results of that form. Actually, the division of responsibility and the certainty of ignorance if not of inefficiency in commissioners make this one of the most fruitful fields for the politician in the bad sense as soon as the citizens relax their vigilance, and practically insures the ultimate failure of this form in any but the small cities. The partial recognition of this fact is the cause of the safeguards which are thrown about the system in all its forms since the first of the elective plans and whose latest development is the City Manager acting under the elected commission and subject to recall by the voters if the commission turns out to be filled with politicians in the bad sense.

THE OHIO CONSERVANCY ACT

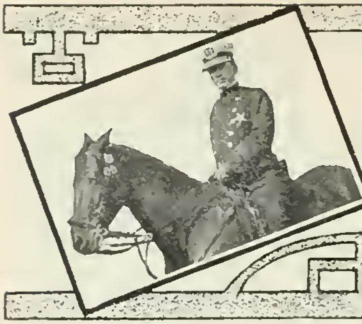
Already attacks are preparing upon the validity of the Ohio Conservancy Act, based largely upon the principle behind the defect mentioned last month in our discussion of the provisions of the law, viz.: the granting of large powers to officers in a small district which can be extended with little or no opportunity for control or even objection to include similar districts coming under the same drainage and conservancy needs.

The rights of eminent domain, of taxation, of policing, etc., conferred by the law are enormous and the control of the body or bodies exercising these rights is a minimum.

Such large projects as are intended to be covered by the act should be carried out by all the people in the district or by the state itself, rather than under the initiative of a small number of people in one political subdivision of a district. The combination of municipalities and counties interested in turning a certain project into a federation acting thru a commission, with representatives from all of them, as in New Jersey sewage disposal and water supply districts, is more democratic, in that it provides for representation of all the people interested. Such commissions should have the expert advice and supervision of a State Board with power to limit districts, care for contests between districts, approve and disapprove of plans, and should be a body to which aggrieved persons can appeal for rehearing of their claims. No such control is provided for the far more heterogeneous organizations provided for in the Ohio act.

Many specific difficulties in carrying out the law have been cited, but when the protests against it are boiled down they are really aimed at the policy of granting such unusual powers to the local bodies provided for and extending them beyond the jurisdiction of the court establishing the district and the body to govern it, rather than making the body large enough and appointing it by an officer with jurisdiction large enough to cover the whole area.

In other words, if a State Board had the control of technical and controversial matters and drainage districts were formed in such way as to have representatives of the whole district on the governing board, the principal objections to the law would disappear.



QUESTION DEPARTMENT

Inspector's Hand Book

Where can I get a good text or hand book for inspectors' and contractors' use on sewer and drain laying, water and gas, and street and road pavements of all kinds.

J., Houston, Tex.

Byrne's "Inspection of the Materials and Workmanship Employed in Construction ($3) is probably the book desired. Harger & Bonney's "Handbook for Highway Engineers" ($3) contains much of value to the inspector on that class of work. Hill's "Concrete Inspection" ($1) is good in its line.

Compensation for Telephone Franchise

I desire to obtain your ideas upon the following matter: The population of this town is 5,000; there are two telephone systems in operation, one has about 1,700 subscribers, the other about 250. The smaller company is asking for a franchise to extend over a period of about fifteen years. The city desires, in granting the franchise, to require the payment of a percentage on the business of the company. The questions I desire to ask are these:

Should the percentage be based on the gross local business or the net local business?

Should the percentage on the long distance business be based on the gross business, or the net business?

In considering the long distance business, should the percentage be charged on the "out" as well as the "in" business?

What would be a proper per cent to charge on the local business?

What would be a proper rate on the long distance business?

The larger company does not pay anything to the city at this time, but it is expected that, when their present franchise runs out, a charge will be imposed.

B., City Engineer,
———, Ore.

The writer believes that the custom of requiring the payment of a percentage on the business of a company as a return for its exercise of a franchise is not based on proper principles. It is proper for the city to charge for the use of its streets a sum which will reimburse it fully for any inconvenience or expense to which it may be put from the presence of the utility in the streets, its operation, or the construction, maintenance, repair and replacement of its plant in the streets.

Public utilities are for the service of the public in whole or in large part, and their operations are, unquestionably, in the nature of monopolies, and their rates and quality of service should be subject to regulation by a competent body, so that the public will receive the best service at the lowest price consistent with good service and proper return on the money invested. Any charges in excess of the expense which the city is put to in its supervision of the utility and enforcement of its requirements are for the benefit of the public at large at the expense of the customers of the plant, and are probably unjust in so far as they are greater than will make the city reasonably safe from loss or expense.

Two telephone companies have little or no justification beyond the possible improvement in service over one, but this is often more apparent than real and costs more than the returns. It can be obtained better thru the competent control referred to.

In Municipal Engineering, vol. xlii, p. 390, is an article sketching the terms in a proposed franchise providing for the control of rates and quality of service and for the ultimate combination of the two existing telephone companies, which was worked out by a civic organization and approved by one of the companies, but was not accepted by the city council and so has not been put in operation. This form provided all conceivable checks on both city and company to secure fair treatment on both sides and enough flexibility to make rates and other requirements conformable at any time with the changes in conditions. The full document is printed in the proceedings of the Indiana Engineering Society for 1910 (50 cents). This embodies largely the ideas of the writer, tho he is not in accord with every detail.

With the above protest against the method outlined by the questions asked, they are answered according to the customs observed or inferred.

Percentage payments for franchise

rights are almost always computed on the gross business. They serve as a method of keeping track of the operations of the company if the necessary access to its books by the city's auditors is provided for. This is true of both local and long distance business.

The form of contract of the local company with the long distance company will determine whether the percentage is to be based on outs or ins or both. The contracts with which the writer is acquainted are on the basis of the outs, but the entire receipts, whether from outs or ins or both, are evidently equally subject to the tax.

If the principle, with the statement of which this article started, is accepted, the percentage should be such as would make the city safe from loss or expense on account of the operations, failures or damages of or incurred by the company. The best measure of this is not the gross receipts, but the length of line, the value of plant, the rate of increase in business, or a combination of them. The amount of the gross business must be known, at least approximately, before a just percentage can be chosen, and it must be subject to change as conditions change.

The same is true, tho to a less extent, of the long distance business, which, tho doubtless much the most profitable to the company, incurs less danger of loss or expense to the city in proportion to the amount of business done.

The principles on which franchises should be based have been discussed in numerous articles and editorials in Municipal Engineering, during the past ten or fifteen years, and occasionally lists of such articles have been printed.

Cost of Engineering in a Small City

It would be of interest to my council if I could inform them what amount is expended annually by municipalities of a population of about 20,000 on engineering works, and the ratio of staff expense.

T., City Engineer,
———, Can.

The writer knows of no compilation showing cost of engineering in a small city. His observation is that in cities of about 20,000 population the ordinary engineering work is taken care of by a city engineer, who receives a salary of $1,200 to $1,800 a year, and one assistant. When surveys for improvements are in progress he is allowed two or more additional assistants, according to circumstances, and when construction is in progress he keeps one or more of these assistants, who may also act as inspectors, or he is allowed inspectors, provided the city councilmen do not assume to themselves the ability to do the inspection casually and inefficiently and thus seem to save the expense.

This makes the office cost regularly from $2,000 to $3,000 a year, which may be doubled in exceptional cases, when work is very heavy.

Of course, when work is light, the percentage of cost of engineering is high, but when improvements are proceeding at a good rate the percentage runs not far from 5 to 8 per cent. A compilation of costs of engineering made some years ago from a list of a dozen cities or so of 25,000 to 200,000 population showed that the cost of engineering, not including inspectors, varied from less than 2 per cent in the smallest city investigated to nearly 12 per cent in two cities of 50,000 and 75,000. The average of thirteen cities was 5.24 per cent of the cost of the work superintended.

Percentage is not the way to compute the cost of city engineering in the smaller cities, for a city of 20,000 has enough work to keep a man reasonably busy all the time, which must be done whether improvements are actually carried thru and their cost definitely ascertained or not.

Crown of Streets with Street Railway Tracks

I wish to get some data as to the proper crown of a paved street with double-track electric railway.

On one of our principal streets, paved with asphalt, the width of the roadway is 50 feet. The distance from outside rail to curb is 17 feet. The average grade of the street is about 0.75 per cent. The present crown from rail to curb is five or six inches. The city plans to increase this crown to about nine inches. This seems excessive, and I should like to get some statistics as to the standard practice used in other American cities. If this subject has been covered in any issue of your publication I wish you would send me a copy of same. Can you tell me any other source from which I can get this information?

T., Chief Engineer,
——— Ry. Co.

The crown of a street is intended only to make it easy to drain the water from its surface to the gutters where it is concentrated enough to run on as low a grade as that mentioned, 0.75 per cent, with reasonable rapidity to a sewer inlet.

The most recent publication in Municipal Engineering on this subject will be found in the article on "Paving Methods in Baltimore," in the January number vol. xlvi, p. 2. Cross sections of several streets with street car tracks are shown, giving the standard crowns. A table of standard crowns for various width of street is also given.

From this table and the parabola forming the cross sections it can be computed that the difference of elevation between the pavement at the rail and the gutter, with a 1 per cent grade, 50-foot roadway and 17 feet from rail to curb, should be full 0.6 foot, or 7¼ inches. For a block pavement this difference would be somewhat greater.

The writer has been obliged in one or two instances to increase the slope from rail to gutter for short distances, but always with unsatisfactory results so far as the comfort of horse travel or automobile travel is concerned.

The flatter the slope can be made and allow for the drainage of the inevitable depressions in the pavement near the rail, the better.

The most difficult problem on such a level street is the disposition of the water between the tracks. The rails will hold it so that it cannot all get out even with an exaggerated crown across the tracks, and and elevation of the inner rail above the outer, if that ever is really admissible for any great distance. Gratings located between rails at convenient intervals, connecting with the same drains as the gutter inlets, are sometimes the only solution of the problem. The space between tracks can be crowned so as to throw all the water falling on it into the space between the rails of each track.

Blanchard's new book on highway engineering has a rather full discussion of this subject which may be of interest.

Harger & Bonney's "Highway Engineers' Handbook" gives the parabolic ordinates used, and other valuable data.

Securing an Equitable Franchise for Public Utilities

This city is preparing to sell franchises for the furnishing of water and for the furnishing of light to this city and the residents thereof, and I thought you might be able to give some assistance in the way of advice and otherwise in the preparation of these franchises, and to that end I would appreciate it if you would write me the names of such cities as you may know which have recently granted similar franchises, and such franchises as you would recommend that this city grant.

In order that you may understand the conditions here, I would say that this is a city of about 4,500 inhabitants, and at present the water and light plant is located on a creek at a distance of about one and one-half miles from the central portion of the city. The pumping station for water and all machinery used in generating electricity are located within the same building, and are owned and operated by the utiilties company. Water is furnished to the city and its inhabitants from a standpipe located within a short distance of the pumping station, which is on the side of the creek. The water is pumped from the creek to the standpipe, from which it is forced thru the mains into the city, and the supply of water is secured by means of a dam across the creek.

I would also appreciate your sending me a list of competent and reliable consulting engineers, as we contemplate procuring the services of such engineer before we grant franchises for the above purpose. If you will, I wish you would inform me about what a competent engineer would charge for his services in such work, and also how I may procure copies of such franchises as you would recommend.

R., Mayor,
———, Ky.

The provisions of a modern public utility franchise adopted by and in operation in Taylorville, Ill., so far as they relate to gas works will be found in MUNICIPAL ENGINEERING, vol. xlii, p. 185. So far as they relate to electric light they will be found in vol. xliii, p. 322. The ordinance is described and quoted from in an article on "Some Provisions in Modern Franchises for Municipal Service Utilities," vol. xxxix, p. 456, which article also quotes from a franchise of water works granted by Mexico, Mo., and compares the provisions in the two ordinances.

A proposed telephone franchise and an existing interurban freight franchise are described and quoted in vol xlii, p. 390.

Lists of articles on the subject will be found in vol. xl, pp. 37 and 38 and elsewhere, including one on "A Modern Municipal Franchise," which gives the provisions in the Indianapolis 60-cent gas contract, to be found in vol. xxxv, p. 306.

In the list of "Consulting Engineers," printed each month in the "Business Directory," will be found the names of several who devote prominent attention to public utilities, their planning, valuation, etc., who could give you good service. Each engineer has his own opinion of the value of his services and there is no standard of fees to charge. In selecting an engineer the largeness or the smallness of his fee is not the first consideration, tho, doubtless, the business man, qualifications being apparently equal, will choose the one making the lowest charge. The first requisite is great care in ascertaining the real qualifications in experience and independence of undue influence of the men considered.

Well-Drilling Machinery Makers

To the list of manufacturers of and dealers in well-drilling machinery given on p. 236 of the March number should be added The Willis-Shaw Company, New York Life Building, Chicago, Ill., who make a specialty of this class of work and the apparatus and materials therefor. The description of a well sunk under their supervision will be found on p. 155 of the February number.

Rates for Gas and Electricity

If it be within your province to furnish me prevailing prices charged to the consuming public in the leading cities of our country for gas and electricity for light and heating purposes, as also the prevailing rates for industrial purposes, I would thank you to refer me to such a list. L., New Orleans, La.

The gas rates and electric light rates in a number of cities are given in MUNICIPAL ENGINEERING, vol. xiv, p. 49, and gas rates in a still larger list of cities on p. 376 of the same volume. There are other still longer lists of both in earlier volumes, for smaller cities.

Equipment for Handling Sand

I am asked to give estimates and all technical details regading the exploitation of sand in the following problem: The company has an island of a very good sand for construction. The sand will be conveyed on barges from the island to the harbor of the city, where it will be unloaded. Will you please tell me:

(a) What would be the best installation on the island; the firms handling this class of equipment?

(b) What would be the installation at the harbor? The sand will be unloaded from the barges and when needed loaded on truck for the distribution.

(c) The specifications regarding those installations and the constructions connected with them? R., ———, Can.

Apparatus of this nature has been described in recent numbers of MUNICIPAL ENGINEERING, and details concerning similar installations can be obtained from a number of firms whose names will be found in the "Business Directory" printed in each number under the headings "Automobiles," "Portable Bins," "Buckets," "Cableway Excavator," "Contractors' Tools and Machinery," "Contractors' Wagons," "Conveyors," "Dump Boxes," "Dump Cars," "Dump Wagons," "Elevators," "Excavators," "Graders," "Motor Trucks," "Scrapers," "Portable Screens," "Spreader Cars," "Tires," "Traction Engines," "Trucks."

In recent numbers will be found the following articles of interest in this connection:

Vol. xlvi: "Motor Dumping Trucks," p. 203; "Economical Plant for Handling Gravel for Road Building," p. 153. "Motor Trucks on Street Work," p. 59, showing bins for loading trucks.

Other articles on the use of motor trucks in the volumes of the past three or four years show still other methods of loading and unloading building materials.

Manufacturers of Incinerators

I am anxious to get all of the latest information in regard to incinerators, etc. I would be pleased to have addresses of any of the manufacturers of such machinery.
W., ———, Wash.

Information can be obtained from the following upon garbage disposal: City Wastes Disposal Co., 156 Fifth Ave., New York City; The Destructor Co., 111 Broadway, New York; J. B. Harris, 209 Stahlman Bldg., Nashville, Tenn.; Morse-Boulger Co., 39 Cortlandt St., New York; P. Wylie, 242 13th Ave., E., Vancouver, B. C.; W. F. Morse, 90 West St., New York; E. B. Stuart, 36 S. Ashland Blvd., Chicago, Ill.

Other manufacturers of machinery and furnaces for incinerating garbage and refuse are Decarie Incinerator Co., Minneapolis, Minn.; Griscom-Russel Co., 92 West St., New York; Lewis and Kitchen, 900 Michigan Ave., Chicago, Ill.; McCall Incinerator Co., Memphis, Tenn.; U. S. Incinerator Co., Buffalo, N. Y.; Kewanee Boiler Co., Kewanee, Ill.; Sims Co., Erie, Pa.; Dixon Garbage Furnace Co., Toledo, O.

Tamping of Sewer Trenches

Can you refer me to articles in your magazine dealing with the tamping of sewer trenches, or the consequences resulting from the lack of tamping, or any court decisions as to the damages sustained.
G., East Liverpool, Ohio.

Articles on apparatus, methods, results, damages from improper filling, for trenches have appeared in MUNICIPAL ENGINEERING at frequent intervals, the following being among the most important:

Vol. xlvi: "Village not liable for defective water trench outside of improved roadway," p. 145.

Vol. xlv: "Mechanical Trench Tamping," p. 292; "Mechanical Trench Filling," p. 494; "Use of Small Power Tamper," p. 563.

Vol. xliv: "Filling Water Pipe Trenches in Macadam Road," p. 36; "Mechanical Trench Tamping," p. 569.

Vol. xliii: "Back-Filling Trenches," p. 180.

Vol. xlii: "Power Tamping Machine," p. 339.

Vol. xl: "A Power Tamping Machine," p. 151.

Vol. xxxix: "Defective Streets—Liability," p. 124; "The Staley Power Tamping Machine," p. 128.

Vol. xxxiv: "Back Filling Trenches," p. 21.

Vol. xxxi: "Earth Settlement in City Streets," p. 361.

Vol. xxvi: "Refilling of Trenches," p. 304.

Vol. xxv: "The Back Filling of Trenches," p. 77; "Methods of Filling Trenches," p. 84.

Vol. xviii: "Damages to Pavement from Trenches Cut," p. 52.

Vol. xv: "Laying Pavements over Recently-Made Sewer Trenches," p. 162.

Vol. xi: "Replacing Earth in Trenches Opened in Streets," p. 155.

But two of the above references are court decisions, and but one of them makes the city or any one else liable for damage due to defective tamping of trench filling.

Cost of Pumping Water and Saving by Use of Water Meters

I am anxious to find out the cost per 1,000 gallons for pumping water against a head of 80 pounds, using a steam compound duplex engine. I would also like to get data on the comparative saving of a metered system as compared with a non-metered system in a city of 15,000 population.

S., City Engineer, ———, Can.

Will our readers under similar conditions supply such information as they can in reply to this inquiry? It will be published with or without statement of the source of the information as preferred.

Prices for Structural Iron

I am at present preparing plans for some new steel bridge structures and repair of others and would therefore like to obtain the price of rolled steel shapes in mill shipments, and also stock order prices.

H., Eaton, Ohio.

Following are the latest quotations of Pittsburg prices: I-beams, channels, angles, tees, smaller sizes, \$1.15; larger sizes, \$1.25; plates, \$1.15; thin, \$1.25 to \$1.30; concrete reinforcing bars over ¾-in., \$1.20 up to \$1.80 for ¼-in. Small lots from warehouse probably ¾ to 1 cent higher.

What Cities Operate on a Cash Basis?

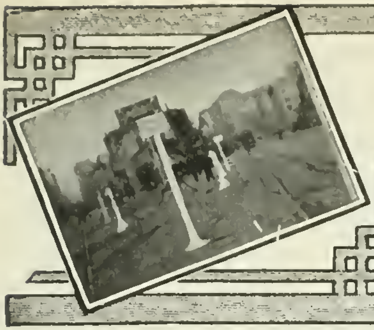
Would it be possible for you to furnish a list of the cities of this country that operate on a cash basis? M., Harrisburg, Pa.

This question, doubtless, does not mean cities without bonded indebtedness, for there are few cities of any size in this condition, especially if the school district is taken into account.

The latest report of "Financial Statistics of Cities" of over 30,000 population, for 1912, issued by the Bureau of the Census, shows the following cities without floating indebtedness, which would indicate that they do their daily business on a cash basis: Philadelphia, Pa.; St. Louis, Mo.; *Boston, Mass.; Cleveland, O.; Baltimore, Md.;* Pittsburgh, Pa.; *Detroit, Mich.;* San Francisco, Cal.; Washington, D. C.; Minneapolis, Minn.; Jersey City, N. J.; Seattle, Wash.; Kansas City, Mo.; Indianapolis, Ind.; Portland, Ore,; Rochester, N. Y.; Louisville, Ky.; Columbus, O.; Toledo, O.; Oakland, Cal.; Worcester, Mass.; New Haven, Conn.; Memphis, Tenn.; Scranton, Pa.; *Paterson, N. J.;* Omaha, Neb.; Spokane, Wash.; Dayton, O.; San Antonio, Tex.; Dallas, Tex.; Trenton, N. J.; *Albany, N. Y.; Reading, Pa.; Camden, N. J.; Springfield, Mass.;* Tacoma, Wash.; *Lynn, Mass.;* Lawrence, Mass.; Wilmington, Del.; Yonkers, N. Y.; Youngstown, O.; Houston, Tex.; Fort Worth, Tex.; Duluth, Minn.; Norfolk, Va.; Schenectady, N. Y.; *Somerville, Mass.;* St. Joseph, Mo.; *Utica, N. Y.; Elizabeth, N. J.;* Waterbury, Conn.; Troy, N. Y.; Akron, O.; Manchester, N. H.; Wilkes-Barre, Pa.; Erie, Pa.; Evansville, Ind.; Peoria, Ill.; Fort Wayne, Ind.; Harrisburg, Pa.; *Savannah, Ga.;* East St. Louis, Ill.; South Bend, Ind.; Terre Haute, Ind; *Passaic, N. J.;* Johnstown, Pa.; *Bayonne, N. J.; Brockton, Mass.; Holyoke, Mass.; Charleston, S. C.;* Wichita, Kan.; *Allentown, Pa.; Covington, Ky.;* Canton, O.; *Mobile, Ala.;* Sacramento, Cal.; Saginaw, Mich.; Sioux City, Iowa; Binghamton, N. Y.; *Atlantic City, N. J.;* Rockford, Ill.; *Augusta, Ga.;* Springfield, O.; *Lancaster, Pa.;* New Britain, Conn.; *Chattanooga, Tenn.; Malden, Mass.;* Berkeley, Cal.; *Bay City, Mich.; Haverhill, Mass.;* Topeka, Kans.; *Salem, Mass.;* Lincoln, Neb.; Davenport, Iowa.; *El Paso, Tex.;* San Diego, Cal.; Tampa, Fla.; *McKeesport, Pa.;* Flint, Mich.; Racine, Wis.; Superior, Wis.; *Wheeling, W. Va.; Macon, Ga.;* Newton, Mass.; Butte, Mont.; *Montgomery, Ala.; Chester, Pa.;* Dubuque, Iowa; Galveston, Tex.; *West Hoboken, N. J.;* New Castle, Pa.; Roanoke, Va.; Elmira, N. Y.; Huntington, W. Va.; *East Orange, N. J.;* Hamilton, O.; *Lexington, Ky.;* Springfield, Mo.; Quincy, Ill.; Charlotte, N. C.; Joliet, Ill.; Pasadena, Cal.; Auburn, N. Y.; *Everett, Mass.;* Decatur, Ill.; *Portsmouth, Va.; Perth Amboy, N. J.; Quincy, Mass.;* Lansing, Mich.; *Pittsfield, Mass.;* Oshkosh, Wis.; San Jose, Cal.; *Amsterdam, N. Y.; Jamestown, N. Y.;* Mt. Vernon, N. Y.; *Niagara Falls, N. Y.;* Jackson, Mich.; *Williamsport, Pa.;* Lima, O.; Muskogee, Okla.; *Chelsea, Mass.;* New Rochelle, N. Y.; Aurora, Ill.; Lorain, O.; *Newport, Ky.; Orange, N. J.;* LaCrosse, Wis.; *Lynchburg, Va.; Shreveport, La.;* Colorado Springs, Col.; *Council Bluffs, Iowa.*

This statement apparently does not mean that these cities do not borrow money to meet daily obligations, but that they borrow this money in the regular way, and do a cash business, at least approximately, in their payments of daily accounts. Nor does it mean that all obligations are paid every day, for of the 155 cities in the list, only the 54 in italics have at the same time no outstanding warrants and audited claims. Many of the other cities in the list have such a small amount of such outstanding authenticated claims that it is probable they should be included in the list of cities on a strictly cash basis, but there is no evident way of making the separation.

It is probable, also, that some of the cities were on the cash basis at the time of the report, which at other times in the year or in other years are not able to meet all their running obligations, and so have many outstanding warrants at such times.



WORKERS IN THE FIELD

Ordinance Creating City Manager for Inglewood, Cal.

The Editor of Municipal Engineering:

Sir—It may be interesting to the members of the engineering profession and your many readers to learn of the recent adoption of the "City Manager" form of government by the board of trustees of the city of Inglewood. This is the first city on the Pacific Coast to adopt this new plan. Paul E. Kressly was appointed to this office in addition to his duties as city engineer on March 2, 1914. He has been city engineer for two years and has been selected as city manager on account of the economical and efficient manner in which he conducted the engineering department, as it is believed by the members of the board that he will be equally as successful in managing the affairs of the city and business of the various departments; engineering, street, water, light, building, electrical, plumbing, fire, police and health, and the park and playground commissions.

The ordinance governing is as follows:

ORDINANCE NO. 171.

An ordinance of the board of trustees of the city of Inglewood, creating the office of city manager in and for the said city, defining the powers and duties and providing for the compensation of said officer.

The board of trustees of the city of Inglewood do ordain as follows:

Sec. 1. The office of city manager of the city of Inglewood is hereby created and established. The city manager shall be appointed by the board of trustees of said city and shall hold office during the pleasure of said board. The city manager shall receive such compensation for his services as the board of trustees shall from time to time determine.

Sec. 2. It shall be the duty of the city manager and he shall have the power:

1. To see that the laws and ordinances of the city are enforced.

2. To exercise control over all the departments of the city and direct the work of all appointive officers.

3. To employ and dismiss all city employes.

4. To superintend the construction of all public work within the said city.

5. To approve or disapprove the requisition for the purchase of any article or articles for the said city, by any department or officer, before the purchase is made.

6. To attend all meetings of the board of trustees and to recommend to the said board for adoption such measures as he may deem necessary or expedient.

7. To keep the board of trustees fully advised as to the financial condition and needs of the city.

8. To perform such other duties as may be prescribed by ordinance or resolution of the board of trustees. Provided, however, that any and all acts of the said city manager under this ordinance shall be subject to the approval and control of the board of trustees of the city of Inglewood, and they shall have full power to correct and set aside any action taken by him under this ordinance whenever they shall deem it proper to so do; and provided further that the legal department of said city and the city attorney are hereby expressly excepted from the operation of this ordinance.

Sec. 3. All officers and departments of the said city, except as in this ordinance provided, are hereby declared to be subject to the control of the said city manager, and no officer or department of the said city shall incur any indebtedness upon behalf of said city until a requisition for the same shall have been first presented to the city manager and shall have received his approval. Any violation of this section shall render the person so violating subject to immediate discharge from the employ of said city.

Sec. 4. The city clerk shall certify to the passage of this ordinance and shall cause the same to be published by one insertion in the *Inglewood News*, a weekly newspaper printed and published and circulated within the said city, which is hereby designated for that purpose, and thereupon and thereafter it shall take effect and be in full force.

Passed and approved this second day of March, 1914. NATHAN SMITH,
President pro tem of the Board of Trustees of the City of Inglewood.

Is This a Case of Electrolysis?

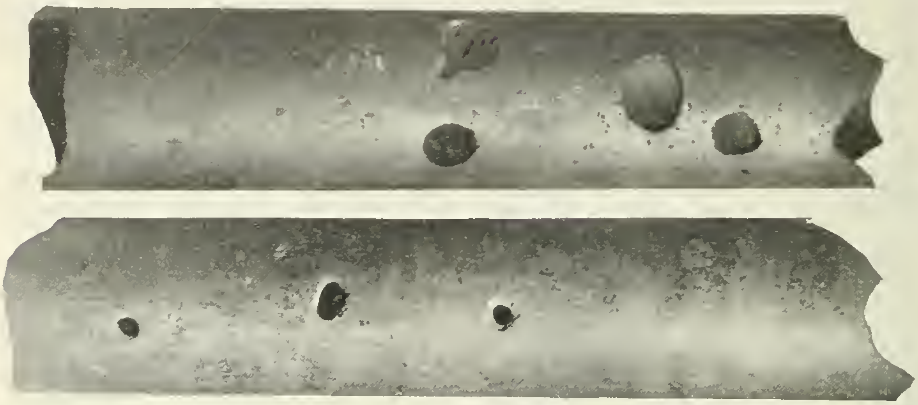
The Editor of MUNICIPAL ENGINEERING:

Sir—Perhaps it would be of interest to your many readers to discuss the cause of carbonizing in cast iron water pipe laid in the ground.

I am sending you photographs of two views of a 10-inch water pipe and would like to have any readers' comment as to cause.

The section of the pipe was cut from a 10-inch water main on Lake street, at Appleton, Wis., in January, 1914. The hole marked "1" on view No. 1 was blown out by pressure during a fire and caused considerable damage to the street and brick pavement. The other soft places were discovered by accident. Upon uncovering the pipe, the pressure being off, we were about to repair the hole with a split sleeve when one of the workmen struck the pipe with a small hammer and happened to strike the carbonized spot, and the hammer went thru the pipe. The coating on the pipe, both outside and inside, was in as good condition as when treated, and nothing on the surface of the pipe could be discovered to indicate there were any bad places. The pipe was laid in the year 1882-3, and for the past fifteen years there has been an interurban electric road passing directly over the pipe. At this point there is a sidetrack or turnout leaving the main line, and at a point about 100 feet from there both the interurban track and the water-pipe line cross a Government water canal. The street car crosses on a draw bridge, the pipe is laid at the bottom of the canal, where it is surrounded with water. At the time of removal of the section of water pipe there was not electric current enough passing between the pipe and the rails of the interurban line to be indicated on a volt-meter, although we could get a good strong spark by connecting with a piece of wire between the two points.

C. H. VINAL, City Engineer,
Appleton, Wis.



Columbia, S. C., Has Water Filtration Plant

The Editor of MUNICIPAL ENGINEERING:

Sir—The first question asked in your question department in the December issue is as to the cities in the South having a filter plant. In making up your list of municipally owned plants you have omitted to name this city, which probably has one of the most up-to-date filter plants in the United States and furnishes a quality of potable water to its citizens which is unsurpassed anywhere.

W. H. GIBBS, Mayor,
Columbia, S. C.

Indiana Spends Fourteen Millions a Year on Roads

The following statistics from the Indiana State Bureau of Statistics show the road funds and road expenditures of the state of Indiana for 1912:

Township gravel road bonds outstanding	$27,849,262.26
Bridge bonds outstanding	1,429,912.33
Gravel road bonds paid in 1912	$ 3,876,881.43
Annual interest on bonds outstanding at 4½ per cent	1,252,205.55
Gravel road bonds sold for future work in 1912	7,204,926.66

Amount paid on gravel road bonds taken up in 1912...	$ 3,876,881.43
Amount paid for new construction	5,611,403.28
Amount paid for gravel road repairs	1,802,925.33
Amount paid to road viewers, etc.	33,326.98
Amount expended on township roads(worked out)..	1,937,407.58
Township cash road fund expended	445,365.46
	$13,707,310.06

The state auditor gives the total gross disbursements of the state of Indiana for 1912 for all state governmental expenses, $10,995,008.02.

In other words, more money was spent for roads in Indiana in 1912 than for all of the activities of the state put together. There are several states officers and some thirteen boards and commissions to supervise and check the expenditure of the state funds, but there is not one to exercise the same sort of supervision over the expenditure of road funds.

Many well-meaning people, during the last session of the legislature, said they were opposed to the creation of any more commissions and so defeated a bill for a state highway board to look after roads, but later passed a bill providing for a public service commission of five members, whose duty it is to supervise all the railroads, interurbans, state railways and toll roads in the state, with power to see that their road beds, rails, cars, engines, etc., are at all times in good condition, to the end that the public, as well as merchandise, may be carried safely, promptly and at the lowest cost commensurate with a fair return on the fair and reasonable value of the utilities. This commission is doing a splendid work in the interest of the public.

Indiana has over 26,000 miles of so-called improved roads, and 36,000 miles of unimproved roads, with a yearly expenditure of nearly 14 million of dollars, with no one to supervise it, or to see that this vast sum is economically and effectively expended, and no one to see that the roads are well built and maintained and public safety secured. The counties and townships have nearly 4,700 unskilled officers of one kind or another to look after all these matters.

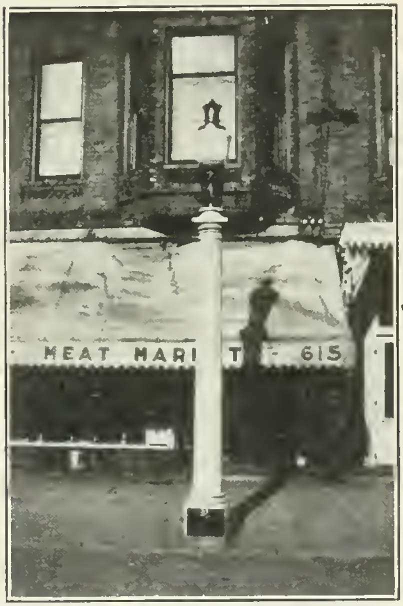
A proper system would produce much better results with an ultimate expenditure of far less money.

Manufacturers of Wood Block for Street Paving

The Editor of MUNICIPAL ENGINEERING:

Sir—Under Question Department in MUNICIPAL ENGINEERING we note an inquiry for information with reference to furnishing wood blocks for street paving. We have laid many streets, docks, walks and round-houses with our Oregon fir wood block paving, the blocks being first treated with avenarius carbolineum.

CARBOLINEUM WOOD PRESERVING CO.
Portland, Ore.

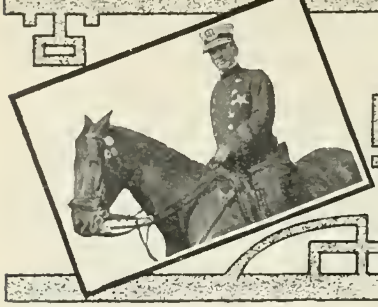


Ornamental Concrete Lamp Post at DeKalb, Ill.

The Editor of MUNICIPAL ENGINEERING:

Sir—I am enclosing herewith a small picture of a light on a concrete post at DeKalb, Ill. DeKalb has seventy-two of these posts, and the lights are what are known as inverted luminous arc lights. This lighting system was installed during the summer of 1913.

DeKalb had the good fortune to be able to remove practically every pole from its main street. The trolley supports were attached to buildings, and where it was not possible to attach to a building, the street car company set an iron pole on the property line, so a clear view was had of the entire street. M.



LEGAL DECISIONS

Damages For Supply of Polluted Water

Dr. H. E. Barnard, head of the Indiana bureau having charge of the purity of foods and drugs, in his report as chairman of the committee on legislation and legal decisions of the Indiana Sanitary and Water Supply Association, has collected the important decisions of the last twenty years or more in cases involving damage for the supply of impure water by public water plants whether under private or municipal ownership, from which the following is taken.

Rights of property from the opinions I have been able to collect appear to have once been paramount over the rights of individuals. While the law may have been as carefully construed than as now, a study of the decisions shows clearly that the courts did not interpret the law in the same light then as at present.

It has been somewhat surprising to me to find how few decisions have been handed down by the higher courts involving the liability of water companies who have distributed polluted water.

The first case to which I shall call attention is the classic Buckingham v. Plymouth Water Company.

Buckingham vs. Plymouth Water Company, 142 Pa. 221.—Where a water company drew water from the river which was infected in its course thru a town in which there was typhoid fever, the company being ignorant of the disease, and the river banks had recently been inspected by the company, it was held that it was not liable in damages for the death of one who drank the water and contracted typhoid fever.

This case grew out of the historic epidemic at Plymouth, Pa., where out of a population of 7,000 there were about 1,200 cases of typhoid fever. The plaintiff proposed to show that dejecta of typhoid fever patients living along the banks of Toby's Creek were carried into and down the creek to the Susquehanna river and emptied into it a mile and a half above the intake of the Plymouth Water Company. This testimony was held to be irrelevant unless it were shown that the company had knowledge of these typhoid fever cases along the alleged source of its water supply. Since the evidence does not show that the defendant company knew of the case of typhoid fevor or of the fact that the dejecta of the patient had been thrown upon the ground near the stream, but does show that the superintendent of the company from time to time went along the banks of the stream, the court deems it its duty to hold that the plaintiff has not shown that the sickness of his children was caused by the negligence of the defendant.

Danaher, Adm'r, v. City of Brooklyn, 119 N. Y. 241.—In an action to recover damages for the death of plaintiff's intestate alleged to have been caused by drinking unwholesome water from a well, used gratuitously by the public, belonging to defendant, and under its control, a city is not bound to make a chemical examination of the water of free public wells maintained by it for the purpose of ascertaining whether or not it is pure and wholesome where it has no notice that it is unwholesome, and it is not liable for injuries caused by drinking unwholesome water from a well maintained by it, in the absence of wilful misconduct or culpable negligence on its part with reference to the water.

The burden upon the city is sufficient if it be held to the responsibility of keeping the pumps and wells in order and clean, and if it be made liable for any injury resulting from the use of impure waters from the wells after it has had notice of their dangerous qualities, and an opportunity to remove the danger. A higher degree of diligence as to whether apparently pure and wholesome, agreeable to the taste and in common use by the public without complaint, would be unreasonable. The court holds opinion that the city is under no burden to make a chemical examination of the waters of the public wells for the purpose of ascertaining whether they were pure and wholesome.

The court further says that this case is not like the cases where a city creates or permits a nuisance, or turns a stream of mud or water upon the premises of private individuals, in which case it is held responsible for the nuisance which it creates or permits.

Green, Adm'r, v. Ashland Water Company, 101 Wis. 258.—A distributor of water under a public franchise will be liable for injury to consumers without fault on their part from using the water furnished, if it knows, or from the situation ought to know, that the water it is distributing is dangerous for domestic use for some cause not discoverable ordinarily by the use of reasonable care, and if it fails to disclose such danger to them, but if the source of supply be contaminated with sewage for a long period of time, causing epidemics of typhoid fever annually in the community for several years, and the fact in that regard be there notorious and a matter of common knowledge, the presumption is that members of such community of ordinary intelligence have notice of that situation; and, in the absence of evidence to the contrary, that presumption will prevail and preclude a recovery by a person injured by the use of such water, on the ground of his contributory fault.

This was an action to recover damages for the death of a user of the water alleged to have been caused by negligence on the part of the Ashland Water Company in that it failed to extend its intake pipe into the Chequamegon Bay from time to time as it needed to secure water free from sewage contamination and suitable for domestic use and took water from Chequamegon Bay that contained typhoid fever germs and distributed it to its customers in the city of Ashland, one of whom drew such water from a surface faucet at his residence and contracted typhoid fever, of which he died.

From this opinion we must draw the conclusion that at least one court holds that if a water company furnishes water so bad that it is notoriously impure it is exempt from liability. In other words, it is safer to sell a bad water than a water ordinarily good but which under certain stress may be temporarily bad.

Commonwealth v. Potter County Water Company, 212 Pa. 463.—Where the evidence against a water company, altho contradicted, tends to show that the company's line was connected with a mill pond into which the sewage of the town was discharged, and that during periods of low water, and when fires occurred, water from this pond was pumped into the main service lines of the company, and that such water polluted the other water, and frequently rendered it injurious and unwholesome and unfit for drinking or cooking, and even for washing, a judgment of ouster on a verdict for the commonwealth on quo warranto proceedings was sustained.

In rendering the opinion the judge said:

"Nothing within the limits of reason could justify the failure upon the part of the water company to furnish to the public water which was at least reasonably pure and comparatively wholesome."

Lockwood, Adm'r, v. Dover, 73 N. H. 209.—A city was held to be liable for the death of a consumer of the water furnished by it, caused by foreign and decayed matter becoming lodged in the city's pipes by reason of its negligence in not cleaning out the pipes.

In the case of *Stein v. State*, 37 Ala. 123.—Indictment does not lie against one for supplying and selling unwholesome and poisonous water, in the absence of any knowledge on his part of its unwholesomeness and poisonous quality.

Case of *Georgetown Against the Water, Gas, Electric and Power Co.*—This was a case in which the corporation undertook to furnish the city a supply of water for domestic use and fire protection from a source furnished by the city. This water became impure and the city petitioned the court to require the defendant company to install a filtration plant. The court held that in the absence of a contract to that effect so long as the city supplied the water it could not impress upon the water company the duty of constructing a filtration plant for the purpose of purifying such water.

Peffer v. Pennsylvania Water Co., 221 Pa. 578.—Plaintiff filed a bill against a water company alleging that the water furnished by it was impure and was the cause of typhoid fever, and the evidence showed that the water was polluted, containing bacteria and bacilli. Held, that a decree directing the company to provide a sufficient supply of pure water and to file a statement, within the time specified, showing what it proposed to do in order to comply with acts regulating public water supply, was properly rendered.

"In a proceeding to compel a water company to furnish pure water, a company is not required to furnish chemically pure water. It must furnish water ordinarily and reasonably pure and wholesome."

"Ordinarily pure and wholesome water" means water reasonably clean and free from bacteria or other contamination rendering it unfit for domestic use and dangerous to individuals.

In this case the analysis showed the presence of colon bacilli in proportionately large quantities in the raw Allegheny river water, the number of which was materially reduced after filtration. However, both bacteria and the colon bacilli in dangerous quantities are found in the water after filtration.

It appeared from the testimony that on account of several features, notably the extensive pollution, the prevalence of typhoid fever above the city, the method of increasing the supply at the expense of impaired filtration and the inability of the company to keep the filter beds in good order, the water furnished by the company was not reasonably pure and wholesome.

In this case the testimony given by physicians, chemists, engineers and eminent filtration experts covering 1,100 typewritten pages, completed the conclusion reached as to the character of the water.

The court further says that modern investigations and scientific attainments demonstrate that water from polluted sources can by proper filtration be made reasonably safe and pure, and therefore the standard of purity as fixed by the well recognized authorities must be secured.

Keever v. City of Mankato. 113 Minn. 55.—A complaint charged that defendant city negligently allowed the supply in its water works system to become polluted, and large quantities of sewage to escape into its water supply, by reason whereof plaintiff's intestate contracted typhoid fever and died. Held, on demurrer, that the municipality was liable for its negligence in its private or corporate capacity, and was not exempt because it was carrying out a government function. Jaggard, judge, says:

"It is obvious that a sound public policy holds a city to a high degree of faithfulness in providing an adequate supply of pure water. Nor does it appear why its citizens should be deprived of the stimulating effects of the fear of liability on the energy and care of its officials; nor why a city should be exempt from liability while a private corporation, under the same circumstances, should be held responsible for its conduct and made to contribute to the innocent persons it may have damaged."

A water company is not an insurer. As said in Green v. Ashland Water Co., 101 Wis. 258, 43 L. R. A. 117, 77 N. W. 722, a mere distributor of water for compensation is not liable as a guarantor of its quality.

A city is not liable for injuries caused by drinking unwholesome water from a well maintained by it, in the absence of wilful misconduct or culpable negligence on its part with reference to the water. Ibid. Affirming 51 Hun, 564, 4 N. Y. Supp. 312.

Liability of water company for furnishing impure water, see Note 81, American State Reports, p. 483.

Cases involving municipal liability for damages caused by pollution of its water supply, see Note (b) Quality, Contaminated water, 61 L. R. A. 88.

Duty of water supply companies to filter water, see Note 24, L. R. A. (N. S.), 303, 304.

Purity and Quality of Water, see 40 Cyc. 786.

Duty of a water company as to quality of water supply, see 1 Farnham on Waters, Water Rights, p. 829, and cases cited.

Waterproofing Patent Sustained

In the United States District Court, northern district of Illinois, on February 13, 1914, a decree was entered declaring the Newberry patent, No. 851,247, under which the Sandusky Portland Cement Co. is making Medusa waterproofing, to be good and valid, and that the McCormick Waterproof Portland Cement Co. and S. T. Sjoberg infringed said patent and are perpetually enjoined from making or selling waterproof cement or carrying on the process described in said patent, and that the complainant shall recover damages resulting from said infringement. Suits against other infringers have been begun and will be vigorously prosecuted.

Standard Specifications for Lumber for Building

In accordance with the plans of the purchasing department of New York City, which were described in MUNICIPAL ENGINEERING, vol. xlv, p. 430, a large number of specifications were adopted by the Board of Estimate and Apportionment in March, after consideration and amendment since July, 1913. Those of special interest are for all kinds and grades of hard and soft wood lumber and posts, except white pine lumber and timber piling.

The specifications are accompanied by a brief handbook on the economical uses of lumber, discussing classifications of woods, defects, selection of lumber for different uses, knots, methods of ordering, prices, etc. The booklet also gives descriptions of each of the kinds of timber included in the specifications and statements of the forms in which it is to be found in the market. The detail of the specifications may be judged by the following specification for long-leaf yellow pnie, prime stepping:

SPECIFICATION FOR LONG LEAF YELLOW PINE (PRIME STEPPING).

"*Character*—All pieces shall be well manufactured, sound, commercial long leaf yellow pine. Pine combining coarse knots with coarse grain shall not be accepted. All pieces shall show three corners heart and shall be free from the following defects: Shakes, worm holes, knot holes and all knots, except that six sound knots which do not exceed one-half inch in mean diameter shall be admitted in any piece.

"*Widths*—All pieces shall be not less than 7 inches wide and furnished in specified widths, as called for in the schedules.

"*Lengths*—All pieces shall be not less than 10 feet long and furnished in either random or specified lengths, as called for in the schedules. In any shipment of random lengths at least 90 per cent of the pieces shall be 12 feet or longer.

"*Thickness*—The thickness shall be the thickness of rough lumber, as called for in the schedules.

"*Dressing*—Pieces shall be dressed on the number of sides as called for in the schedules.

The allowances that shall be made for dressing are as follows:

For dressing each edge, one-quarter inch .

For dressing the two faces, according to the following table:

Dressed stock..13-16, 1 1-16, 1¼ and 1¾ in.
Rough stock... 1, 1¼, 1½ and 2 in.

"*Defects*—Defects specified refer to the worst piece that shall be accepted.

"*Measurement*—All lumber shall be sawed square edged and saw butted unless otherwise specified in the schedules.

The dimensions of lumber shall be taken in the rough, and the width and thickness of lumber before dressing shall be taken as the measurement of dressed lumber.

"*Payment*—Lumber measured and accepted in accordance with this specification shall be paid for at the price bid per one thousand feet board measure, for each width and thickness, when furnished in random lengths and at the price bid per one thousand feet board measure, for each width, thickness and length when furnished in specified lengths.

"*Definitions of Defects—Shakes* are splits or checks showing a separation of the wood fibers between the annual rings."

The detail is still further shown in that there are similar specifications for the following uses: Prime boards and plank, prime scantling and dimension sizes, merchantable boards and planks, merchantable scantling and dimension sizes; merchantable rough-edge or flitch-sawed boards, standard boards and planks, standard scantling and dimension sizes, standard rough-edge or flitch-sawed, clear heart face edge grain, flooring sap-edge grain, flooring sap-flat grain, B sap edge grain, B sap flat grain,

North Carolina pine is almost equally detailed and cypress, short leaf yellow pine ,spruce and others are detailed enough for market requirements. There are about twenty different kinds of timber included.

The handbook describes long leaf yellow pine as follows, this being a fair sample of the treatment given each of the more important woods:

"Long Leaf Yellow Pine is a very good, strong, heavy, coarse grain and serviceable wood of compact structure and more or less resinous. The sap-wood is yellowish white, the heart-wood an orange brown. It seasons rapidly, without much injury, works well and is never too hard to nail. It is durable, and when well seasoned is not subject to the attacks of boring insects. The heavier the wood the darker, stronger and harder it is. This wood is recommended to be used for all important structures where durability and strength are essential, such as: Girders, joists, trusses, purlins, stringers, struts, columns, rafters, piles, dock timbers, planks, bridge work, trestles, etc.

"The standard grade is suitable for rough construction purposes, where finish and looks are not essential.

"The merchantable grade is recommended for nearly all construction purposes, and is used more generally than any other grade.

"The prime grade is used in important permanent structures, where appearance as well as strength are essential.

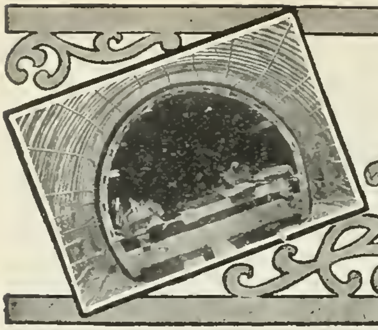
"A very useful "Manual of Standard Wood Construction," giving strengths of yellow pine and formulas for computing loads, is published by the Yellow Pine Manufacturers' Association, and can be obtained by writing to the secretary, at St. Louis, Mo.

"Long Leaf Yellow Pine Flooring is recommended for service where it is under constant wear, such as halls, runways, passageways, vestibules, corridors, etc., etc."

Sewage Disposal in Belfast, Ireland

The single-sewer system is in use in Belfast. At one time all sewers emptied directly into the River Lagan, but sedimentation tanks are now used and the purified effluent is stored in ponds until high tide, when the discharge commences. The sludge is pumped into a ferro-concrete loading tank, whence it is discharged into a steamer and carried to sea.

Experiments have been made with various systems of sewage disposal, but the city authorities are of the opinion that the method now used is the most economical for a city situated on the seashore. A refuse destructor having 12 cells, each with a capacity of 10 tons per 24 hours, has been constructed. An incinerator furnace has been added, and in this are consumed all infected articles, typhoid excreta, diseased carcasses, fish, offal and other objectionable material. Unobjectionable matter is either used to fill up hollow ground or sold for manure.



SANITATION

Garbage Reduction by the Hirsh Process

By Dr. J. M. Hirsh, Chicago, Ill.

MAYOR HARRISON, of Chicago, the City Council and the Waste Committee of the city delegated Dr. Young, Commissioner of Health; Col. Lawrence McGann, Commissioner of Streets, and Col. H. A. Allen, City Engineer, as a committee to investigate all methods of garbage disposal, including incineration, reduction and combined systems of the two. After numerous tests, carried on since last spring, they brought in a report to the Waste Commission and the City Council, containing the following conclusions:

"1. We do not believe it possible that the rendering company (using the old process) can operate their plant in an inoffensive manner, even after expending the sum of $125,000 in repairs.

"2. Your committee does not think that it would be justified in recommending the acceptance of a proposal involving the donation of free water in unlimited quantities.

"As to the Hirsh process, your committee reports that it considered:

"1. Is it possible to reduce the garbage by the Hirsh process in a sanitary and inoffensive manner?

"2. Are there any inherent or considerable mechanical difficulties involved in the erection of the necessary apparatus for applying the reduction method outlined by Dr. Hirsh?

"Your committee has carried on a number of experiments along the lines indicated, employing therefor tanks provided by the Hirsh Company and successive charges of five tons each of garbage of the average composition supplied by the city.

"As a result we feel justified in reporting that it is possible to reduce large quantities of garbage by the method suggested by the Hirsh Company in an entirely sanitary and inoffensive manner."

The experiments referred to consisted, first, in the treatment of garbage with chemicals, which, within a few minutes, destroy all odors of decayed matter or otherwise offensive odors, destroying maggots and all other animal life; not substituting one odor for another, but completely destroying all offensive odors and preserving the garbage at the same time in a fresh condition indefinitely, for immediate or future use.

Some of this garbage was kept for months without change and then, upon treatment according to the Hirsh process, was promptly converted into products many times more valuable than the products heretofore produced by other processes, namely, grease, fertilizer and bone.

The tests were made with wagonloads of two and a half tons at a time, the garbage having been left purposely in the hot sun in the closed wagon tanks for two and a half weeks before being subjected to the deodorizing process, teeming with myriads of maggots and emitting the vilest odors imaginable.

In addition numerous tests were made in the conversion of the garbage. Treating it with chemicals and steam for fifteen to thirty minutes, the garbage was mostly dissolved, 90 to 95 per cent of it, and converted into dextrin, dextrose, stearic and oleic acid of light color, into glycerin, superphosphates and some other products commanding a market price of 5 to 10 cents a pound, or $100 to $200 a ton, instead of 3½ cents a pound for grease and $5 or $6 a ton for fertiliser, which sum, after deducting expenses of production, leaves a small margin of profit.

The machinery to produce these results consists chiefly of tanks, which can be erected quickly and require no machinery in motion. Within one hour a tankful of 5 or 8 tons can be filled, treated and discharged, so that one tank can handle in an absolutely inodorous manner 50 to 80 tons in ten hours or double that amount working day and night. The tank set up for the tests of 5 tons, but which holds 8 tons, was set up with steam connections in three days. Ten or twenty tanks can be set up just as quick. This is quicker than any other system can be installed, be it dryers, incinerators or destructors or rendering tanks, which require ten hours cooking and emit offensive odors upon opening the tanks.

Dr. Young described the odor from the tanks used in the Hirsh process as that of baked apples. It can be made at will that of strawberries, raspberries, pineapple, pears, not by the addition of these odors or perfume, but by the conversion of a portion of the garbage into ethers possessing these odors. Ethers made in a similar way were used for years as artificial fruit essences in ice creams and soda water.

The garbage treated contained corncobs, shavings, excelsior, newspapers. All of it was dissolved. Several chemists from the health office and others, including aldermen and the Waste Committee, were present at these tests, took samples, which, at the city laboratories, upon analysis proved the presence of dextrin, dextrose and the other products mentioned. A lecture on this subject before the American Chemical Society by Dr. Hirsh was largely attended and brought at the instance of Prof. Heighty of the Chicago University, the president of the association, a vote of thanks to Dr. Hirsh on the part of the association for the discovery of the first and only method known of handling garbage absolutely without offense, in a sanitary manner, and creating new values from garbage unknown and unsuspected heretofore.

Stable manure and street sweepings can be treated the same way, producing similar results. The stable manure, after conversion into useful products, the same as garbage, leaves the ammonia and other products valuable as fertiliser in a concentrated form, to be used or sold, saving the freight on all the waste matter, which serves only as a vehicle for the products useful in agriculture.

New Sewage Disposal Plant in Worcester, England

From A Spcial Correspondent.

THE new plant for the bacterial treatment of the sewage of the city of Worcester, England, is now complete. The works have cost, in capital expenditure, quite $500,000; the repayment of loan and interest, covering a period of 30 years, will exceed $30,000 yearly, and the running expenses will amount to $10,000 a year, thus involving a rate of at least 10 pence in the pound.. The author of the scheme is T. Caink, the city engineer.

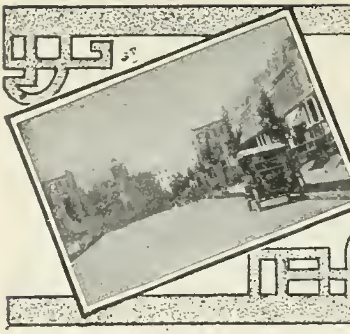
The sewage from the city proper is conveyed under the River Severn by means of a tunnel, at a point where it used to be turned into the stream. That from the suburbs on the western bank, which used to enter the river close to Worcester bridge, is now diverted thru meadows to a junction with the deep level sewer connected with the tunnel, and thus the whole of the city sewage is conveyed to the works at Bromwich-lane. After passing thru a screening chamber it goes to the detritus well, 84 feet deep, where the heavy inorganic solids fall by gravitation to the mouth of sluice lifts devised by T. Caink which bring them to the surface for disposal. It is then passed to the primary pumps, one delivering 2,000,000 gallons daily and the other 6,000,000 gallons a day, and which is used for lifting storm water when the quantity flowing along the sewers exceeds the capacity of the other pumps.

The primary pumps discharge the sewage into a series of chambers containing gravel disintegrating screens, and thence it is returned to the engine house, where it is raised by secondary pumps into the distributing tower. From the tower it is sent into a series of six rotating sprinklers, of the Candy-Caink type, and distributed over the primary bacterial filters. The latter are six in number, circular in form, 200 feet in diameter and 8 feet deep (of fine gravel). The beds are under-drained by drain pipes and tiles laid radially from the centers to effluent channels which encircle the beds near their circumference. Each filter is surrounded by a number of vertical air shafts, which communicate with the effluent channel. From the channel the air passes along the under-drain, and upwards, taking the reverse course to that followed by the liquid. The sprinklers run upon rails carried upon arched concrete tracks, and are said to be the largest successful self-propelled sprinklers in the world. After passing thru the beds the liquid is taken to a series of sand filters 3 feet deep on a layer of gravel a foot deep and is finally discharged into the effluent channel in cascades, which assist, it is believed, in oxygenating it before it flows into the river.

Sewage Disposal About Glasgow, Scotland

The single-sewer system is used in Glasgow, Scotland, and the sewage is purified by chemical precipitation; a portion is filtered. A portion of the sludge is filter-pressed; the bulk of it is sent to sea. Part of the street sweepings, garbage, and ashes is destroyed in destructors and part is sold.

In Greenock, a town of over 74,000, the household sewage and the street washings are carried off in the same sewer; the sewage is emptied into the river without previous treatment. Street sweeping, garbage, and ashes are sold as manure, tipped onto vacant land, or sent to the destructor, depending on the material.



ROADS AND PAVEMENTS

Old Asphalt Pavements

A census was recently undertaken by The Barber Asphalt Paving Company to locate as many as possible of the more-than-20-year-old asphalt streets in the United States. In some cases this was very difficult, owing to the lack of accurate city records. It proved to be even more difficult to get the cost of maintenance on these pavements, but in many cases this was obtained.

In New York City there were found 184,290 square yards of Trinidad sheet asphalt 20 years old or older. This yardage is now in existence on some fifty odd streets. The asphalt on 82d, 121st and 11d streets, laid in 1889; on 36th, 37th, 49th, 50th and 51st streets, in 1890; and on 67th, 68th and 69th streets, dating from the same year, is reported in good condition, as is also a large yardage on streets which may be classed as heavy-traffic thorofares which were constructed in 1891, 1892 and 1893. The Borough of Queens contributed about 4,000 yards to the census of more-than-20-year-old lake asphalt pavements.

Of Buffalo's sheet asphalt pavements laid more than 20 years ago, 1,200,896 square yards are still in use. This is a little more than half of the yardage laid prior to 1892. There are some 65,000 yards of Trinidad asphalt at Buffalo that is 30 years of age.

Albany, Schenectady and Troy have small yardage of sheet asphalt from 20 to 25 years of age.

Examination of the paving records of Chicago led to the discovery of sheet asphalt on 12 to 15 streets that was in fair condition after 20 years' service. Boston contributes 62,000 square yards of Trinidad sheet asphalt which has given 20 years' service or better; 9,000 yards on Beacon street laid in 1892, and therefore 22 years old, is in good condition today, the maintenance cost having been 3½ cents per yard per year.

About 200,000 square yards of more-than-20-year-old sheet asphalt is found in St. Louis. Some of this pavement (Pine street from 19th to Grand avenue and Locust from 14th to Ware) was laid in 1883 and is there 30 years old. The maintenance cost is reported as 2½ cents per yard per year for the whole period.

Cincinnati has about 106,000 square square yards of Trinidad pavement which has lasted 20 years or more.

Cleveland contributes 59,600 square yards to the list; 13,600 yards of this pavement is still in service. On Prospect street there is 7,000 yards of 23-year-old asphalt.

Columbus, Ohio, shows no less than 140,000 square yards of sheet asphalt that wore for 20 years. On East Towne street there are 12,573 square yards, laid in 1888, the maintenance cost of which per yard per year has been 1.2 cents. The same maintenance cost is reported on King avenue, laid in 1890; 9,878 yards on Ohio avenue, has shown a maintenance cost of 3.6 cents per yard per year for its life of 25 years.

Toledo and Youngstown also contribute small yardages to the Ohio list.

Indianapolis and Fort Wayne together show about 122,000 square yards of Trinided sheet asphalt that has given a service of 20 years or more.

Detroit, Michigan, has about 83,000 square yards of sheet asphalt laid from 20 to 25 years. The oldest of this pavement, Ferry and Palmer avenues, is 25 years of age; and some 48,000 yards laid from 1887 to 1891 is reported in good condition at the present time.

Going further south, Savannah, Georgia, reports 42,500 square yards of Trinidad pavement which has had a life of 17 years; Charleston, S. C., 12,152 years of 20-year-old pavement; Louisville, Ky., has an asphalt pavement on Second street that is 29 years old; and 30,000 yards on three other streets gave 26 years' service before it was replaced in 1909. In all this city has had nearly 130,000 square yards of sheet asphalt that lasted more than 20 years. New Orleans has several 30-year-old sheet asphalt pavements, on St. Charles avenue, Prytania and Polydras streets. Pavements from 22 to 27 years of age are found on Jackson avenue and Baronne street, and in other parts of the city.

Washington, D. C., has had more than 1,000,000 square yards of Trinidad asphalt laid between 1877 and 1901 which gave an average service of 23 years, at a cost for repairs per yard per year averaging 1.8 cents.

Other cities where Trinidad and Bermudez sheet asphalt has exceeded the 20-year limit of service are Philadelphia, Harrisburg, Altoona, Erie and Wilkes-Barre, Pa.; Grand Rapids, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Omaha, Neb., and several additional places that were not mentioned above.

The Tractor For Heavy Hauling

Notwithstanding the remarkable growth of the motor truck industry in the past few years, it has not yet brought a satisfactory solution of the heavy hauling problem.

The rapid introduction of all kinds of commercial motor vehicles has more or less distorted the vision of the press and public to the actual results attained and has not brought out clearly the fact that there is a strong necessity for a more efficient method of heavy hauling than the present form of motor trucks has made possible.

The costly experiments which have already been made with the motor truck of large capacity have proved that it has two serious but unavoidable defects in its design, which makes it impractical for the purpose—one the necessity of using expensive rubber tires under the entire vehicle with load, and the other the inability of cushioning the vital parts against the severe starting shocks encountered in work of this character.

Either one of these drawbacks is sufficient in itself to make heavy hauling by motor trucks a doubtful economic experiment.

The utter hopelessness of trying to solve the problems of heavy hauling by the conventional motor truck design led the Knox Automobile Co. to adopt the Knox-Martin Tractor after exhaustive tests, as they found that it not only fully overcame these two serious difficulties but also offered a great many secondary advantages which make it ideal for the purpose.

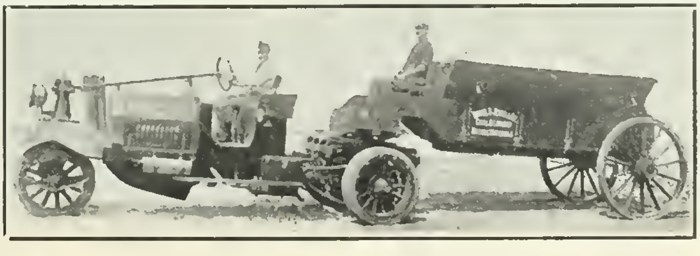
In the first place it should be noted that the motor truck carries its load as well as machinery on its back, so to speak, whereas the tractor draws its load on a body either entirely separate from the tractor itself or only partially supported on it.

In order to protect the vital parts from excessive road vibrations as well as to secure good traction, it is necessary to use rubber tires on all the wheels of a motor truck. The same condition, of course, holds true in the case of a tractor, but in the latter part the load on the rubber tires is very much less than with the motor truck and the rear portion of the load being entirely separate from the vital parts can be carried on inexpensive steel tires. This, of course, makes for big tire economy with the tractor system.

As regards the other problem of cushioning the vital parts, this is easily accomplished with the tractor as now built by us under the Martin patents thru the method of spring suspension used. The rear springs of the tractor are of the cantilever type, attaching direct to the front axle of the trailer wagon, and as they are only called upon to support the rear end of the tractor itself—a constant predetermined load—they can be made very flexible. Whenever the vehicle is started or stopped these springs give a little under the strain, thus cushioning the excessive shock which would otherwise come upon all the mechanical parts.

This severe extra strain on all the vital parts when starting heavy loads is the greatest burden which ever comes upon them and it is at such times that the expensive damage occurs, if they are not properly protected by some such device as mentioned above. On the larger types of motor trucks no relief can be obtained from the spring suspension in this regard, for the latter must be made very stiff and heavy in order to stand the great weight of the vehicle and load.

The motor truck has brought about a great improvement in transportation over the horse methods up to certain limits and the tractor is now the logical means



to carry the improvement a step higher. Its effect will be not so much to cut into the legitimate field of the motor truck as to confine the latter to its best working capacities, the tractor itself restoring the confidence and interest of businessmen in heavy hauling by motor thru the marked economies which it can effect.

The sooner the merits of the tractor system for this class of trucking are recognized and accepted, the better it will be for the industry as a whole as well as for all lines of business which require heauling facilities of large capacity.

An Automobile on Runners

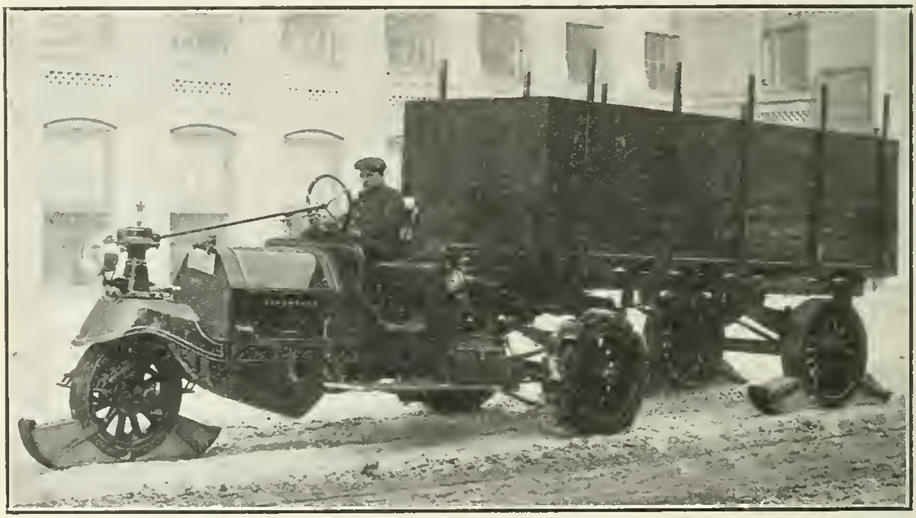
Springfield, Mass., was hard hit in the recent severe snow storms, having a total fall of nearly 30 inches. All motor vehicle transportation was practically paralyzed except on the streets kept open by the snow plows. The Knox Automobile Company, however, overcame the difficulty in an ingenious way on their tractor-trailer combination by putting runners under the trailer wheels and also under the front steering wheel of the tractor.

an object lesson in scientific and economical management and maintenance. The local officials have agreed to submit to this control and the engineers for the work have been appointed. It is intended to have the whole road in good condition for touring to the American Road Congress to be held in Atlanta, beginning November 9.

Revision of Manufacturers' Specifications for Brick Pavements

Revision of the National Paving Brick Manufacturers' Association specifications for constructing vitrified brick pavements was decided on at an enthusiastic and well attended meeting of the board of directors of the Association at New Orleans March 2 and 3. A committee appointed to conduct the revision consists of Secretary Will P. Blair, H. S. Renkert, of the Metropolitan Paving Brick Co.; W. T. Blackburn, civil engineer, Paris, Illinois; Eben Rodgers, Alton Brick Co., Alton, Illinois, and C. C. Blair, Bessemer Limestone Co.

The committee will call for suggestions



AN AUTOMOBILE *on runners which is successfully used in a northern city having much snow.*

Government Supervision of Road Maintenance

The U. S. Office of Public Roads has agreed to supervise the expenditure of the funds devoted by the state and local officials to the maintenance of the great highway from Washington to Atlanta as

with reference to the new specifications from every paving brick manufacturer in the country and from collegiate institutions, road builders and other interested persons. The new specifications will embrace the best methods of construction under all possible conditions.

The Association authorizes MUNICIPAL ENGINEERING to say that it will be pleased to receive suggestions from any interested engineers thruout the country. Suggestions may be addressed to the chairman of the committee, Will P. Blair, Cleveland, Ohio.

Creosoted Yellow Pine Block Pavements in Dallas, Tex.

Dallas, the metropolis of the Southwest, is the pioneer city of Texas in wood block paving.

Up to January 1, 1914, Dallas had 208,774 square yards of creosoted yellow pine block pavements, and there is under contract now 29,112 square yards, and the paving of Cochran street is contemplated this season, which is proof enough that the pavement is still popular.

When one considers that bitulithic pavement, with a five-year maintenance, costs the city of Dallas $2.30 per square yard; rock asphalt, $1.87; Bermudez bituminous concrete, $1.92, and three-and-one-half inch creosoted pine blocks, $3.16, and yet the people in many instances insist on wood block, can there be any doubt as to the satisfaction wood block has given the property owners of Dallas? The accompanying table may be very interesting in this connection, as it gives the date of completion of each contract; the amount laid and by whom laid; the amount of oil used per cubic foot of timber; the depth of block, and the price per square yard.

It may be interesting to note that Elm and Commerce streets are two of the three parallel main streets of the city.

PLATE II. *Elm street, Dallas, Tex. Four-inch yellow pine creosoted wood blocks, in two contracts. Completed May,* 1911.

PLATE 1. *Commerce street, Dallas, Tex. Four-inch yellow pine creosoted wood blocks, in two contracts. Completed April,* 1911.

These streets were originally paved with sheet asphalt. In laying the wood block, what was left of the old asphalt was removed and sufficient sand used to bring the foundation to a smooth surface for receiving the blocks. This sand cushion varies in depth from one-half to six inches and of course has shifted in places and caused unevenness in the surface.

There has been some buckling, due, in the main, to breaking of water mains and old service pipes under the pavement. On McKinney avenue, before the contract was completed, nineteen service pipes had broken and several thousand yards of pavement had to be relaid. The accompanying picture of McKinney avenue shows how it looks after all of this trouble, and also shows the grade, which is 5 per cent.

The other pictures show that wood block is popular not only for heavy traffic business streets, but also for residence streets. In two instances, Ross avenue and Tenth street, the wood block pavement extends to the city limits.

Notice the photograph of Stone street, the first wood block laid in Dallas and done by the city street force. This single block, between Main and Elm streets, with very heavy traffic, is today quite as

PLATE III. *McKinney avenue, Dallas, Texas. Three-and-one-half-inch yellow pine creosoted blocks on 5.05 per cent. grade. Completed March,* 1913.

smooth as a good tongue-and-groove floor. About a year ago a ditch was cut down the center of this roadway in order to lay a new pipe, and it would be impossible today for the most critical to locate where this cut was made, and the surface was replaced almost entirely with the old blocks as they were taken up.

In these various contracts the creosote oil has varied in specific gravity from 1.03 to 1.14. In the case of the very heavy oil, the bleeding has been bad and a good deal of sanding required for two summers. The present specification requires an oil of about 1.07 specific gravity, and no excessive bleeding has been noticed.

The Stone & Webster Engineering Corporation employ a very high grade method of construction in their track work. In their street railway areas they use a flat slab construction, making the concrete six inches thick under the ties, covering the entire area, which, in the case of a single track is nine feet and in double track is nineteen feet. For business streets they use a heavy grooved girder rail, and on residence streets a heavy T rail. In their more recent contracts they have been using a mortar cushion and a bituminous filler. It has been their custom for some years to use wood block exclusively for liners, placing three parallel rows of block on each side of each rail. This has proven highly satisfactory to all concerned where a bituminous pavement has been laid.

The paving blocks for the above contracts were furnished by the Southern Creosote Works, Gulfport Creosoting Co., Louisiana Creosoting Co., National Lumber & Creosoting Co., and International Creosoting & Construction Co.

On February 22, 1912, the viaduct which connects Dallas with its suburb, Oak Cliff, was opened to traffic. This, the longest reinforced concrete viaduct in the world, had been designed for a pavement of creosoted wood block, but in order to cut down the original cost it was decided by the county commissioners to substitute for wood block an asphalt macadam

PLATE IV. *Stone street, Dallas, Tex. Four-inch creosoted yellow pine blocks. Completed January,* 1909, *by the street department.*

at about one-half the price. This material, totally unfit for such heavy traffic, began to wear in six months time and within twelve months had been patched almost to the extent of a new surface. In less than another twelve months the voters of Dallas county voted a bond issue of $75,000.00 to repave the viaduct with creosoted yellow pine wood blocks, and the bonds are now with the attorney general for approval.

The city officials of Dallas should be complimented for the careful study and watchful supervision they have given the construction of their street pavements. There are very few municipal engineers in the state of Texas who have not visited Dallas for the purpose of studying its method of street construction.

PLATE V. *Tenth street, Oak Cliff, Dallas, Tex. Three-and-one-half-inch inch yellow pine creosoted wood blocks. Completed October*, 1913.

PLATE VI. *Ross avenue, Dallas, Tex. Three-inch yellow pine creosoted wood blocks. Completed February*, 1914.

Texas offered the first sample of a creosoted wood block pavement in America some twenty years ago. After these years of experience in various kinds of wood for use in pavements, and various methods of treatment, the best practice has crystallized on southern yellow pine as a little the best timber for the purpose and upon the creosoting process under the present standard specifications as the best method of preserving and waterproofing the blocks and the pavement made of them.

The cities of Texas are in close proximity to the supplies of southern yellow pine and to creosoting plants, so that it is natural that they should turn readily to a class of pavement which has demonstrated its durability and its economy in the long run.

Street	Depth of Block, in.	Treatment lbs.	Price Sq. yd.	Completed	Contractor	Yardage
Stone St., Elm to Main	4	20	$2.57	1908-09	City of Dallas	504.00
Jackson St., Opp. Telephone Exchange	4	16	3.35	10-29-09	Ockander Bros.	376.50
S. Harwood St., Jackson to Commerce	4	16	3.37	5-19-10	Texas Bitulithic Co.	1,011.98
Commerce St., Harwood to H.&T.C.R.R.	4	16	3.20	3-30-10	Ockander Bros.	8,656.60
Commerce St., Harwood to Jefferson	4	16	2.40	4-14-11	Jno. C. Underwood	21,491.10
Elm St., Ervay to Market	4	16	2.54	5-15-11	Municipal Paving Co.	15,767.40
Elm St., Ervay to H.&T.C.R.R.	4	16	3.10	5-19-11	D. J. Grigsby	10,199.80
Camp St., Anard to Lamar, 4.34% grade	4	16	3.30	5-31-11	D. J. Grigsby	4,756.61
Ross Ave., Garrett to City Limit	3	20	2.59	2-14-12	Creo. Wood Block Paving Co.	5,942.53
N. Akard St., Caruth to McKinney	4	20	3.24	4-5-12	Creo. Wood Block Paving Co.	2,819.37
Houston St., Commerce to Viaduct	4	20	3.14	7-8-12	J. A. Gregory	6,640.71
Bryan St., Pacific to Cantegral	3½	20	2.85	7-8-12	Creo. Wood Block Paving Co.	10,956.80
Grand Ave., Ervay to Exposition	3	20	2.59	7-20-12	Creo. Wood Block Paving Co.	23,376.83
Parry Ave., Exposition to Haskell	3½	20	2.95	11-8-12	Roach-Manigan Pav. Co.	4,165.96
Exposition Ave., Main to Parry	3½	20	2.95	11-15-12	Roach-Manigan Pav. Co.	15,516.59
Bryan St., Cantegral to St. Joseph	3½	20	2.85	12-2-12	Creo. Wood Block Paving Co.	12,703.20
Ross Ave. & Austin St., Lamar to Pacific	4	20	3.24	12-20-12	Creo. Wood Block Paving Co.	1,584.28
Cochran St., McKinney to Griffin	3½	20	2.85	1-8-13	Creo. Wood Block Paving Co.	2,957.38
McKinney Ave., Harwood to Cochran	3½	20	2.85	3-7-13	Creo. Wood Block Paving Co.	5,996.38
McKinney Ave., Harwood to Haskell	3½	20	....	7-—13	Stone & Webster Engrg. Co.	3,000.00
McKinney Ave., Routh to Haskell	3½	20	3.08	7-14-13	Roach-Manigan Pav. Co.	19,309.00
Lancaster Ave., Viaduct to 10th 4% grade	3½	20	3.03	9-12-13	Creo. Wood Block Paving Co.	15,224.00
Pacific Ave., Bryan St. intersection	3½	20	3.03	9-29-13	Creo. Wood Block Paving Co.	816.25
Preston St., Main to Commerce	4	20	3.24	3-7-13	Creo. Wood Block Paving Co.	569.00
Tenth St., Lancaster to Bishop	3½	20	3.03	10-29-13	Creo. Wood Block Paving Co.	14,630.60
Young, Wood, Tenth St.	3½	18	3.18	Under con.	Texas Bitulithic Co.	22,212.09
Griffin St.	4	18	3.42	Under con.	Texas Bitulithic Co.	700.00
Lamar, Laws, Cochran St.	4	18	3.43	Under con.	Creo. Wood Block Paving Co.	5,952.34

MISCELLANEOUS

Electrolysis in Springfield, Ohio

One of the most careful studies of electrolysis conditions that has been made has recently been completed in Springfield, O., and reported upon by thirteen representatives of various interests, including three experts from the National Bureau of Standards and one representative from each of the artificial and natural gas companies, the local and long distance telephone companies, the street railway company and three interurban railway companies. We are indebted to Samuel S. Wyer, of Columbus, O., consulting engineer, representative of the natural gas companies, for a copy of the report, made to Charles E. Ashburner, city manager of Springfield.

Besides setting forth the existing electrolysis conditions, this report includes specific recommendations, made unanimously by the parties affected, embodying the procedure which is believed to be for the best interests of all concerned. The data include: (1) a complete set of overall potential measurements in the electric railway tracks in the city; (2) an extended set of potential gradient measurements in the tracks thruout the city; (3) measurements of potential differences between rails and water pipes, gas pipes, and lead sheathed cables; and (4) measurements of current flow in water and gas pipes and cables. The points where measurements were taken were, in general, selected with a view to including the worst conditions.

The potential differences on the tracks of the Springfield Railway and Ohio Electric Railway have been greatly reduced by the installation of insulated return feeders supplemented by track bonding. The potential differences in the tracks of the three other electric railways, which are interurban lines, have also been materially reduced within the limits of the city of Springfield by rebonding the tracks. The present voltage conditions existing in the tracks in Springfield, as shown by the electrical survey just completed (with some exceptions specifically noted in the report, where the track repair work is not completed) are almost as good as the corresponding conditions prevailing in cities in Great Britain and other European countries where experience has shown that there is substantial freedom from injury by electrolysis of underground structures.

From the results obtained in Springfield, and also from similar work which has been done in a number of other American cities, as well as from extended experience in Europe, particularly in Great Britain and Germany, the members of the committee are convinced that the insulated return feeder system, combined with proper maintenance of track bonding, is the best means of dealing with the electrolysis problem in all cases where it is not practicable to insulate the tracks from ground, since it attacks the source of the trouble and affords an economical means of removing in a large degree the conditions which give rise to electrolysis damage and other dangers arising from stray electric currents. It is of interest to note that the opponents of the insulated return feeder system are in no case so far reported those who have had actual experience in its construction or operation. All electric railway engineers known to have built or operated electric railways on this principle are strongly in favor of it.

In particular the parties to the report express their conviction that the insulated return feeder system is much superior to the plan of pipe drainage which was previously proposed for Springfield.

It should be explained that neither the insulated return feeder system, nor, indeed, any known method of dealing with the electrolysis problem other than the complete insulation of the railway circuits from earth, can entirely eliminate electrolytic effects; but the insulated return feeder system as now installed in Springfield, in combination with effective track maintenance, particularly as to bonding of rail joints, will substantially prevent injury by electrolysis to water and gas pipes. If in future any appreciable amount of trouble should develop in certain localities, such residual trouble can most effectively and economically be taken care of by extension of the insulated feeder system or by the insertion of suitably located insulating joints in the pipes, or by both, as conditions may require.

Fortunately it is not necessary to extend the insulated return feeder system so as to eliminate the last trace of stray currents in order to bring about safety to the public and a reasonable degree of immunity from damage to underground pipes. Instead of carrying the feeder system to this extreme, the greatest economy will be realized, all things considered, by supplementing the insulated return feeder system by a certain proportion of insulating joints in water pipes and gas pipes, as such pipes are laid in the future, and in some cases it may be found advantageous to insert insulating joints in existing pipes.

As to lead cable sheaths, these are very much more susceptible to injury by electrolysis than iron pipes. It would be theoretically possible, but is not commercially practicable, to extend the insulated return feeder system so that even the lead cables would be safeguarded against electrolytic action.

It is, therefore, cheaper to apply, as may be necessary, a limited amount of drainage protection to the cables, which, being continuous conductors, can be protected in this way. By this plan a very large expense in the construction of the railway distribution system is avoided.

In order to provide convenient means whereby the voltage drop in the rails can be measured regularly and any change in conditions made known, it is desirable that pilot wires should be installed and maintained, extending from suitable central points in the city, convenient for making observations, to properly chosen points on the rails, and that suitable instruments be provided for making such voltage measurements. Such points are specifically designated in the report.

In constructing this insulated return feeder system the Ohio Electric Railway Company has installed 20,100 pounds of return feeder copper, and the Springfield Railway Company has installed 63,400 pounds of return feeder copper.

The report is understood to be a preliminary statement of the results thus far obtained in the investigation of electrolysis conditions in Springfield. In order to secure the full benefit from an insulated return feeder system two requirements must be met: First, the entire track network of all the electric railways in the city must be made a continuous electrical conductor of the highest practicable conductivity, which means that all rail joints and all special work must be adequately bonded and cross-bonded; second, properly proportioned insulated return feeders must be provided, radiating from the power supply stations to suitable points in the track network. Up to the present time the former of these two requirements has not been fully met, and several sections of track remain in which the rail bonds are defective. It is understood that the work of repairing these bonds will be pushed forward to completion as rapidly as practicable. However, the results obtained during the investigation show such a marked improvement over former conditions that the correctness of the method employed is established beyond doubt, and it therefore seems desirable to report what has thus far been accomplished.

The unanimous recommendations of the committee are as follows:

1. The insulated return feeders now installed on the lines of the Springfield Railway Company and the Ohio Electric Railway Company should be made permanent, subject to such extensions as future experience, growth of traffic, or other changes of conditions may require.

2. Because of the light loads on the lines of the Springfield & Xenia Traction Company, the Springfield, Troy & Piqua Traction Company, and the Springfield & Washington Traction Company, and because the power houses of these railways are outside the city limits, no insulated negative feeders are necessary on these lins at present, provided adequate track bonds and cross bonds are installed and maintained on the tracks of these lines, altho such feeders may become necessary in the future.

3. All electric railway tracks within the city limits should be so constructed and maintained that every joint in each rail has a resistance which does not exceed the resistance of eight feet of rail.

4. Arrangements should be made whereby all electric railway tracks within the city limits shall be inspected at least once each year and a report of such inspection filed with the City Manager.

5. No metallic connections between the water or gas pipes and the railway return circuit should be permitted.

Prizes for Highway Study

To encourage investigation of methods and materials for road and street construction, and to interest engineering students in highway problems, the Barber Asphalt Paving Company has offered prizes of $100 for the best paper written by a member of the graduating classes of the leading engineering schools.

The title suggested is "Asphaltic Materials for Highway Construction." The paper and its conclusions may be based upon service tests and the lessons of experience; the physical qualities or chemistry of asphalt; or it may combine any two of these lines of investigation. The length of the paper is limited to 3,000 words, and all manuscripts must be received not later than June 1, 1914.

The purpose of this prize offer is to turn the attention of engineering students to street and road construction as a field of work in which there is great need and great opportunity for trained men.

Commission Government for Buffalo, N. Y.

The New York State Senate has passed over the veto of Mayor Fuhrmann, of Buffalo, the bill providing for the submission to the people of Buffalo at the next general election the question of the adoption of the commission form of government.

Technical Associations

At the April 9 meeting of the Brooklyn Engineers' Club, J. S. Langthorn speaks upon "Explosives on the Catskill Aqueduct." Informal Thursday night talks will be given on April 23 by P. J. Eder on "Columbia and Its Possibilities," on April 30 by F. B. Erwin on "Financing of New Enterprises," and on May 7 by G. W. Tillson on "European Pavements."

The American Road Builders' Association will hold its next congress and exposition in Chicago, December 14-17, 1914, at the new International amphitheater, Halstead and 42nd streets.

The National Fire Protection Association will meet in Chicago May 5-7. A visit to the N. F. P. A. laboratories is scheduled for the second day.

The Technical League of Engineers and the American Society of Engineer Draftsmen have been consolidated into the Technical League of America, with offices at 74 Cortlandt street, New York, with Walter M. Smyth as general secretary.

At the New England Water Works Association meeting, April 15, in Boston, an exhibition will be given of gate operation by an attachment to an automobile. A study of cast iron bell and spigot water pipe joints by the Boston public works department will be reported upon by Clarence Goldsmith.

The first Canadian and International Good Roads Congress will be held in Montreal May 18-23, under the auspices of the Canadian Highway Association and the Canadian Automobile Federation. George A. McNamee, 909 New Birks building, Montreal, is general secretary.

The American Road Congress held by the American Highway and Automobile Associations will be held in Atlanta, Ga., November 9-12, 1914.

The thirty-fourth annual convention of the American Water Works Association will be held in Philadelphia, May 11-15, 1914. J. M. Diven, secretary, 47 State street, Troy, N. Y.

A Better Industrial Relations Exhibit will be held April 18-25 at 2 West Sixty-fourth street, New York City. It will show the devices in modern business which tend to make more harmonious the relations between employer and employe, and to better the conditions of employment. The business men's group of the Society for Ethical Culture has charge of the exhibit, which will appeal to both employer and employe in the manufacturing trades. There will be special evening lectures by industrial leaders of the country. No admission will be charged.

Technical Schools

The summer session of the University of Michigan offers a number of courses in the departments of engineering and architecture as well as the other departments, bulletin and complete announcement of which can be obtained of T. E. Rankin, secretary, Box 7, Ann Arbor, Mich.

The School of Commerce, Accounts and Finance of New York University issues a preliminary circular of work for 1914 and 1915, both day and evening sessions, which can be obtained at the University building, Washington Square, East, New York.

The statement that graduates of engineering schools do not follow the engineering profession is shown to be erroneous in the case at least of the College of Engineering of the University of Illinois. Data recently collected by the college show that of the 2,165 graduates, 1,933 or 89 per cent. are engaged in one way or another in engineering work, and that only 173 or about 8 per cent. have gone into other fields.

An engineering experiment station has been created by the board of regents of the University of Wisconsin. This organization will be established in the College of Engineering and will have general charge of the testing and research work of the college. The staff of the station will consist of the dean as director, and the members of the instructional staff in the various departments of the College of Engineering, with fellows, scholars and assistants who may be engaged in experimental and research work.

National Old Trails Road Association Meeting

The next meeting of the National Old Trails Road Association, which is promoting the improvement of the national road and its connections east and west from New York to Los Angeles and San Francisco, will be held in Indianapolis, Ind., May 6, 7 and 8, 1914. Judge J. M. Lowe, of Kansas City, is president of the association. The local arrangements for the convention are in the hands of the Indiana Good Roads Association, which will hold its annual meeting on the last day of the convention.

Good Roads Organization for Indiana

The Indiana Good Roads Association has heretofore been a convention-holding organization which has also done considerable work in developing sentiment in favor of good roads. The time seems to have come for the crystalization of the desire for improvement in the roads of the state, and the association sees that this can be done best by means of local organizations. It has therefore engaged G. E. Minor, who has recently been doing similar work for the National Old Trails Road Association, to visit the cities and towns of the state and form these local organizations. The Indiana Good Roads Association will serve as the central clearing house of information to keep the local associations supplied with speakers, lantern slides, literature, etc. Mr. Minor is an energetic enthusiast on the subject of good roads and skilled in imparting his enthusiasm to others.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual place as follows:

April 22-23: Heating and ventilatiug engineer and draftsman in supervising architect's office at $1,200 a year.

May 6-7: Computer and estimator in supervising architect's office at $1,600 a year.

May 6: Examiner of surveys in Forest Service at $1,200 to $1,500 a year; junior civil engineer in Interstate Commerce Commission valuation of railways at $1,200 to $1,500 a year.

May 11: Mine statistician at $1,800 to $2,400 a year; mining engineer at $2,400 to $4,000 a year, in Bureau of Mines.

Personal Notes

George A. Tabor, consulting professor of water supply and sewage disposal in the Polytechnic Institute of Brooklyn, and for over twelve years in responsible positions on the water supply of New York in various boroughs, has become a member of the engineering staff of Nicholas S. Hill, Jr., consulting engineer, 100 William street, New York.

Frank Koester, city planner and consulting engineer, Hudson Terminal building, New York, is the author of a volume on "Modern City Planning and Maintenance," which is just published by McBride, Nast & Co., of New York.

E. M. Harvey, formerly assistant construction superintendent for the Sanitary District of Chicago, has accepted a position with the Curtis-Ward Company, general contractors, 28 E. Jackson street, Chicago, as construction superintendent at Greeneville, Tenn., in charge of a large road construction job for this company, and will be located there for the better portion of the coming year.

King G. Kellogg, chief engineer of the E. E. Brownell Engineering Company for four years, will devote his entire time to consulting work, specializing in matters pertaining to the elestrolytic corrosion of underground metallic structures from stray electrical currents.

Hering & Gregory, consulting engineers of New York City, have been retained by H. M. Waite, city manager of Dayton, O., to make a sanitary survey of the city and to investigate and report on the best method of collecting and disposing of the refuse; they have also been retained by the Board of City Commissioners of Trenton, N. J., to prepare plans and specifications for the sewage pumping station to be built in connection with the sewage disposal works, capacity, 25,000,000 gallons daily.

Publications Received

The International Institute of Agriculture, Rome, Italy, has issued two pamphlets on the merits of the landschaft system of co-operative rural credit.

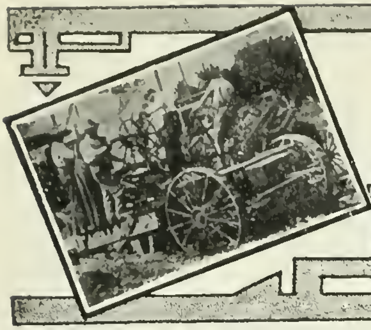
The Standard Corporation, Penna building, Philadelphia, Pa., now issues cross-ruled sheets on which to keep manuscript notes to be filed with their Lefax index sheets.

Conservation of Water: Addresses delivered in the Chester S. Lyman lecture series, 1912, before the senior class of the Sheffield Scientific School, Yale University. By Walter McCulloh, C. E. Cloth, 100 pp., $2.15 postpaid. Yale University Press, New Haven, Conn.

Sixth Annual Report of the Public Service Commission, second district of New York, for 1912. Cloth, 2 vols., 1020 and 412 pp. Frank W. Stevens, chairman, Albany, N. Y.

Diagram Giving Stresses in Beams. By H. R. Thayer, assistant professor of structural design, Carnegie Institute of Technology, Pittsburg, Pa. Paper, 25 cents. D. Van Nostrand Co., 25 Park Place, New York City.

Annual Report of the Bureau of Water, of Pittsburg, Pa., for 1912. Paper, 176 pp. Charles A. Finley, superintendent.



MACHINERY AND SUPPLIES

Large Road Contract in Greene County, Tennessee

The Greene county pike commissioners, Dr. J. D. Campbell, chairman, and R. O. Gallaher, chief engineer, of Greenville, Tenn., awarded a contract recently for the construction of 130 miles of graded roads, amounting to about $150,000, in Greene county, to the Curtis-Ward Company, general contractors, Chicago, Ill. This work is to be started April 15, 1914, and it is planned to complete same within one year.

The Curtis-Ward Company are not only general contractors, but are in the bond business as well, and have purchased $200,000 worth of Greene county road bonds, paying par and accrued interest, plus a considerable premium.

The Curtis-Ward Company are contractors of ability, and in highway construction work are using the most modern methods of doing work and are constructing very high class roads. This is the first contract this company has taken in the southeast, their efforts having been confined heretofore to the north and middle west. Realizing the amount of road construction to be done thru the south, they have entered into this field.

It Is Now the Pittsburg-Des Moines Steel Company

On February 1 the Des Moines Bridge and Iron Company, of Pittsburg, Pa., and Des Moines, Iowa, adopted the name of Pittsburg-Des Moines Steel Company. There has been no change in the management of the company. The change has come as a natural result of the growing business of the firm which has made necessary a name that more properly describes its natural scope.

The company has built a large share of the elevated steel water tanks which have been constructed thruout the United States and Canada during the last fifteen years. Because of the wide territory covered the old name was found to be a serious inconvenience, since it frequently created an erroneous impression that the home of the company was in the west. Seven years ago a plant was built in Pittsburg, Pa., to obtain the full advantages of prompt deliveries of materials and minimum freight charges. Since that time this eastern plant has been enlarged and thoroly equipped with all modern machinery until it has a greater capacity for steel water towers than any other plant in the country.

The general offices of the company were also moved to Pittsburg and the firm is now situated most advantageously for handling business in any part of the United States or Canada. Contracting offices have been maintained in Pittsburg, Des Moines, Iowa; Dallas, Texas; Charlotte, N. C., and San Francisco, Cal., for some time, and on January 1, 1914, a new office was opened at 50 Church street, New York City. J. E. O'Leary, who has represented the Des Moines company in the eastern coast territory for a number of years, is in charge of the New York City office. All business in the coast states north of Virginia and in eastern Canada will be handled thru the New York office.

Aztec Liquid Asphalt for Oiling Roads

Aztec liquid asphalt comes from the famous petroleum fields in the state of Vera Cruz, Mexico. It is a pure maltha, liquid asphalt or fluid bitumen.

When used for oiling roads the lighter or volatile constituent causes the asphalt to penetrate well into the surface of the roadway. Upon evaporation of this volatile element, the asphalt remaining forms a strong binder and firmly holds the mineral particles of the roadway together, making a hard, plastic and durable surface.

Practice has shown that paraffine oils or semiasphaltic petroleum containing a high percentage of paraffine are of no benefit to a roadway. The temporary result of having the dust laid by such oils is of no value to the wearing qualities.

Applied to a macadam roadway Aztec asphalt will make a compact and lasting surface. It is furnished in two grades—"A" for cold application and "B" to be applied hot.

In applying grade "A," the surface of the macadam roadway should be carefully swept with stiff, hard brooms, removing all surface dirt as well as the stone or sand filling. On this rough, clean, dry surface the asphalt should be applied cold to the extent of about one-third of a gallon to a square yard. After the liquid has been applied, a covering of dustless screenings or coarse sand should be spread upon the roadway.

On roads of very light traffic, the liquid asphalt can be applied in diminished quantities, in which case it would not be necessary to use the stone screenings or sand. When applied without the covering of stone screenings or sand, the quantity of liquid asphalt applied should be at the rate of about one-eighth of a gallon to one-fifth of a gallon to the square yard.

Grade "B" should be applied when heated to a temperature of about 250 degrees F.

As in the case of the cold application, the surface of the macadam roadway should be carefully swept to remove all dirt as well as the stone or sand filling. On this rough, clean, dry surface a coating of Aztec liquid asphalt "B" is spread, using about one-fifth to one-third of a gallon per square yard. It should be applied by hand sprinkling pots or spread on by specially devised pressure sprinklers. It should then be covered with a layer of three-fourths-inch stone or dustless screenings and thoroly rolled.

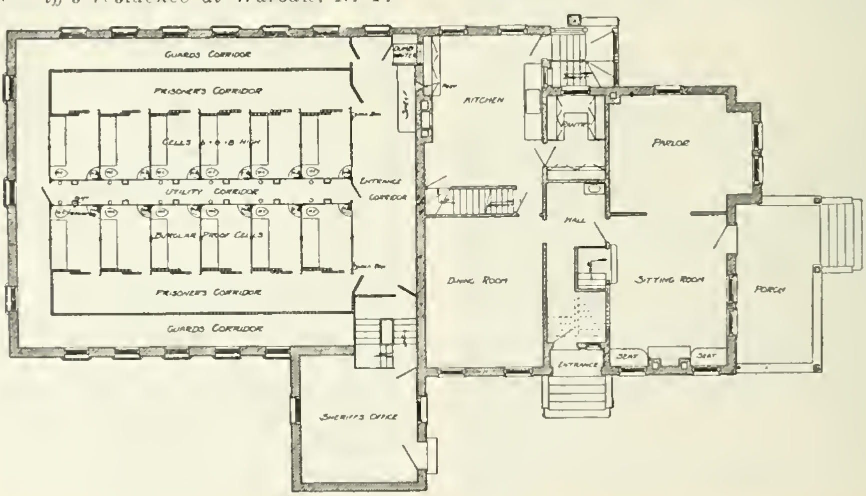
WYOMING COUNTY JAIL *and sheriff's residence at Warsaw, N. Y.*

Construction of Jails

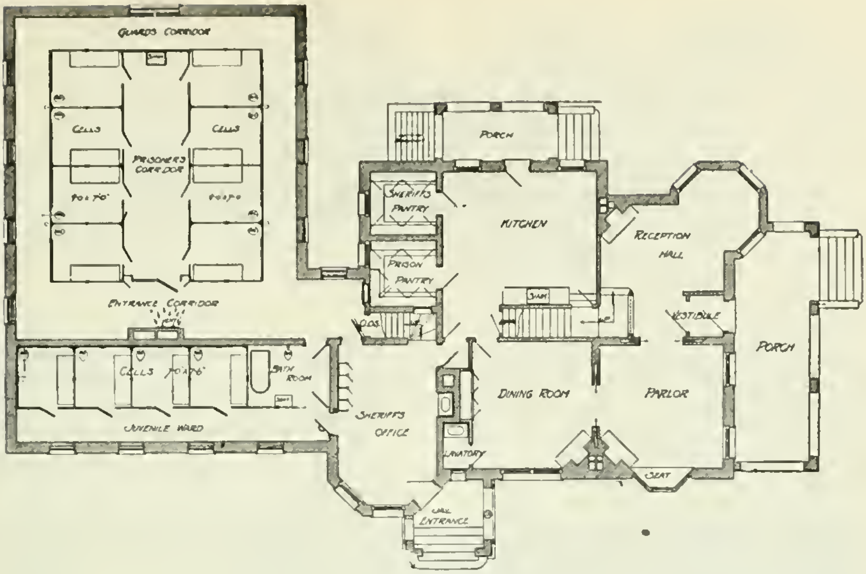
The dimensions of the Wyoming county jail and sheriff's residence at Warsaw, N. Y., are about one hundred feet in length by fifty-seven feet in width over all. The structure is built of brick, with stone foundation, caps, sills, coping, etc., the entire structure being covered with black slate. The basement of the sheriff's residence contains furnace and coal rooms, laundry and store rooms and prisoners' separate laundry, which are well guarded from escape by steel window guards and doors.

The first floor contains parlor, reception and sitting-room, large kitchen and dining-room with entrance at kitchen and dining-room hall. Convenience for feeding prisoners is provided for by a steel food slide placed in the wall between the kitchen and prison proper, a dumb waiter for carrying the food to the second story of the prison department being provided for and placed in connection with the food slide from the kitchen. Six sleeping rooms are provided for on the two floors above. The sheriff's office being located at the entrance of the cell department, controls the only entrance to this department.

In the prison proper on the first floor there are twelve large and commodious steel cells placed back to back, forming two rows, each row being provided with a prisoner's exercise corridor, with a guard's corridor on the outside. Five of these cells are made of the "Van Dorn" white diamond burglar-proof steel. The remaining cells on this floor, as well as those on the second floor, are of high-grade Bessemer steel, the second floor being reached by means of iron stairs. On the second floor are provided a hospital ward, ward for female prisoners, boys'



First Floor Plan



First Floor Plan

JAIL *and sheriff's residence at Bedford, Pa. Fireproof prison department. Note toilet facilities in each cell and baths.*

and juvenile departments, all of which have been fully equipped with shower and tub baths, closets and wash bowls complete.

A large and commodious work room has also been carefully arranged for on the second floor. The sanitary arrangements thruout are modern and up-to-date, the prison department being fireproof, no fear of roasting prisoners alive by reason of the prison proper catching fire need be entertained.

A safe method of locking and unlocking the cell doors on the first floor is installed, being the latest and most modern device in use. By a simple motion of a small lever all doors are unlocked, and by a reverse motion of the same lever all doors are instantly locked. Any door may be locked or unlocked separately and independently of the lever locking system by a key, without disturbing the lever system; at the same time any number or all of the doors may be locked with a dead lock. The doors are sliding in operation and move very easily and quietly on pin-bearing rollers.

The white diamond steel above mentioned is manufactured by a special process, the patents on which are owned by the Van Dorn Iron Works Company of Cleveland, Ohio, which concern was awarded the contract for designing and building the Wyoming county institution as described.

The designing and building of the jail and sheriff's residence at Bedford, Pa., was also awarded the above concern. They may be briefly described as follows:

The principal idea of the Bedford plan was to get in addition to the first essentials, viz., security, convenience, sanitation, etc., light into the jail department from four sides and at the same time isolate in a degree the jail from the residence, which feature was nicely accomplished as will be observed from accompanying illustration. The structure was built of brick with stone trimmings, sills, caps, etc. Cellar is provided under entire residence end with all the apartments necessary for the abode of the sheriff and his family. A prison pantry is provided for separate and distinct from the residence pantry. All prison departments are fireproof. Sheriff's office is conveniently located in connection with all departments. The main prison contains sixteen steel cells, divided into two tiers, eight cells in each, which are entirely departed by floor between, extending from wall to wall. The juvenile ward contains four cells on first floor, with same number above on second floor for female prisoners. All departments have bath rooms as shown. All cells are equipped with bunks, water closets, drinking and bath water, vent system, etc. A secure and well-lighted hospital ward is provided for on the second floor. All appointments are the most modern and complete in every respect.

The Operation of the Kindling Street Washing Machine

The operation of the Kindling street washing machine is very simple. The tank feeds four sprinklers, between the front and rear wheels, all operated with valves by the driver on his seat. One or more of these sprinklers can be used at the same time, according to the amount of water required to remove the accumulation on the pavement, or the water supply can be shut off entirely where the pavement is already wet enough, as after a heavy rain.

Geared to the left hind wheel is the cleaning roller, or squeegee. This is a heavy steel cylinder, with twenty-four rubber fins, each 7 feet long, 5¼ inches wide, and 5/16 of an inch thick. As the cylinder revolves, the rubbers remove all mud, dust and slime from the pavement.

To the right of the driver's seat is a large lever, by which the cleaning roller can be raised or lowered. Should the roller be too high, set the counterweight back a few inches; if too low, set it forward. On the counterweight are two iron plates which can be removed as required. The rubber blades should merely touch the pavement and should not be bent very much; the latter position not only causes the rubber to break and wear faster, but has a tendency to smear the accumulation instead of removing it. The rubber blades should rest lightly on the pavement, just as a paint brush is used.

The two levers for the center sprinklers are on the right side of the driver, and the side sprinklers are operated by the foot levers, one on the right, the other on the left.

The left foot lever should only be used when the machine makes the first trip in the middle of the street, to soften the accumulations; after this it should not be used again, so that the pavement when already clean is not wet again.

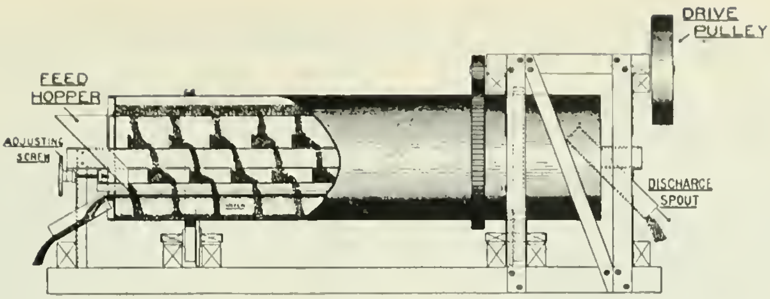
Care should be taken that the perforated pipes are kept clean. Should they become clogged up, remove the caps on the end of the pipes by means of the wrench in the tool box, let the water rush thru and the dirt will be flushed out. This should be done daily to assure sufficient water to clean the pavement.

Smith Hot Mixer in Annapolis

The accompanying photograph shows a Smith hot mixer which has been making some records in Annapolis, Md., having mixed bituminous paving concrete for over 7.750 square yards of pavement during the last season.

Dull's Improved Tubular Washer for Sand and Gravel

Preparation of concrete materials on the job often offers such opportunities for greater convenience and important economies as to justify the constructor or contractor in having a thoroly practical and effective washer as a part of his equipment. Wherever the sand and gravel user has available a supply of bank materials suited to his work, the use of a washer of proper size and capacity for his requirements will place him in a position of complete independence, giving him the best obtainable materials without necessity for purchasing from distant sand and gravel washeries. He thus saves shipping costs, unloading expense and the producer's profit, besides avoid-



ing losses and annoyance due to irregularities in receipts of carloads of purchased materials. The owner of a good washer can suit his supply of materials exactly to his needs, preparing them just as carefully as he pleases and having the entire work directly under his control.

On concrete construction work, the local washer is particularly valuable and is easily operated as a part of the equipment for preparing and handling the materials.

For small consumers of sand and gravel it is equally advantageous, also for block manufacturers, sidewalk and paving layers, building constructors, concrete road contractors, etc.

Sand and gravel producers whose bank materials are unusually difficult to wash, find the tubular washer a great help as a preliminary scrubber. For work of this character the washer is built in large sizes, for correspondingly large capacities.

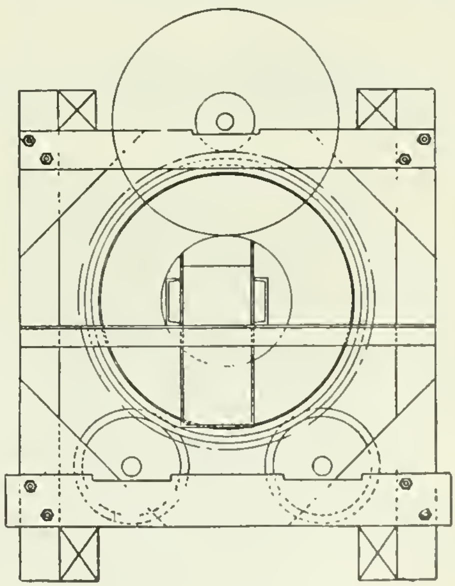
The operative principle in the Dull improved tubular washer is that of tumbling the materials about in a bath of water, as they progress thru the length of the cylinder. By repeated lifting and dropping onto intermediate shelves and into the water the lumps of materials are broken up, all sticking foreign matter is scoured off and the pebbles and sand are delivered clean and bright at the discharge end. Lengthwise of the inside of the cylinder are lifting blades set in angular position. As the cylinder rotates, these blades carry up materials and water, discharging them onto a double series of stationary angle-shaped shelves.

The shelves retain certain quantities of the materials, to assist the scouring action on the falling materials. The presence of the retained materials also acts to prevent wear of the shelves themselves.

To make clear the action, the fall of material from the lifting plates direct to the lower shelves is not shown. The material striking the higher shelves, falls next to the lower ones and thence drops into the water below.

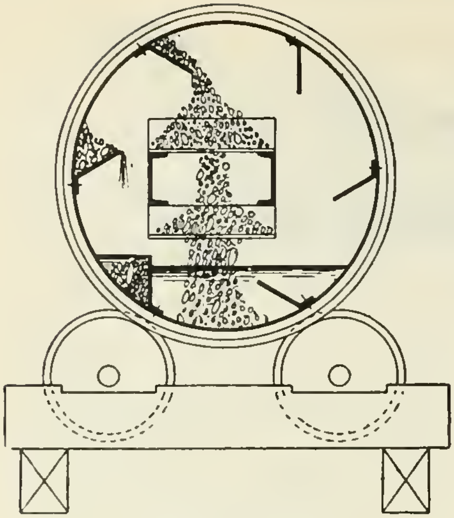
The quantity of water raised with the materials by the lifting blades can be increased or decreased by varying the speed of rotation of the cylinder.

The materials progress thru the length of the cylinder by the forward movement caused by the arrangement of the shelves. Regulation of the rate of forward progress—and therefore the time required for passage thru—is effected by movement of the lower series of shelves. These are movable lengthwise of the cylinder, by means of the adjusting screw shown in the drawing. The lower shelves may be set directly beneath the upper ones, and for this position the progress of the materials is slowest. When set as far forward as will permit



END ELEVATION

them just to catch the fall from the upper shelves, the rate of progress is fastest. With this easy adjustment for the rate of progress, the washer may be made to suit exactly the peculiar requirements of any materials, or any variation in the materials.



SECTION

Difficult materials may be washed very slowly; easier materials may progress rapidly thru.

The direction of flow of the water is opposite to that of the materials, the water entering at the discharge end (on the right in the drawing) and flowing out at the feed end. In this way the washed materials as they tail out are rinsed clean by the fresh water, and the primary work of breaking up the lumps is done by the dirty water at the feed end.

By the very nature of the operative principle in this washer the quantity of water required is a positive minimum. Only so much water is necessary as will flush away the impurities at the discharge end. Continued tumbling of the materials loosens and scours off all the clinging dirt, regardless of how dirty the water may be, and final cleaning is assured by the rinsing inflow of clean water at the delivery end. No greater economy of water could be possible.

Size separation may be provided for in very simple manner by attachment of a conical screen extension at the delivery end of the washing cylinder.

For independent screening and better separation if several sizes are wanted the discharge from the washer may be passed to any suitable set of independent screens.

The wide range of application for these washers calls for their construction in several sizes. They are now built regularly in diameters from 30 to 60 inches, with lengths of 8 to 20 feet. Special proportions can be arranged to meet any peculiar conditions to which a regular size may not be suited.

The nature of the work calls for very highest grade of construction, and for this reason the Dull tubular washer is not built cheaply. It is made as economically as good design will permit, but there is no slighting of important features to cut corners off the cost.

The cylinder is made of heavy steel, encircled by steel tires which run on four flanged wheels with chilled treads. Driving gears are extra heavy and are so placed as to avoid contact with the materials. The drawing shows straight drive; angle drive may be furnished at no extra cost.

Washers are regularly furnished complete with supporting frames of wood, substantially as per drawing. If purchaser desires to construct his own supporting structure, drawings for the same will be furnished and the washer shipped without the frame.

The guarantee of good service lies in the high reputation of the Raymond W. Dull Company, of Chicago, in design, construction and equipment of plants of highest efficiency for sand and gravel washing; the reputation of its expert engineers in analysis of conditions and application of correct methods for treatment; its extensive mechanical tests of all devices before placing them on the market; its twenty years of practical engineering and manufacturing experience; its record of success in the numerous plants that have been built.

Improved Measuring Tapes

Measuring tape cases in use are of various construction but in a general way it is true that until now the superior features of a steel case liner for leather cases and a push-button opener for winding handles have been embodied only in the very highest priced steel measuring tapes.

The Lufkin Rule Company (factories at Saginaw, Michigan), announce that they have now added these improvements to their general line of steel tapes and without advance in price.

"Challenge" and "Challenge Junior" steel tapes now have leather cases, steel lined thruout. This gives the case extraordinary stability, also has made it possible to make it narrower than before by a full ⅛ inch, and hence neater in appearance and more compact. These cases now also have a positive action push-button opener of new design for the winding handle.

"Rival" and "Rival Junior" steel tapes have nickel plated steel cases as before, but the edge or case band is knurled to afford a good firm hand-hold. The cases of these tapes are now also equipped with a positive action winding handle opener same as the "Challenge" and "Challenge Junior" described above.

An Important Point in the Cableway Excavator System

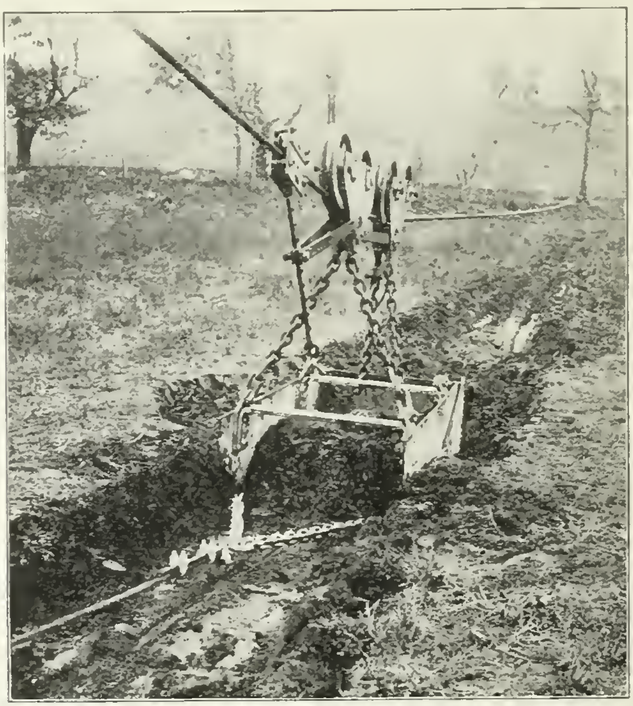
The slack line or cableway excavator having proven its economy and efficiency the time has come when we look toward further and finer improvements of the parts.

In brief, the slack line or cableway excavator system consists of a bucket and trolley carried on an overhead or track cable and a drag line or load line. The machine is operated and controlled by a double friction drum hoisting engine. One end of the track cable is securely anchored to a "dead man" or other suitable fastening and the other end is supported by a mast. The track cable can be pulled taut or slackened by means of a set of blocks and lines leading to the rear drum of the engine. The drag line leads from the bucket over a sheave on the mast to the front drum of the engine.

Of the individual features probably the most important is the bucket and in this point the Dull system merits unusual attention. The Dull excavator has as a special feature, designed by Mr. Raymond W. Dull, a rear dumping bucket—powerful but simple of operation. The main cable is permitted to slacken and the bucket runs down by gravity to the digging point. The drag line is then pulled in, causing the bucket to fill. When the bucket is filled the operator tightens the track line at the same time continuing to pull in the drag line, thus pulling the bucket along the track cable. A button is fastened on the track line over the discharge point, and the small dumping trolley which is pushed ahead of the main trolley by a rigid connecting line, hits this button and stops. The pull from the drag line keeps the bucket and trolley moving up the cableway and forces the lever hanging from the dumping trolley to swing ahead and a cable fastened to the lower end of this lever pulls open the rear gate allowing the material to slide out.

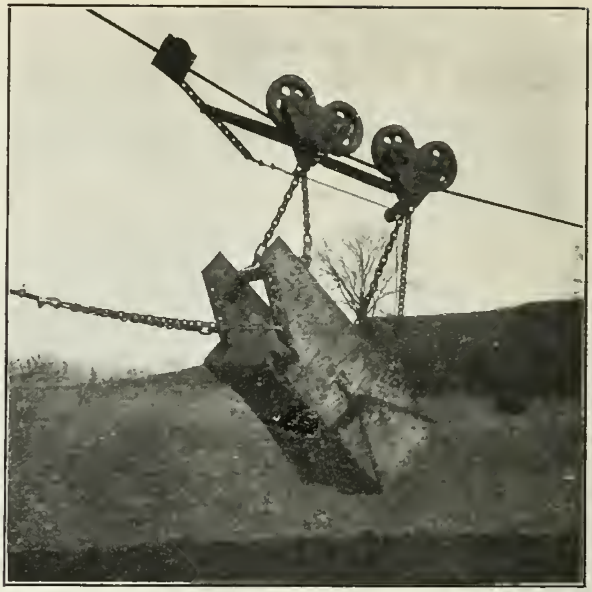
By the use of this rear gate, the amount of power consumed in dumping is reduced to a minimum. Great care has been taken in the manufacture of this bucket. The trolley wheels, of large diameter, are made with chilled grooves, bronze bushings, and provided with grease cups for proper lubrication. The digging lip is forged from steel. For severe service manganese sheaves, pins,

DULL BUCKET *taking its load. Note the pull of the drag line to the foreground to fill the bucket, which continues to pull after the track line is tightened, causing the bucket to lift and travel up the cableway.*



digging lip and teeth can be furnished at slight additional expense. The main body of the bucket is made of one sheet of steel, bent into shape. Sled runners on the bottom tilt the bucket forward so that it will "bite" into the ground and not slide along the surface. The drag line is attached to the bucket by heavy chains and shackles. Its point of application is adjustable so that the same bucket may be used for either hard or soft digging.

There are many other features of the Dull system that make it the most efficient for excavating, which will be explained on application to the Raymond W. Dull Co., Chicago, Ill.



REAR DUMPING DULL BUCKET. *Note the lever ahead and cable attached to lower end, which pulls open the gate in the rear to dump.*

Pliable Stone Roof for Modern Machine Works

A notable feature of the new South Works of the J. I. Case Threshing Machine Works, at Racine, Wis., is the roofing, which is made of asbestos and Trinidad lake asphalt, two of the most enduring mineral substances in existence. Asbestos is an indestructible, fibrous rock, the same substance which is used in the manufacture of fireproof theater curtains. For roofing purposes it is made into a felt, layers of which are cemented together with Trinidad lake asphalt, the greatest of all waterproofing substances. The combination of these two materials produces a roofing that is literally a sheet of pliable stone.

Because of its all-mineral composition this roofing can not rot, rust nor deteriorate, hence it never requires painting or any other form of coating. It is also said that this roofing is proof against the action of chemical fumes, and that sparks and burning brands have no effect on it. Hundreds of cases are on record in which it has for years withstood a continuous shower of sparks from stacks and cupolas.

The manufacturers of this roofing which is known as J-M Asbestos Roofing, claim that their product is the cheapest on the market, on the cost-per-year basis, on account of its comparatively low cost and the fact that it never needs coating.

This roofing is not affected by changes of temperature. The hottest weather cannot cause it to dry out, melt or run, and the coldest weather can not crack it. It is used on every type of building, in every climate, and is still in good condition on hundreds of buildings after 15 to 30 years of service without costing a cent for repairs. J-M Asbestos Roofing is furnished in rolls or sheets, ready to lay, or in built-up form.

An interesting booklet describing this roofing in detail will gladly be sent to anyone who writes to the H. W. Johns-Manville Co., New York.

Book for Truck Buyers

That manufacturers of trucks and accessories are uniting in their efforts to give truck buyers wanted facts about motor transportation is brought out by the publication of Vol. II, Motor Trucks of America, by the B. F. Goodrich Company, Akron, O. This book contains a buying guide compiled by the Review of Reviews which greatly simplifies the task of purchasing and ought to be of value to every truck buyer.

It appears that a motor truck can be worked at a profit in almost every class of delivery service, provided that the right type of truck is selected for the particular class of work it must do. And when trucks have not been profitable investments, it has been found due to lack

of information and consequently wrong selection.

The aim of the book seems to be to supply prospective buyers these needed data about motor transportation that will enable them to select exactly the right truck for their particular service.

This book also contains illustrations and specifications of truck manufacturers whose combined output represents about 90 per cent. of the trucks made in this country.

The publication of such a guide for truck buyers is bound to be of much value to the buyer, and will react favorably for the good of the truck industry.

Of especial interest in the volume is an article "Efficiency in Buying and Operating Motor Trucks," by W. A. McDermid, which appeared in The Review of Reviews, November, 1913. In this article Mr. McDermid emphasizes the necessity for taking the standards of the engineer as the standards for the motor truck operator and explains how to obtain the largest number of productive minutes of time per unit of machinery.

The first announcement of this book flooded the Akron office with requests from all over the country and has compelled a second volume. Prospective truck buyers would do well to write to the B. F. Goodrich Company, Akron, Ohio, who will be glad to send you a copy upon receipt of your request on your business letter head.

Service Facilities for Motor Fire Apparatus

"No class of motor vehicles demands more prompt repair service probably than fire department cars," says C. N. Perkins, Manager of the Knox Automobile Company's Fire Apparatus Department, "for if anything goes wrong on a fire car, no matter how trivial, if it affects the running of the machine, it should be fixed at once or serious fire losses might result.

"This is particularly true in the case of the smaller towns or cities, who have all their eggs in one basket, so to speak, i. e., who only own one or at the most two pieces of motor-driven apparatus.

"Fire cars are, of course, particularly liable always to damage from collision with other vehicles and the crippling of one of these machines in such a community might easily become a serious matter in case a bad fire broke out while it was out of commission.

"For this reason fire chiefs and commissioners are wisely paying more and more attention every year to the service facilities offered by the maker of the car they purchase.

"Undoubtedly many of the orders for fire cars which we have received in recent years have been given us very largely as a result of the thoro service facilities we maintain at the factory as well as at our branches and principal agencies for the express purposes of rendering prompt attention to damaged cars including fire vehicles.

"At the factory in Springfield, for instance, we have constantly ready for day or night service, a special truck fitted up with every conceivable device useful in prompt repair work or for towing cars back to the factory. This car can take care of a radius of 50 to 75 miles from the factory and render very effective work in case of trouble.

"Our Boston branch maintains two cars constantly for work of this character, taking prompt care of all the fire cars in its district. The Boston territory is ideal for this purpose as the towns and cities are close together and our service station in Cambridge is so located that all the suburban towns and cities where we have fire vehicles can be reached very quickly. The New York and Chicago branches and our agencies in Philadelphia, San Francisco, Pittsburgh and other cities, where we have sold many fire cars, maintain similar equipment and are constantly supplied with parts from the factory, so that the least possible delay is occasioned by damage to any of their customers' cars.

"The value of prompt service, particularly in the case of fire vehicles is fast being recognized as secondary in importance only to the value of the machines themselves and the effect will undoubtedly be to stimulate the sales of certain makes of cars in territories where they are able to give the proper attention which this necessity demands."

Mixing of Concrete

Creosoted Wood Block Paving Company, Dallas, Texas.

The mixing of concrete should be done as rapidly as possible and it should not be mixed in larger quantities than is required for immediate use. We have made it a point to exercise great care in the mixing of concrete and see that it is thoroly mixed and not permitted to appear raw when deposited in the forms. The materials should be mixed wet enough to produce a cement of such a consistency as will flow into the forms and about the metal reinforcing, when used, and which, on the other hand, can be conveyed from the mixer to the forms without separation of the coarse aggregate from the mortar. In other words, the consistency of the concrete should be soft and wet without being sloppy, and in general should be such

that after dumping the concrete into the forms it may be consolidated and worked into place with spades and shovels and a slight quaking secured with little or no effort. A good concrete worker can tell whether the concrete permits of easy tamping. The mixture should be moderately wet. Care, however, must be taken that the concrete is not too wet, so that the stone and sand settle under the water during its transportation to the forms, altho what is usually known as the wet mixture should be used for all reinforcement work.

For ordinary work concrete should be mixed wet, soupy. From the standpoints of quality, ease of handling and manipulation, resulting finish, and the cost of surfacing there is absolutely no question as to this point. This choice of wet concrete applies to walls, bridges, reinforced buildings, etc., but for sidewalk and pavements, economy demands a dry mixture requiring tamping in order that the workmen applying the finishing may follow as quickly as possible after the depositing of the concrete.

No concrete should be placed until it is definitely determined that the forms are correct and properly braced. It is cheaper to delay the work than to cut out work already done. Concrete should be placed as quickly as possible after mixing and not be disturbed thereafter. The placing of concrete is one point where the material is abused to the greatest extent. We take great care of a green brick wall but do not hesitate to walk over and conduct operations over concrete which has not reached its final set, thereby destroying the surface on the concrete for all time.

Various types of work naturally demand various types of machinery and arrangement but in general it may be said that too large a mixer is not economical. Use preferably nothing smaller than 4½ cubic foot mixer, which will deliver up to 50 yards of mixed concrete per day. Only use a larger mixer than this if the work will justify it. Also in general it may be stated that each batch from the mixer should be handled as a whole as nearly as possible to the place of deposit. The wheelbarrow is no longer the primary method of transportation of concrete. There is no doubt as to the majority of opinion being in favor of batch mixers but whatever type adopted, it would be well in the long run to make sure that the engine is of sufficient power to handle "real" work with ease.

We use a 4½ cubic foot per batch mixer wherever possible, having found that this size of machine is easily moved by its crew from and to different parts of the work during its construction. A number of batch mixers of this size could be more profitably employed on large work than a machine of greater capacity.

In our concrete curb and gutter work, we easily average 450 lineal feet or 30 cubic yards per day with a crew of five feeders and three wheelers. We shovel direct into the mixer, but later on will add to our mixer an automatic loader, which is now out, and increase our capacity nearly 50 per cent. The average time consumed producing each batch is 2½ minutes, most of which time is taken up with the loading. Before the adoption of machine mixing, we secured very uniform results by the hand methods but at a considerably greater cost. Our mixers are of the "Big-an-Little" type, and were furnished us by The Jaeger Machinery Company, of Columbus, Ohio.

W. O. Rutherford

The announcement that W. O. Rutherford has been made assistant general sales manager of the B. F. Goodrich Company is received with pleasure by everybody in the automobile world who knows Mr. Rutherford.

This change carries with it official recognition for the duties which have been performed by Mr. Rutherford during the past four years as assistant to Mr. H. E. Raymond, second vice president and general sales manager, and marks another step in a career which has been an unbroken record of energetic efficiency.

All Municipal Buildings, Schools, Colleges, Halls, Etc.,
may be cleaned with an outfit such as shown when using one of

PATENTED

INTERIOR VIEW

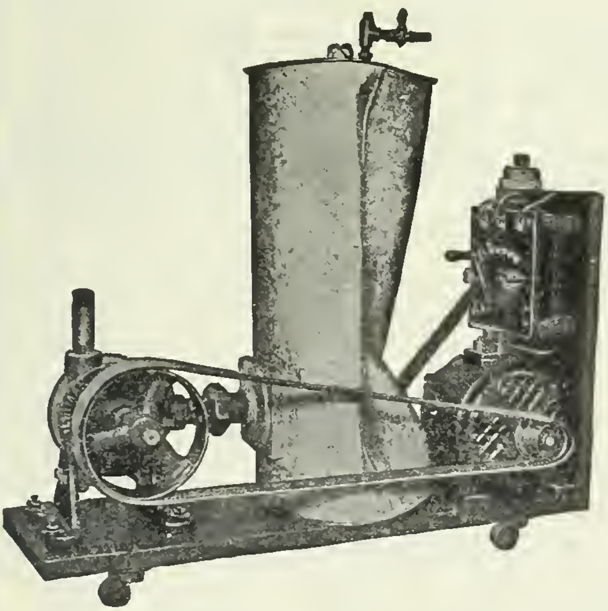
LEIMAN BROS. VACUUM PUMPS

may also be mounted on a horse drawn wagon or hand truck for

VACUUM CLEANING

also used for pressure blowing in quickly clearing land by burning over tree stumps; for many uses in the laboratory or shop; for high pressure gas service, testing pipe lines, etc.

The Illustration below shows the power of these pumps; the smallest size is shown.



LEIMAN BROS. SAND BLAST

for cleaning laboratory utensils of rust and corrosion; for renewing school blackboards, slates, etc.; for frosting window panes, lighting globes and fixtures.

Uses same sand over and over.

We also supply motor driven outfits for cutting and polishing quartz specimens and gem stones; for polishing, dust collecting, lathe outfits, drilling; also work benches and tools.

LEIMAN BROS. 62 John St. NEW YORK

The Cost of Bad Roads

A newspaper paragraph reports that the roads between Lewiston, Idaho, and Paradise, Ore., are so bad that a shipper of timothy grass seed found that he could put 3,300 pounds of the seed into packages and forward by parcel post at $1.04 a hundred pounds, or $34.32 for the whole, cheaper than he could haul it for this distance, some fifty miles, by wagon. The expense in this case is transferred to the post office department.

Another Viaduct for Birmingham, Ala.

After some months of expert study of the grade separation problems of Birmingham, Ala., which involve track elevation in part and in part viaducts, with or without track depression, an agreement has been reached for a viaduct on First avenue, extending from a point near 25th street to one near 32nd street. The total cost will be about $200,000, of which the city will pay about $41,000 in five annual payments.

Prizes for Landscape Architecture in Italy

The Compagnia Italiana dei Grandi Alberghi (Italian Large Hotels Company) has opened an international competition for projects for the construction of villa residences on a large piece of land facing the sea at the Lido, Venice.

Three prizes will be awarded, one of 12,000 francs ($2,400); one of 8,000 francs ($1,600); and one of 5,000 francs ($1,000) to the three projects considered best.

Any explanations required will be furnished by the Direzione della Compagnia Italiana dei Grandi Alberghi, Riparto Concorso Internazionale dei Villini, S. Maria del Giglio, Venice, Italy.

Trade Notes

Thomas M. Roche, formerly of the American Asphaltum and Rubber Company, has become the western sales agent for The United States Asphalt Refining Company, with headquarters in the Monadnock building, Chicago, where he will push the sale of Aztec asphalt for paving streets and roads and Aztec liquid asphalt for oiling roads.

The National Water Main Cleaning Co., of New York, has taken a contract for cleaning water mains at Selma, Ala., and is now at work on such contracts at North Baltimore, O., Columbia, S. C., and Salt Lake City, Utah.

The Epping-Carpenter Pump Company, of Pittsburg, Pa., has been awarded the contract for a ten-million-gallon horizontal cross-compound Corliss high-duty pumping engine for the city of Omaha, Neb.

The Raymond Concrete Pile Company has contracts from H. J. Heinz Company, Pittsburg, for about 1,500 concrete piles; also for foundations of approach of North Side Point bridge, Pittsburg.

On March 12, 1914, the latest and final patents were officially allowed by the U. S. Patent Office on the Harris municipal garbage incinerator and steam generator. Owing to the advanced age of Dr. Harris, he does not contemplate exploiting his invention in any of the foreign countries, except Canada. He now offers for outright sale by assignment the patents on this invention in all the foreign countries, except Canada, at the flat rate of $1,000 each, provided they are taken before June 1, 1914, at which time the U. S. patents will be ordered issued. Copies of specifications and drawings as applied for may be seen at his office in Nashville, Tenn.

The American ingot iron culvert business of the Colorado Ingot Iron Pipe and Culvert Company has been taken over by the R. Hardesty Manufacturing Company, of Denver, Col.

The Rock Island Bridge and Iron Works, Rock Island, Ill., have been awarded, by Rock Island city, a contract for elevated water tank of 500,000-gallon capacity, which will require 225 tons of steel; also by the city of Woodbine, Iowa, a contract for a complete water works system, including a 100,000-gallon capacity tank on a 50-foot steel tower; also for 1,000 tons of structural steel erected in the Black Hawk hotel building in Davenport, Iowa; four sand bins of 50 tons each for the Interstate Material Company, of Davenport, and 150 tons of structural steel for the Sacred Heart Academy, Fargo, N. D.; also for 50,000-gallon steel tank for Rock Island Brewing Company.

The Empire City Subway Company has moved its offices to 138 Spring street, New York.

The Universal Road Machinery Company, of Kingston, N. Y., has located a permanent representative in Harrisburg, Pa., in the person of James G. Anderson, formerly associated with the Bradley Contracting Company, of New York. Mr. Anderson is a practical machinery man as well as a hustling salesman and will have charge of the development of the Universal Road Machinery Company's business in Pennsylvania.

The necessity for larger space and better facilities compelled the Indianapolis (Ind.) and Louisville (Ky.) branches of the H. W. Johns-Manville Company to seek larger quarters. The new address of the Indianapolis branch is 408-410 North Capi-

tol avenue; that of the Louisville branch, 659-661 South Fourth avenue. Both of these branches will include ample warehouse accommodations, and service departments for the benefit of the customers who desire speedy adjustments, repairs or replacements.

The F. D. Cummer & Son Company, of Cleveland, Ohio, have just been awarded a contract by the city of Pittsburg for a Cummer stationary asphalt paving plant, to be erected on the North Side. The capacity is to be 2,500 yards of completed pavement per day, consisting of 2-inch top and 1-inch binder. The plant is to be of their most up-to-date design and of the double-unit type with two Cummer dryers, two 15-foot mixers, etc. They recently received the contract for the new asphalt paving plant, of semi-portable type, for the city of Cleveland.

Trade Publications

The Directory of Cement, Gypsum and Lime Manufacturers for 1914, published by the *Cement Era*, Chicago, Ill., is just out and contains its usual full information regarding cement companies, their officers, capitalization, brands and principal machinery, brought down to date. It also has a map and geographical list of cement plants, an alphabetical list of officers and sale agents, an alphabetical list of brands, a list of makers of gypsum and one of makers of lime. It can be purchased for $1.

A new catalog illustrates and describes the Shearer & Mayer dragline cableway excavator. The description and numerous photographs contained in this catalog will give the trade a good idea of this class of excavating machinery and the many uses to which the excavator can be put for the economical handling of material. The excavator is being extensively used for handling material which cannot be economically handled with ordinary boom-line or steam-shovel excavators, as with this cableway excavator it is possible to dig over areas exceeding 200 to 800 feet, and convey the material direct to spoil piles or elevate it into bins or hoppers in one operation with a double drum hoist. The machine was primarily designed for digging material over long spans from under water. The catalog is issued by Sauerman Brothers, Monadnock Block, Chicago, Ill.

The Directory of Cement, Gypsum and Lime Manufactures for 1914 is out, and contains its usual full and up-to-date information about manufacturers of these products and their official and sales forces.

"The Song of the Roads" is a handsomely illustrated setting of some verses on roads past and future, issued as a souvenir by the Universal Portland Cement Company.

The Electrical Blue Book contains the National Electrical code of rules and requirements of the National Board of Fire Underwriters, a number of pages of useful information for electrical engineers and advertisements of makers of approved materials and apparatus, and will be sent for $2 by the Electrical Review Publishing Company, Chicago, Ill.

The Hassam Paving Company, Worcester, Mass., have issued a handsome catalog describing their product.

The Pneumatic Concrete Placing Company, Chicago, Ill., of which H. A. Leeuw, 45 Broadway, New York, is the New York manager, are lessees and operators of the pneumatic mixer and conveyor owned by the Concrete Mixing and Conveying Company of Chicago, and have issued a booklet describing the principles on which are based the mixing and placing of concrete by means of compressed air, with a description of their apparatus for that purpose.

The American Mason Safety Tread Company, Lowell, Mass., have published a fully illustrated catalog of their safety treads for stairs, car-steps, cement surfaces, sidewalk-light areas, covers for sidewalk openings, etc.

The Globe-Anderson Valve Specialty Company, Pittsburgh, Pa., send circulars regarding their valves of various special sorts.

Book No. 189 of the Link-Belt Company, Chicago, Ill., is a fully illustrated catalog of the conveyors they manufacture for sand, stone, gravel and the like.

FIRE DEPARTMENT ADDITIONS.

Arizona—
Douglas: One motor combination hose and chemical wagon.

Connecticut—
Hartford: Complete motorization of fire apparatus.

Idaho—
Boise City: One combination chemical and hose wagon, one 4-wheel chassis combination wagon, one chassis for No. 1 steamer.

Louisiana—
Shreveport: Tractor.

Mississippi—
Jackson: One triple combination motor pump, chemical and hose wagon.

Montana—
Helena: Auto truck.

Ohio—
Pioneer: Chemical engine.
Steubenville: Chemical auto hose and fire truck.

Porto Rico—
San Juan: 1,000 ft. hose and new chemicals.

Utah—
Salt Lake City: Ahrens-Fox motor pumping engine.

Municipal Improvements for 1914

RECEIVED TOO LATE FOR INSERTION IN TABULATED REPORT

ROADS AND PAVING.

Alabama—
Hamilton: 3 miles draining, grading and surfacing with gravel.

California—
Long Beach: Asphalt, 131,000 sq. yds.; asphalt macadam, 40,000 sq. yds.
Sacramento: 15 miles concrete road, 5.1 miles asphaltic concrete.

Illinois—
Chicago: 750,000 sq. yds. asphalt, 250,000 sq. yds. asphalt concrete, 350,000 sq. yds. asphalt macadam, 450,000 sq. yds. brick, 60,000 sq. yds. cement concrete, 40,000 sq. yds. granite, 150,000 sq. yds. wooden block.
DesPlaines: $89,703 to be expended on concrete pavement.
Rockford: About $40,000 to be expended on brick.
Springfield: 5 miles street paving, kind not designated.

Indiana—
Indianapolis: About $90,000 to be expended for paving and widening streets and alleys.
Michigan City: Grading and filling; amount not designated.
Plymouth: Two stone roads in Marshall county.

Iowa—
Leon: 5,877 sq. yds. pavement, kind not designated.
Missouri Valley: $52,000 to be expended on brick paving.

Kentucky—
Whitesburg: 6 miles macadamized road.

Louisiana—
. Donaldsonville: 19 miles gravel roads in First road district.

Michigan—
Crystal Falls: 5 miles road construction; earth excavation, 29,200 cu. yds.; loose rock excavation, 2,100 cu. yds.
Ludington: 28,000 yds. resurfacing water bound macadam.

Minnesota—
Winona: Concrete road construction, cost about $93,000.

Missouri—
Kansas City: Macadamizing across state highway.
Moberly: 1,000 sq. yds. brick.

Ohio—
Columbus: National pike Ohio-post road, cost about $221,280; national pike, Muskingum county, $162,080.
Fostoria: 12,530 sq. yds. brick or asphalt block pavement.
Painesville: 10 miles, one course concrete, two course concrete, and brick or Warrenite on concrete foundation, Lake county.
Toledo: $60,000 to be expended on tarbound macadam roads.

Pennsylvania—
Kingston: 5,500 sq. yds. brick pavements on concrete foundation.
Sharpsville: 12,000 sq. yds. brick paving.

South Carolina—
Charleston: 60,000 to 70,000 sq. yds. creosoted wood block, sheet asphalt or asphaltic concrete pavement.

Virginia—
Fairfax: 32 miles grading, graveling and surface treatment.

Washington —
Tacoma: 4½ miles brick, Warrenite or asphalt paving.

Wisconsin—
Lake Geneva: 2,000 sq. yds. creosoted wood block paving.

Porto Rico—
San Juan: 1,000 meters asphalt concrete, 1,000 meters macadam.

SIDEWALKS.

California—
Long Beach: 60,000 lin. ft. cement.

Illinois—
Chicago: 200 miles cement, 30 miles cinder.

Mississippi—
McComb City: 5,000 lin. ft. concrete.

Missouri—
Moberly: 2 miles cement.

Porto Rico—
San Juan: 3,000 sq. metetrs cement.

CURB AND GUTTER.

California—
Long Beach: 50,400 lin. ft. concrete gutter, 82,000 lin. ft. concrete curb.

Illinois—
Chicago: 300,000 lin. ft. concrete curb, 60,000 lin. ft. concrete curb and gutter, 20,000 lin. ft. sandstone curb.

Iowa—
Leon: 3,207 lin. ft. curb and gutter.

Pennsylvania—
Kingston: 2,100 lin. ft. stone curb in concrete.

Porto Rico—
San Juan: 2,000 meters concrete curb.

SEWERS

California—
Long Beach: $350,000 to be expended.
Los Angeles: $662,000 to be expended.

Illinois —
Chicago: 20 miles brick 2-ft. to 10-ft. diameter; 50 miles vitrified pipe, 12-in. to 24-in.; 2,500 manholes; 4,500 catchbasins.

Indiana—
Greencastle: $60,000 to be expended on sewer system.

Iowa—
Osage: $96,000 to be expended on sewer system.
Sumner: 4 miles sewers.

Michigan—
Ludington: 6,000 ft. trunk sewer, either brick, concrete or segment block tile.
Otsego: 320 ft. sanitary sewer, 12 manholes.

Missouri—
Caruthersville: $40,000 to be expended on system.

North Dakota—
Park River: $20,000 to be expended on system.

Ohio—
Lowellville: $19,000 to be expended on system.
Toledo: 2 new sewer districts.

Porto Rico—
San Juan: 700 meters vitrified pipe.

SEWAGE DISPOSAL PLANTS.

Indiana—
Greencastle: $5,000 to be expended.
Kendallville: Sewage disposal plant being considered.

Maryland—
Baltimore: Imhoff tank and sludge beds at Black river disposal works.

Ohio—
Dover: Plans are being prepared for a plant.
New Philadelphia: Plans have been approved for new plant, cost $25,000.
Urbana: Sewage treatment plant.

WATER WORKS.

California—
Long Beach: $200,000 to be expended.

Illinois—
Chicago: 1,600 h. p. boiler at Lake View; 600 h. p. at Roseland intakes; 5 miles 12-ft. tunnel; 3 miles 10-ft. tunnel; 1 intake crib; 2 trenching machines.

Georgia—
Ball Ground: Being considered.

Iowa—
Coin: Being considered; bond issue $12,000.

Michigan—
Highland Park: 3,000 ft. 36-in. intake pipe, 1 submerged crib, 58,200 36-in. supply pipe, trenching, laying, back filling, etc.

Minnesota—
Sanborn: Water works system to be constructed consisting of water mains and water tanks.

Missouri—
Butler: Plans being prepared for system.

Porto Rico—
San Juan: 1 settling basin, 1 filter plant, 1 reservoir, secondary distribution.

New York—
Albion: $65,000 to be expended for extension and improvement of.

LIGHTING.

California—
Long Beach: $100,000 to be expended.

Georgia—
Ball Ground: Being considered.

Michigan—
Lapeer: Will be voted on April 6.
Wakefield: Overhead distributing system.

Montana—
Great Falls: 80 5-cluster ornamental lighting posts.

BRIDGES AND BUILDINGS.

California—
Monterey: High school building, cost $30,800.
San Francisco: Two-story brick, cost $65,000.
Santa Monica: $150,000 bonds voted for municipal auditorium.
Venice: Group of Polytechnic high school buildings, cost $140,000.

Colorado—
Boulder: Four concrete bridges.

Illinois—
Chicago: Ten-story and basement in downtown district for police department; twenty-one new police stations at total cost of $2,340,000; one swinging bridge and four bascule bridges.
Rockton; One reinforced concrete bridge.
Roscoe: One reinforced concrete bridge.

Indiana—
Anderson: Three bridges in county.
Boonville: Eleven county bridges.
Crown Point: One iron bridge with concrete abutments across Kankakee river and one deck plate girder bridge with tubular abutments across Cedar creek, in town of Lowell.
Fountaintown: School building at cost of $14,000.
Idaville: Brick school building at cost of $19,890.
Indianapolis: Buildings—two-room addition to Fisher School No. 3, $11,087; four-room school on German pike, $19,280; four-room school on site of township house, District No. 5, $19,413. Bridges—Several culverts and bridges in Marion county.
Knox: School building, cost $3,000.
Lebanon: Third ward school building, cost $23,680.
Newcastle: Fourteen bridges and arches in county.
Petersburg: One steel bridge and relocation of two steel bridges in county.
Warsaw: School building at cost of $16,000.

Iowa—
Burlington: Two school buildings.
Mason City: Two-span concrete arch bridge at cost of $12,900.

Massachusetts—
Salem: To rebuild turnpike bridge, cost $28,237.

Missouri—
Kansas City: One concrete superstructure in county.

Ohio—
Canton: Two-span 30-ft. bridge in county.
Cincinnati: One county bridge, four concrete bridges and three reinforced concrete viaducts in city.
Columbus: One county reinforced bridge over Olentangy river; alterations to court house.
Range township.
Eaton: Superstructure of bridge across Browers run.
Hamilton: 200-ft. span over Seven Mile Creek in county.
Hartford (Buffalo P. O.): Two one-story school houses.
Lorain: Superstructure of East 28th street subway.
Strasburg: Fireproof high and grade school building.
Toledo: City hall.
Zanesville: Superstructure of 40-ft. bridge, steel.

Pennsylvania—
Allentown: Three-story stone and brick fireproof court house.
Media: Improvements to court house.

South Dakota—
Gann Valley: Bonds voted for court house.

Texas—
Houston: City hall annex.

Washington—
Elma: Three-story brick and concrete addition to high school building.

Wisconsin—
Milwaukee: Bond issue for central police station, $250,000; for public bath in Fourteenth ward, $60,000; for bridge across Milwaukee river, $350,000.

GARBAGE DISPOSAL IMPROVEMENTS.

Michigan—
Pontiac: Garbage reduction plant being considered.

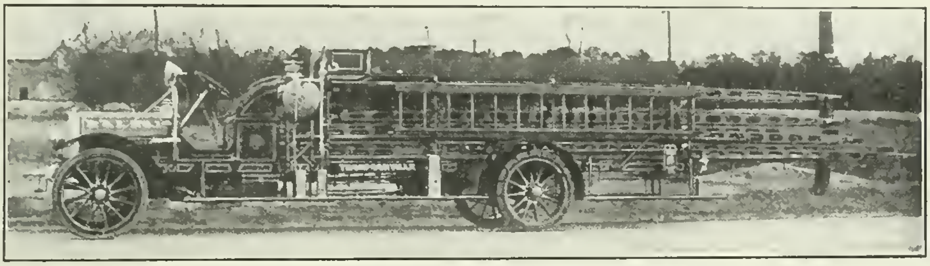
POLICE DEPARTMENT IMPROVEMENTS.

Ohio—
East Liverpool: One auto patrol.

Porto Rico—
San Juan: Probably an electric signal system.

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.



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There is an opinion that parties in free countries are useful checks upon the administration of the government and serve to keep alive the spirit of liberty. This within certain limits is probably true, and in governments of monarchical cast patriotism may look with indulgence, if not with favor, upon the spirit of party. But in those of popular character, in governments purely elective, it is a spirit not to be encouraged. A fire not to be quenched, it demands a uniform vigilance to prevent bursting into a flame, lest, instead of warning, it should consume.—George Washington.

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GRANITE BLOCK PAVEMENTS

RECUT TO SMALL SIZE AND RELAID

By Charles A. Mullen, Wakefield, Bronx, New York City.

This is a detailed description of an interesting and successful experiment made by the author when he was commissioner of public works in Schenectady, N. Y., whereby he was able to cut the large old-fashioned granite blocks on the streets of the city and relay them to cover double the surface at a very low cost for this expensive class of pavement.

UNLIKE her sister cities, Albany and Troy, that form the other points of the municipal triangle known as the Capital City District, the city of Schenectady has not much stone block pavement. All told, there are probably fifty thousand square yards within the city limits. This, however, does not mean that Schenectady lacked a serious problem in worn-out granite block surfaces, for nearly all of hers were located where their noise and discomfort would not much longer be tolerated. State and Albany streets, on the grades leading from the old business district to the new, could only be traversed with agony to man and beast; and the noise from the worn-out blocks in front of the new Court House made it impossible to hold sessions in the front rooms during weather that required open windows. Many other important points needed urgent attention, and the public insisted that something be done to relieve the intolerable conditions.

The budget appropriations for 1913 provided about $50,000 for street pavement maintenance, and it was decided to spend approximately half of this to make some very radical changes in these old granite block surfaces. The next question was how it should be done, and this proved a matter that could not be determined satisfactorily without considerable study. The writer had seen the old blocks taken up, broken in two across their lengths, dressed and relaid in a sand cushion upon a new concrete foundation, with cement grout joints, as it is done in the Borough of the Bronx, New York City, and elsewhere. He had also tried, in Milwaukee, breaking the old blocks the Bronx way and laying them upon a dry small-stone concrete mixture, afterwards wetting this concrete foundation thru the joints of the blocks before grouting, and this method proved fairly satisfactory. It seemed, however, that much greater improvement in relaying granite block surfaces might be possible; and, therefore, some experiments were made before the Schenectady work was started that developed a new method of breaking, dressing and laying the blocks that we thought better than any then in use. Better in the pavement surface produced, and of far greater paving economy.

As soon as spring weather appeared, a stone cutter was taken to a lot on which some old stones were lying and directed to break blocks, first one way, then another, until it seemed that blocks had been broken in every possible size and direction. It developed, from this experiment, that the most satisfactory result could be secured by breaking each old block, measuring about twelve inches in length, eight inches in depth and four inches iu width, into four new blocks, each measuring about six inches in length, four inches in depth and four inches in width; that is, by halving the

REPAVING *State street around Crescent Park, Schenectady, N. Y. Old granite large block pavement in foreground. Cutting old blocks into smaller sizes in the middle ground, and laying the new small block pavement in the background. All stages shown within 200-foot length of street.*

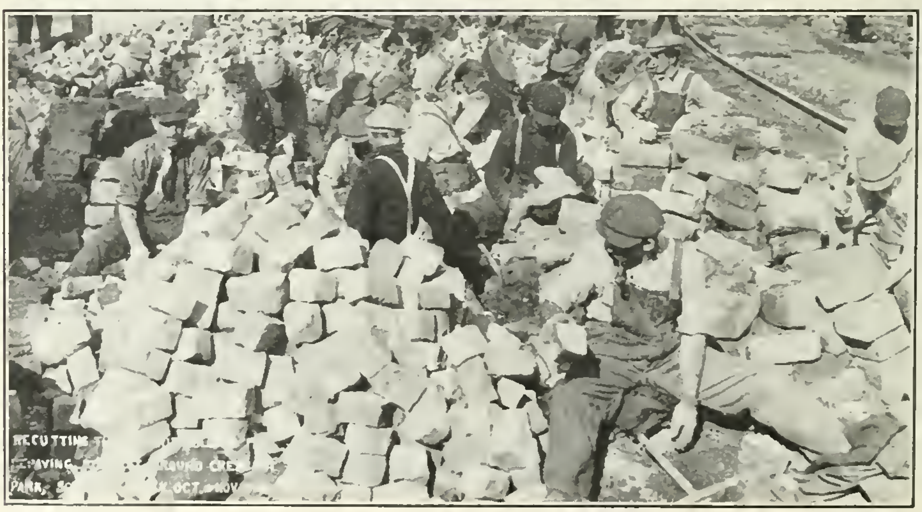
length and the depth, which gives one-half the surface thickness and twice the surface area in the new pavement as compared to the old. The blocks that are very large or very small, and will not break to advantage as described above, receive special treatment at the hands of the cutters. Sometimes the first block is taken from the length, and the remainder makes two by dividing the depth; sometimes all the blocks are taken from the length of the old block. In actual practice, as afterwards tested, the new blocks measured from five to eight inches in length, from three and three-quarters to four inches in depth, and from three and one-half to four and one-half inches in width. These blocks pave very regularly, and to a remarkably good surface. In doing his work, the block maker usually sits on an old stone, throws the block he is to break between his legs with its side resting on the ground, marks it across the length on the uppermost side with a sharp-edged tool called a tracer that he strikes with a hammer weighing about four pounds, then breaks the block by turning it over and striking directly opposite the marking with a hammer that weighs from eight to ten pounds. Each half thus produced is next broken across the former depth of the old block in the same way, and the resulting quarters are dressed into new, high-class little pavers. The amount of waste in this process, as evidenced by the chips and bats remaining when the work is done, is surprisingly small, and this is broken up and used in the concrete. The 100 per cent. increase in surface area of the blocks, to a city that has real paving economy at heart, is a very important consideration. It means a saving of more than $1 per square yard over the amount of money new granite blocks of equal value would cost for some other street needing this type of pavement. It also means home labor employed in doing the work.

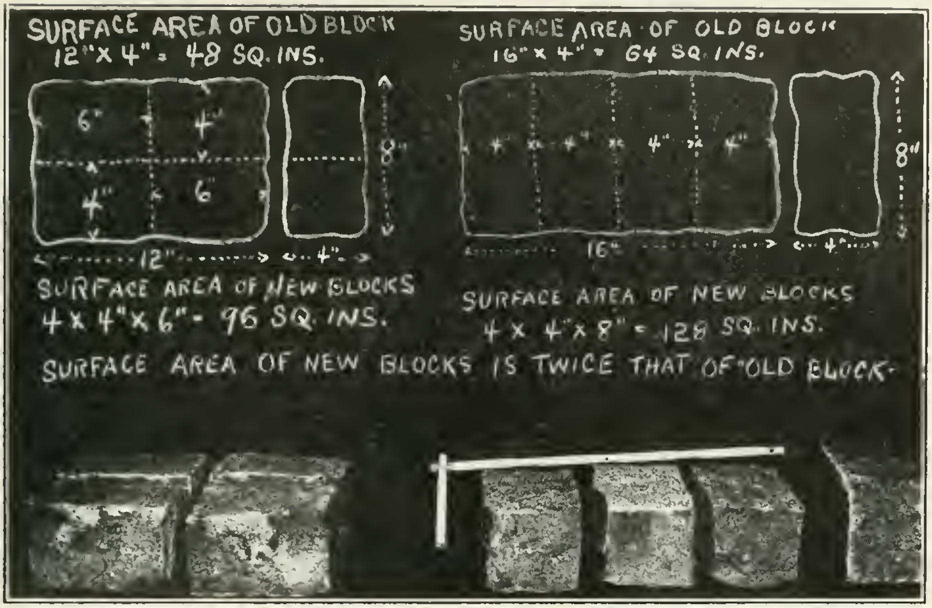
The old granite blocks from Lower State Street, where a wood block pavement was laid, the only one in Schenectady, at the abutting property owners' request, expense and later regret, were taken to the Albany street grade, where they were recut, dressed and laid upon the old concrete foundation from which an asphalt block surface, ten years old and in tatters, had been removed. A mortar bed was placed under these blocks, in some places three inches deep because of the defects in the old concrete, and the joints cement grouted. All the other recut block pavements were laid in places where there had previously been no concrete, or where the old concrete had to be removed because not at the grade proposed for the new work.

The roadway shown in the accompanying photographs, that of State street around Crescent Park in front of the new Court House and the State Armory, is typical of those relaid by the new process of cutting and dressing. In one photograph, the entire work is shown in progress, from the ripping up of the old pavement to the finishing of the new; there being not 200 feet between the ancient and the modern. Between forty and fifty men are seen at work, the nearest barring out the old blocks, the farthest finishing up the new surface; and in between are paving cutters, block handlers, graders, concrete men, mortar bed men, block pavers, rammer and grouters. The old blocks are taken up in the usual way, with a crowbar, and are piled on the subgrade so the paving cutters can get at them handily. The cutters break and dress them, sitting alongside the piles, and replace them on the subgrade near at hand. Just behind the piles of new blocks, the grade stakes are driven, and any regulating of the subgrade that may be necessary is done; tho, as the old blocks were eight inches deep, and the new pavement, including the new blocks and the concrete foundation, is to be but eight inches deep, very little regulating is usually necessary. Then the hand-mixed concrete is placed and tamped, the dry mortar bed is spread thereon, the new blocks are carried across the prepared subgrade and thrown in the mortar bed directly back of the pavers. No sooner is the paving done than a man follows it up with a hose, flowing water thru the joints to the dry mortar bed beneath. Immediately, the first application of grout is placed in the joints, the blocks are then rammed to the best obtainable surface, thru a thick oak board, and the finishing coat of cement grout is placed. The pavement should be at once barricaded and carefully guarded by watchmen for ten days at least.

In laying the blocks on the Schenectady work, the greatest care was taken to get a true surface, and this was found a difficult thing to accomplish. After everything else had failed, a system was arrived at that gave good results. Grade stakes were driven ahead of the pavers, in a line from curb to curb, the stakes being placed about four feet apart, and lines were run from these stakes to the surface of the completed pavement just in front of the pavers. A series of bond-

NEAR *view of process of recutting the old granite blocks.*





stones were then placed under these lines, also spaced about four feet apart, and the pavers worked carefully to these lines and stones. Tho they thought it red tape at first, as soon as they saw the result they concluded it was worth while after all; for, as soon as the work got a fraction above grade, the line was raised from the nearest bond-stone, even if the raise in grade was so gradual as not to show on the line extending back over the completed pavement. It was the special duty of the timekeeper on this work to set these lines and watch them. The resulting pavement surface is one that, in a pneumatic tired vehicle, cannot easily be distinguished from asphalt; and, as it was laid to a straight line cross-section, a fourteen-foot straight-edge can be set up on it and turned completely around without disclosing a variance of one-half inch. The only drop from straight lines is at the gutter, where there is a grade of two inches in the last two feet. Yet, while this pavement seems absolutely smooth to ride over, it presents such a gritty granite surface that horses seem to get the best of footing, and heavy loads go up the Albany and State street grades without the least hesitation, where before it was necessary to stop for wind.

The pavement, as now laid, shows a

ABOVE *are diagrams of large blocks of two different sizes, showing the lines on which they are cut to make the small blocks. Below are photographs of the resulting small blocks.*

monolithic mass, with a cross-section presenting a shade under four inches of concrete, a shade under four inches of block surface, and the difference of the eight inches made up of the mortar bed between. It might well be compared to a concrete pavement with a granite block top. The concrete foundation, in the Schenectady work, was the usual mixture of one part portland cement, three parts sand and six parts crushed stone; and the mortar bed mixture was one part cement to three parts sand. The grout in the joints was a mixture of one part cement to two parts sand, great care being taken with this. To those who visit the city of Schenectady, and want to inspect these pavements, the following will be of value:

	Sq.Yds.
Albany street, Veeder avenue to Hulett street	4,180.0
State street, Lafayette street to Veeder avenue	2,587.1
State street, approaches to Erie Canal bridge	775.4
State street, intersection of South Ferry street	42.5

State street, intersection of South Church street	1,163.8
Liberty street, approaches to Erie Canal bridge	757.1
South Center street, intersection of Veeder avenue	392.2
Nott terrace, driveway between high school buildings	205.5
Total square yards of relaid block surface	10,112.6

It would seem, from the accompanying summary of cost sheet on the State street work around Crescent Park from Lafayette street to Veeder avenue, the most nearly normal of all this work, that under proper management and supervision, any city may turn its old noisy and rough granite block pavements into the most modern form of new, reasonably quiet pavement for about \$2.00 per square yard. Small yardages, at intersections and other difficult points, will, of course, cost more. The work at the intersection of State and Church, for instance, cost \$2.28½ per square yard, not including extra work on curbs and sidewalks, but including a \$0.27 grade and an item for watchmen of \$0.18 per square yard, made necessary by the doing of the work in sections so as not to interfere with traffic, and the impossibility of barricading a street railway switching point. It will be noted from this Crescent Park work cost sheet that 77 per cent. of the \$2.00 per square yard was spent in pay roll for direct city labor. Of this, \$1.54 per square yard, \$0.74 per square yard went to the block makers. It is cheaper, of course, to break the blocks in the Bronx way, but the result is not nearly so satisfactory, and the saving of blocks for use on other work is much less. In Schenectady, about five thousand square yards were taken up, and about ten thousand laid down with the same material.

Cost sheets in detail similar to the one given for the work around Crescent Park were prepared, the totals for four of which follow, the unit prices for labor and materials being the same as those given in the table:

The resurfacing of the intersection of State and Church streets and the portion of South Church and Water streets leading to the intersection included taking up and disposal of some old asphalt and brick pavement as well as the granite. It covered 1,163.8 square yards and was completed between Nov. 7 and Dec. 14, 1913.

Ripping up the old pavement and

LAYING *the small blocks in sand cushion on concrete base. On the right mixing mortar for the grouting of the joints.*

Summary of Cost Sheet—Repairing Around Crescent Park, the Albany St. Side from Lafayette St. to Veeder Ave. and the Veeder Ave. Side from Albany St. to State St.

The work consisted of taking up the granite block pavement, breaking each old 12x8x4-inch granite block into four 6x4x4-inch blocks, dressing these new small blocks, laying them in four inches of new wet 1-3-6 portland cement concrete with a thin bed of 1-3 dry portland cement grout on top, in which to bed the blocks, thoroly wetting the blocks and the mortar bed thereunder, filling the joints with a 1-2 portland cement grout and leaving a thin surplus of the grout on the surface of the pavement, and the other work incident thereto.

This work around Crescent park was done by men, excepting the block cutters and pavers, who had had little or no experience in street paving, under a foreman taken from the machine shop of the General Electric Co.; and it was performed without, at any time, blocking traffic on the street or any of the cross streets or private driveways.

This report covers the 2,587.1 square yards of work completed between September 23 and November 18, 1913.

Ripping Up Old Pavement, Regulating and Grading the Sub-Grade.

Detail Description of Work.	Cost Total	Cost Sq. Yd.	Labor Total	Labor Sq. Yd.	Teams Total	Teams Sq. Yd.	Materials Total	Materials Sq. Yd.
Labor, ripping up asphalt and concrete...	$ 115.28	$0.0445	$ 115.28	$0.0445	....	....	....	....
Team hire, hauling asphalt and concrete...	40.27	.0156	....	....	$ 40.27	$0.0156	....	....
Labor, ripping up old granite blocks......	78.76	.0305	78.76	.0305	....	....	....	....
Labor, regulating and grading sub-grade...	107.81	.0417	107.81	.0417	....	....	....	....
Team hire, haul. materials from sub-grade.	62.41	.0241	....	....	62.41	.0241	....	....
	$ 404.53	$0.1564						
1-3-6 Cement Concrete Foundation 4 Inches Thick.								
Labor, mixing and placing concrete fnd...	308.27	.1192	308.27	.1192	....	....	....	....
Material, cement delivered on job.........	263.35	.1018	....	....	....	....	$ 263.35	$0.1018
Material, sand delivered on job...........	71.08	.0275	....	....	....	....	71.08	.0275
Material, stone delivered on job...........	216.22	.0835	....	....	....	....	216.22	.0835
	$ 858.92	$0.3320						
1-3 Cement Mortar Bed for Blocks.								
Labor, mixing and placing mortar bed.....	190.80	.0738	190.80	.0738	....	....	....	....
Material, cement delivered on job.........	224.42	.0868	....	....	....	....	224.42	.0868
Material, sand delivered on job...........	62.80	.0242	....	....	....	....	62.80	.0242
	$ 478.02	$0.1848						
Breaking, Dressing and Laying Granite Block Surface.								
Labor, breaking and dressing granite.....	1,910.57	.7385	1,910.57	.7385	....	....	....	....
Labor, sharpening and making tools.......	129.38	.0501	129.38	.0501	....	....	....	....
Material, sharpening and dressing tools....	15.00	.0058	....	....	....	....	15.00	.0058
Team hire, shifting blocks on job.........	15.30	.0059	....	....	15.30	.0059	....	....
Labor, handling granite blocks to pavers...	102.38	.0396	102.38	.0396	....	....	....	....
Labor, paving granite blocks.............	464.77	.1796	464.77	.1796	....	....	....	....
Labor, ramming granite blocks...........	16.98	.0065	16.98	.0065	....	....	....	....
	$2,654.38	$1.0260						
1-2 Cement Grout Joints and Surface.								
Labor, mixing and placing cement grout...	120.66	.0466	120.66	.0466	....	....	....	....
Material, cement delivered on job.........	182.85	.0707	....	....	....	....	182.85	.0707
Material, sand delivered on job...........	27.55	.0106	....	....	....	....	27.55	.0106
	$ 331.06	$0.1279						
Overhead Charges.								
Labor, foreman, assistant foreman, etc....	211.94	.0819	211.94	.0819	....	....	....	....
Labor, watchman	142.87	.0552	142.87	.0552	....	....	....	....
	$ 354.81	$0.1371						
Extra Work.								
Repairs to curbs, sidewalks, sewers, etc...	111.18	.0430	111.18	.0430	....	....	....	....
Total	$5,192.90	$2.0072	$4,347.96	$1.5507	$117.98	$0.0456	$1,063.27	$0.4109

The prices paid for labor and material for this work were as follows, labor being per day of eight hours:

Foremen	$ 4.00	Horse, wagon and driver........................	4.00
Assistant foremen	3.50	Portland cement, bbl. f.o.b. cars.................	1.24
Granite block cutters..................	5.00	Sand, ton f.o.b. bank...........................	.25
Granite block pavers..................	5.00	Crushed stone, 1½-inch, ton f.o.b. job.............	1.75
Laborers and watchmen................	2.25	Crushed stone, ¾-inch, ton f.o.b. sidetrack..........	1.30
Teams, wagon and driver..............	5.00		

disposing of it cost $312.55, or $0.2686 a sq. yd.

Concrete foundation, 1:3:6, 4 inches thick, cost $298.29, or $0.2563 a sq. yd.

Cement mortar bed for blocks, 1:3, cost $242.43, or $0.2083 a sq. yd.

Breaking, dressing and laying the granite block surface cost $1,375.36, or $1.1818 a sq. yd.

Cement grouting joints and surface, 1:2, cost $158.48, or $0.1361 a sq. yd.

Overhead charges were $272.68, or $0.2343 a sq. yd.

Extra work cost $183.32, or $0.1575 a sq. yd.

THE *completed granite block pavement with grout surface is as smooth as asphalt. The court house on the right makes less complaint of the noise, which was quite unbearable with the old pavement.*

The total cost was $2,843.11, or $2.4429 a sq. yd.

Separating this into labor and material costs, the total cost of labor on the job was $2,289.19, or $1.9670 a sq. yd., which is 80 per cent. of the total cost.

Teams cost $174.16, or $0.1496 a sq. yd.

Materials cost $379.76, or $0.3263 a sq. yd.

Resurfacing of State street between Wall street and the canal bridge and 142.8 feet of Dock street south from State street, except raailway track, covered 575.5 square yards, done between Nov. 3 and Dec. 17, 1913.

Grading cost $104.54, or $0.1816 a sq. yd.

Four-inch concrete foundation, 1:3:6, cost $148.16, or $0.2576 a sq. yd.

Mortar bed for blocks, 1:3, cost $91.67, or $0.1593 a sq. yd.

Breaking, dressing and laying granite block surface cost $700.20, or $1.2168 a sq. yd.

Cement grout joints and surface, 1:2, cost $60.82, or $0.1057 a sq. yd.

Overhead charges were $74.34, or $0.1292 a sq. yd.

Extra work cost $35.11, or $0.0610 a sq. yd.

The total cost was $1,214.84, or $2.112 a sq. yd.

If the cost is analyzed as to labor and material costs the showing is as follows:

Labor, $1,101.25, or $1.7574 a sq. yd., which is 83 per cent. of the total cost of the pavement.

Teams cost $28.16, or $0.0488 a sq. yd.

Materials cost $175.43, or $0.3050 a sq. yd.

Resurfacing of approaches to canal bridge on Liberty street leading into Liberty street and of 924 feet of College street leading into Liberty street, including removing and disposing of old asphalt wearing surface and taking up and relaying granite block wearing surface as described in the Crescent Park table covered 757.1 square yards, done between Nov. 6 and Dec. 4, 1913.

Ripping up the old pavement and regulating and grading subgrade cost $181.47, or $0.2397 a sq. yd.

Concrete foundation, 1:3:6, cost $175.01, or $0.2311 a sq. yd. The old concrete was crushed and used as stone in the new concrete.

Mortar bed for blocks, 1:3, cost $167.13, or $0.2208 a sq. yd.

Breaking, dressing and laying granite block surface cost $862.38, or $1.1391 a sq. yd.

Cement grout joints and surface, 1:2, cost $90.35, or $0.1193 a sq. yd.

Overhead charges were $83.87, or $0.1107 a sq. yd.

Extra work cost $53.54, or $0.0707 a sq. yd.

The total cost was $1,613.75, or $2.1314 a sq. yd.

If the cost is classified as labor and materials the results are as follows:

Labor cost $1,298.43, or $1.7149 a sq. yd., which is 80 per cent. of the total cost.

Teams cost $79.75, or $0.1053 a sq. yd.

Materials cost $235.57, or $0.3112 a sq. yd.

The resurfacing of Albany street between Veeder avenue and Hulett street, except the railway tracks, is the earliest work of the kind, being done between June 2 and Oct. 29, 1913. It covers 4,189 sq. yds. The work is also somewhat different from that of the others, consisting of removing and disposing of the old asphalt block wearing surface, repairing and adjusting the old concrete foundation, recutting old 4 by 8 by 12-inch granite blocks from Lower State street to 4 by 4 by 6-inch new granite blocks, dressing same and laying them in 1:4 portland cement mortar bed with 1:2 portland cement grout and surface plaster.

The grading and removing of old materials cost $507.84, or $0.1212 a sq. yd.

Patching the old concrete base cost $185.65, or $0.0443 a sq. yd. This is not the cost per square yard of concrete patch but the total cost of the patching of foundation divided by the number of square yards of completed pavement, and the sand in the old cushion for the asphalt blocks was used for making concrete and mortar bed. Concrete 1:3:6.

The mortar bed for blocks, 1:4, cost $851.36, or $0.2033 a sq. yd. It was laid much thicker in some places than others, the old concrete surface being very uneven and requiring a mortar bed 1 to 4 inches deep to bring it to uniform surface.

Breaking, dressing and laying the granite block surface cost $4,330.63, or $1.0339 a sq. yd., the blocks in the yard, hauled there by contractors with a few by the city from other streets, being cut and used. The block laying is so evenly done by the pavers that the only ramming is done by the men grouting the joints when this shows high blocks.

Grout joints and surface, 1:2, cost $621.19, or $0.1483 a sq. yd.

Overhead charges were $649.76, or $0.1550 a sq. yd.

Extra work cost $26.07, or $0.0062 a sq. yd.

The total cost was $7,172.52, or $1.7122 a sq. yd. Excepting the block cutters and pavers, the men on this job never had worked on street paving and were under a foreman taken from the machine shop of the General Electric Company. There was no blocking of traffic on the street or on any of the cross streets or private driveways.

Classified under labor and materials the costs show as follows:

Labor cost $5,756.61, or $1.3743 a sq. yd., being 80 per cent of the total cost.

Teams cost $386.48, or $0.0922 a sq. yd.

Materials cost $1,029.43, or $0.2457 a sq. yd.

John Hickey was the superintendent of streets and Robert K. Wilson was general foreman of street repairs, under Charles A. Mullen, commissioner of public works.

The Small Consumer and the Central Electric Station.

By S. E. Doane, Engineer, National Lamp Works.

This rather neglected and despised class of customers of American light and power companies is cultivated to their financial advantage by European electricity and gas producing companies and an expert gives herewith the results of a careful study of the foreign methods, as outlined before the Wisconsin Electric Association.

A YEAR and a half ago, the time having come when it seemed to us wise to spend a little time on the question of the small customer, I sent one of my assistants to Europe, where the small customer business is cultivated, and followed myself some months later. Mr. Eisenmenger began his work in August, 1912, by sending out circular letters to 600 central stations, from which he received 300 replies. Two hundred of these replies indicated that the central stations were more or less actively going after the business of the small customer. To cut a long story short, Mr. Eisenmenger investigated such of these as he apparently was most interested in and joined me in the south of Europe in March, 1913, and we together spent two months just touching the high spots. The result of our work, which occupied about a year, is embodied in a report of ninety typewritten pages which he have handed to the National Electric Light Association.

In one large European city the entire service is on meters, but every care has been taken to embody best practice. The meters are cheap. The distribution system is well loaded by intensive business cultivation, and, tho the rates are not low, the income from individual customers is extremely low because of the customers' small size. This central station stated that it obtains an average return from its city territory of 70,000 population and on adjoining country district of about the same, of almost $9 per small customer per year, whereas the minimum return for any customer per year was $4.50. This was a private company and its balance sheet apparently shows a healthy financial condition and 11 per cent dividends for the year 1912.

In another case, covering very different practice, one city of about 650,000 people, where the private plant was in competition with the municipal plant, the private plant had about 40,000 meter customers and about 25,000 customers on limiting devices. The city plant has about 24,000 customers on limiting devices (I have no record of the customers on meters of the municipal lines), making a total for the city of over 90,000 customers. This, as you will notice, is one customer for less than seven people. It certainly is an intensive development.

Speaking now of the private company, who extended to us every courtesy and facility for investigating their 25,000 customers on limiting devices, it has an average connected load of 21.7 watts. Their rates cover everything from a single 10-watt lamp upwards. This single 10-watt lamp is supplied for 16 cents per month, including wiring rental. They did not think they made money on this customer, but are very sure that if the customer paid 25 cents a month he would be profitable.

The various schemes I am about to mention are more generally applicable to small customers on limiting devices than to small customers on meters. The practices can be treated under five heads: Soliciting, installing, billing and collecting, metering or its equivalent, relations with contractors.

As a general thing the advertising solicitation is addressed to the small customer on the theory, which seems to have worked out, that the housewife, whom they figure they must address, will insist on electric light being installed in her home if her poorer neighbor has it, whereas the reverse is not true, so that solicitation addressed to the smaller customer reaches the larger customer automatically. The obverse of this does not hold. This advertising is cleverly done and is fully up to our standards. They have in Germany a Co-operative Electrical Development Association in full operation.

We find that the customer's installation is often financed in some manner. They have several ways of doing this, but they all have the same purpose, which is to relieve the customer of the comparatively large expenditure necessary to wire his building. Collections are made periodically in small installments, with a sufficient additional amount to pay interest on the money thus invested.

The billing and collecting schemes are ingenious. I think the most ingenious is a scheme in use in several places, of making out a card with a number of coupons attached, once a year, and handing this card with the coupons attached to the collector and billing the collector at each period for the total amount charged to his account. Twelve of these coupons are attached if collection is to be made once a month, four if to be made once a quarter, etc. At the period named the collector exchanges a coupon for the cash. The collectors in many cases work without commission. This is equivalent to our corner drug store agreeing to collect for his neighborhood, as is sometimes practiced in this country. You will note that this practically almost entirely eliminates the cost of billing and collecting.

It is generally recognized in Europe that the cost of a small customer, with normal use of lighting, is over 90 per cent fixed, and, consequently, it is more equitable to charge him a flat rate than it is to charge him a rate which varies with the kilo-watt hour component of its cost. In case it is decided to charge a customer a flat rate, there are then two problems. The first one is how to prevent him from using a greater amount of electricity at any one time than would be normal for his contract. The second one is to prevent his using electricity for more hours than would be normal under his contract.

The first condition is very often met, in fact, invariably, so far as our information goes, by a circuit breaker of neat, compact appearance and low first cost, which opens the circuit when the load thereon exceeds the rating of the instrument. This circuit is restored, then broken again, etc. I think that we are all familiar with this practice, but development over there is proceeding along such lines that they say in general the cost of the device does not exceed $1.50.

The question of lamp efficiencies also comes in here, as the central station, in order to carry the largest number of customers possible on its investment, must have the smallest possible maximum demand from each. Very high efficiency lamps are used, and, in consequence of these high efficiency lamps, high efficiency reflectors and not too high intensity, the average small customer in the illustration I have chosen gets along with 1.8 lamps connected and with an average connected load of 21.7 watts.

To guard against the second danger, that of a customer operating his installation too many hours, the customer is made to buy his own lamps. The life of this lamp is short, about 500 hours, we are informed, so that the customer from time to time buys a new lamps and understands that the more hours he burns his lamps each night the greater will be his lamp renewal cost, which, of course, is not negligible to the man of small means.

In practically every city we noted that the contractors and central stations are working in harmony. There is usually the finest kind of co-operative effort. The contractor secures in some cases financial assistance in the purchase of his supplies. The central station points out that, inasmuch as they expect to finance their customer at any event, they only have to carry this financial load a few days more if they finance the contractor also.

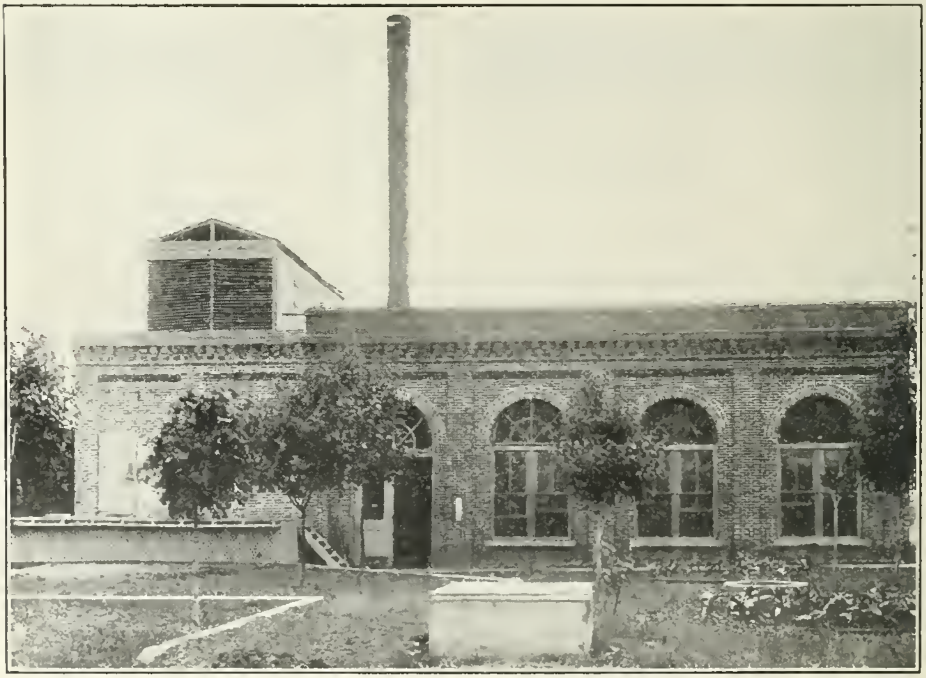
A MUNICIPAL ICE PLANT

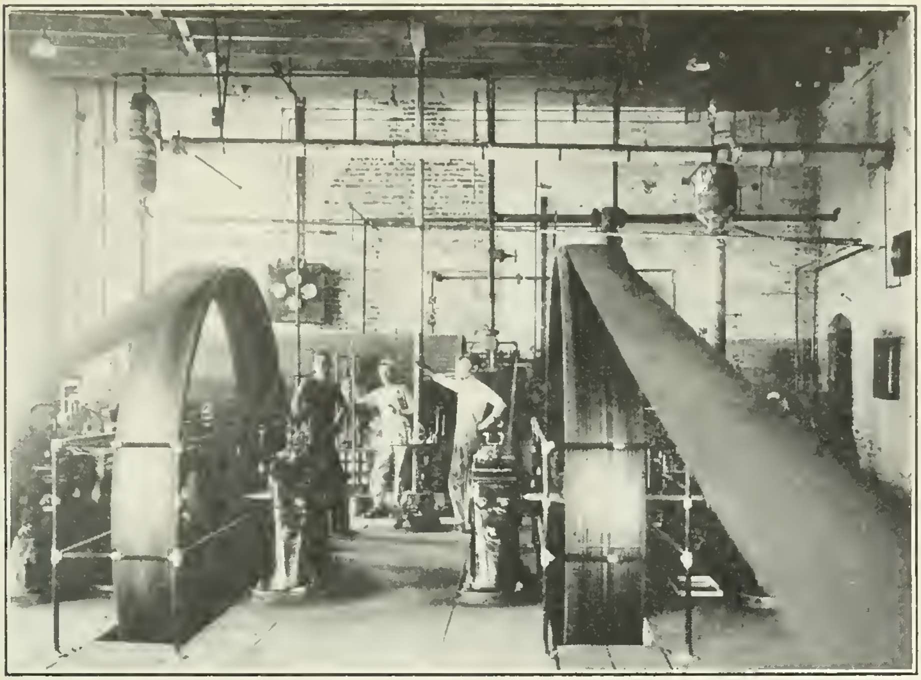
The manufacture of ice as a practical by-product of an electric light plant which has but little load on it during the day has been advocated for several years and has been applied with more or less success in some small private plants. This is the first successful municipal ice plant, largely because previous efforts in some states have been stopped by the courts on the ground that municipal ice making was not specifically permitted by the statutes.

AN exhaustive report has recently been made to the President of the Borough of Manhattan on municipal and government ice plants. From this it appears that, while the latter has operated a highly remunerative plant at Manila, even after reducing the price 25 per cent., another at Panama, as well as several in the department buildings in Washington, the City of Weatherford, Okla., is the only municipality operating its own ice plant. It showed, however, that a great interest was being taken in the matter and that cities in over a dozen states were considering the question. With the spread of the home rule idea and the commission form of government, it is probable that there will be many more such municipal ice plants in the near future. There is no real reason why a city which can distribute and sell water in its liquid form should not sell it in the solid state. Legislatures may have to enact new laws, but the municipal ice plant is coming.

Ice is as much a public necessity as

THE *electric light plant at Weatherford, Okla. The new ice plant is in the new addition at the left.*





INTERIOR *of engine room of electric light plant at Weatherford, Okla. The ice-making equipment is in the rear of the room where the men are standing.*

electric light and water. Weatherford largely owes its successful ice plant to its commission form of government and to the sagacity and untiring energy of its commissioner of public works, Mr, Hugh J. Cooper. Weatherford is a city of about 2,500 inhabitants and is fortunate to have such a live wire in its service. If the Dayton idea spreads of appointing general managers to run cities on a business basis, Weatherford may lose Mr. Cooper to some larger municipality.

Weatherford had voted a bond issue of $9,000 for a City Hall. Before this was built, however, the commission form of government was adopted and Mr. Cooper and his associates rightly decided that to build it would only add unnecessary salaries and expense to the community. The city was operating its own water and light plant, but was getting its supply of ice from outside sources at high prices,, with very considerable shrinkage and irregularity. When most needed it was not to be had.

After an active campaign in the spring and summer of 1912, the voters upheld Mr. Cooper's suggestion to use the City Hall fund for a municipal ice plant. In November a contract was closed with the Carbondale Machine Company, of Chicago, Ill., for one of their ten-ton exhaust-steam ice plants of the atmospheric type.

In this system, ammonia gas is driven off of aqua ammonia and condensed by steam heat in the generator coils. The only moving part about the system is a small pump corresponding to a boiler-feed pump requiring hardly more than a tenth of a horse-power per ton of ice capacity. As exhaust steam at three pounds pressure from the electric light engines and pumps is used in the generator coils and as the city water supply is first used for condensing purposes in the ice plant without extra pumping, ice is made practically as a by-product. When running full capacity, Mr. Cooper says the total operating cost of making a ton of ice is not more than 50 cents, of which 10 cents is for fuel and 40 cents for labor. During the spring and fall, when the capacity is reduced, the cost runs higher than this.

One of the accompanying photographs shows the interior of the engine room with the generator of the ice machine in the background. This, with the small aqua pump, receiver and exchanger, are the only parts in the engine room. As the generator itself can be placed on a platform out of the way if necessary, the extra floor space required is merely nominal. The atmospheric parts of the machine, including the absorbers, condensers, rectifier and weak liquor cooler, are placed on the roof of the new tank building.

Another photograph shows the interior of this tank building. The new tank house is 20 feet by 54 feet 9 inches. The machinery and building represent an expenditure of $11,000. This is abont $2,000 more than the cost of installing an electrically driven compression machine, but Mr. Cooper wisely decided on low operating cost instead of low first cost. Figuring current at 2 cents per k.w. hr., the power cost per ton would have been at least $1.25, as against 10 cents fuel cost in the Carbondale machine. The saving in operating cost will very soon make up the difference in first cost.

THE *interior of the tank room of the new ice plant in connection with the Weatherford, Okla., electric lighting plant. Under each cover with hand-hold is a can in which a cake of ice is being frozen.*

The plant was started in April, 1913, and on January 1, 1914, their report shows ice sales amounting to $4,628.55. The total cost of making the ice was $2,137.19, of which $1,103.70 was for delivery and $1,033.49 all other expenses.

The ice is sold direct to the citizens. The prices, delivered, are: Less than 1,000 pounds, 40 cents per 100; 1,000 pounds or more, in full blocks on one delivery, 30 cents per 100. Prices on the platform are: Less than 300 pounds, 40 cents per 100; 300 pounds to 1,000 pounds, full blocks, 25 cents per 100; 1,000 pounds or more, 20 cents per 100. Carloads, f. o. b. municipal siding, 15 cents per 100, or $3 per ton.

Perhaps other municipalities having light and water plants can form an idea of the probable ice sales by Mr. Cooper's annual report. This shows the following receipts:

Water sales, $4,108.96

Electric current sales, $8,499.90.

Ice sales, $4,628.55.

He reports that the cost of operating the water and light plant just about equals the receipts, but the ice plant shows a handsome profit. It is probable

that in 1914 the tonnage may be materially increased by taking outside contracts, for they are in a better position to tell just how much surplus they will have over and above their local needs.

In addition to the direct profit there was an indirect profit to the citizens of at least $1,200, due to the reduction in cost of ice. Then full weights were given instead of those reduced by shrinkage.

The value of this plant to the municipality could be still further increased by the addition of several well-insulated cold storage rooms. Such small cold storage rooms do not pay in the independent plant when the machine has to be operated solely for same. But with by-product refrigeration, the operating cost is practically nil. Local eggs could be stored in April for the fall and winter, meats could be brought in by the carload and kept until needed.

Municipal and Government Ice Plants

In connection with the above paper on the ice plant at Weatherford, Okla., some items from a report on municipal and government ice plants in the United States and other countries made to the president of the Boro of Manhattan, New York City, will be of interest. This report was prepared by Jeanie Wills Wentworth, and contains the available information upon this subject.

Weatherford is the first city actually to enter upon the successful manufacture and sale of ice, tho several attempts have been made to provide ice thru municipal officials. Schenectady, N. Y., is, perhaps, the most noted of these. A supply of ice was cut from the river and stored for delivery by gift or sale at cost, and the distribution was begun at a price well below that charged by local ice companies. This distribution was prevented by an injunction granted on the ground that the city had no authority under its charter to make and sell ice. The same decision has been made in cases arising at Mt. Vernon, N. Y., and Lewiston, Me.

Camilla, Ga., has obtained a favorable decision from the Supreme Court on the question of its right to establish a municipal ice plant, but has not yet availed itself of the privilege on account of lack of funds. Ruston, La., received a favorable decision on the same question from the lower court, and the question is now before the Supreme Court.

Cities in Minnesota, Missouri, Michigan, Ohio, Oklahoma, Oregon (probably), Wisconsin, Connecticut, Colorado, and California can construct ice plants either under special acts or general charter laws.

Plants for artificial or natural ice are proposed and funds have been provided in Fernandina, Fla.; Willimantic, Conn.; New Britain, Conn., the two latter being natural ice storage plants recently put in use.

A number of other cities are agitating the question, results in some being delayed by lack of legislation, in others by lack of funds, and in still others by the successful opposition of local business interests.

The United States Government has a number of plants in operation for the supply of its own needs in Washington, D. C., in four buildings; one in Manila, Philippine Islands, which sells to government employes also, and at the local market price to others, but not delivered, so as not to compete with the local manufacturers; in Panama; and is constructing a plant at Pearl Harbor, Hawaii. Details of cost and production in these plants are given in the report.

In the cities in the hot and the dry regions in the United States, and in all cities during the summer, ice is a necessity rather than a luxury under modern city conditions, and should be sold at the lowest possible price to those unable otherwise to obtain it.

BITUMINOUS ROAD CONSTRUCTION

A REPORT OF ENGLISH EXPERIENCE

By Francis Wood, Boro Engineer and Surveyor, Fulham, England.

England has studied and experimented with the use of bituminous binders in the construction of roads more extensively than the United States and has more years of experience behind her. This report of their practice, which received the prize of the International Road Congress, will therefore be read with interest, especially as the intensive traffic which follows the completion of adequate roads is showing the certainty of development in this country just as it has in England.

IN considering the methods that should be adopted in road construction to satisfy the various classes of traffic, it is desirable that a close and careful investigation should be made into the various forces that are brought to bear on the road, and the reason for the failure or success of the present methods.

Generally speaking, waterbound macadam is the form of construction that fails to respond satisfactorily to the new forces. For many years this method has been employed successfully, and it probably would have continued if it had not been that the new types of traffic quickly developed or exposed its real and inherent weakness. This weakness of the macadam road cannot be set down deliberately to the form of construction which has been so universally employed for many decades. It is entirely due to the fact that moisture is employed in the construction as an agent for binding the particles together, whereas moisture has no real binding qualities whatever. When an old macadam road has its surface in an almost dry condition, it is very dense and gives an excellent road surface, but if the moisture in the construction is at all in excess, or if there should not be quite sufficient moisture to enable the particles to be retained in their position, then the road begins to fail, and, if the traffic is considerable, the failure is, comparatively speaking, very rapid.

One is therefore led to the conclusion that, although the material that is used to make up the structure may itself and individually be satisfactory as a wearing substance, there is, when it is an unstable mass, so much interior attrition, abrasion and disintegration, due in a very considerable degree to certain atmospheric conditions, that, as a whole, the construction may be regarded as quite unsatisfactory, especially where the traffic is of such a character as will emphasize its weakness.

If we take other examples of roads, we find illustrations demonstrating by inversion the position taken up, viz., that weather is the principal factor in the destruction of the macadam road, e. g., a rail on a railroad will be found to wear in an almost exact proportion to the tonnage which passes over the rail.

Similarly, granite sett paving wears proportionately to the amount of traffic; it is true that the edges are rapidly broken and rounded, but if the paving was made close jointed there would be found to be very little wear, except in the manner which has been suggested, and, of course, depending on the quality of the stone.

Wood paving wears proportionately to the traffic, but, as wood paving is of varying consistency, due to the fact that the heartwood and the sapwood are hard and soft respectively, we have, after a period of time and where there is considerable traffic, a series of small depressions which make the surface somewhat uneven; probably a more careful selection of timber with a regular grain thruout the full width of the block would give the even surface which is desired.

Horse traffic will deteriorate the waterbound macadam road more rapidly than motor traffic, if the latter is traveling at the same rate as the former, because the force that is brought by the horse's foot is much greater than is warranted by the load the horse is pulling; the frictional resistance is greater, because it is confined to the point of a toe, whereas in a motor vehicle the resistance is spread over a much larger area, *i. e.*, the area of the driving wheel in contact with the surface of the road.

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THE SPEED *of the motor vehicle offsets the advantages of tire traffic over horseshoe traffic, and more.*

From these remarks, one might be led to expect that the motor vehicle would have a less wearing effect on the road than horse traffic, and this would actually be the case if the speed of the motor was no greater than the speed of the horse, and the load was similarly proportioned, but we have to recognize that the speed of the motor propelled vehicle is from two to four times that of the horsed vehicle, and, as the kinetic energy of the vehicle increases as the square of the velocity, it follows that the conditions must always be different. For example, if the horse travels at an average rate of four miles per hour with a heavy load, and a similarly loaded mechanically propelled vehicle travels at twelve miles per hour, the kinetic energy of the latter is nine times that of the former. This increased kinetic energy would not affect adversely the ideal resilient roadway, and it is shown by the remarkable change from horsed vehicles to motor vehicles in the great cities that the wood paved, asphalt and granite set paved roads are not very seriously affected. It may even be the case that the decrease in the quantity of manure collected from the streets is a compensating factor for any increase in the cost of the maintenance due to whatever increased wear there may be due to the altered form of traffic.

On the other hand, if there should be any depression, however slight, this depression extends in a very rapid manner, and there is found a second depression a little further along; from this a third depression is made, and so it continues. This is due to the jumping of the vehicle out of the first depression, the place to which each jump extends being subjected to a much greater force than would be the case if the surface had been even. Therefore, as soon as one depression is observed in the roadway, it should be remedied at once, otherwise, not only will there be material wear, but the foundations may give way, and the repair be a more serious item than would otherwise have been necessary.

It follows, therefore, that roads will have to be regularly and carefully watched by experienced men, very much in the same way that plate layers on a railway are continually attending to the rails, and looking out for any unevenness that may arise or that is likely to do so.

Vehicles are usually fitted with springs, and it may be proved to be the case that the swaying of the body will cause weight to be transferred to the wheels in excess of the weight when the vehicle is in a standing condition; thus, any calculations that may be based on the normal or standing conditions of a vehicle may be rendered useless.

It is due to these factors that a road is being subjected to different conditions, even when the same type of vehicle is traversing the road.

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OTHER *exterior forces of importance in their effect on roads are constant, whether there is traffic or not.*

These may be termed the exterior forces, but there are exterior forces which affect the interior of the structure, viz., the changes of temperature, and atmospheric influences. We have seen that, as a consequence of the atmosphere absorbing moisture from the waterbound road the road rapidly ravels. There is, however, another phase when the atmosphere deposits moisture by condensation on the surface of the tar and bituminously constructed road. This moisture being continually beaten into the surface of the road, and not being in sufficient quantity to run off into the channels, is a disintegrating force, for the reason that in tar there are naphthaline and free carbon, which are materials having a great affinity for moisture, and there are bitumens which are fluxed with oils which are in some degree capable of emulsification. The bitumen, if it has been fluxed with a large quantity of oil, or if it be bitumen from a residual of oil, will be deteriorated more rapidly than would be the case if a natural bitumen was used, requiring only a small quantity of fluxing oils. This factor is one that requires careful consideration; if the road is examined and watched in the late autumn, when the temperature is low and the atmosphere heavy with moisture, the effects may be easily seen. The fact also that in low temperatures the adhesive and flexible qualities are much less than at higher temperatures assists in the deterioration. Where the traffic is not so marked, it may be almost ignored. Hence, one is led to conclude that tar is, from its composition, a material not suited to heavy or even continuous light traffic, and that any bitumen that is used should be of a very stable and consistent character, and should be fluxed with the least quantity of emulsifying oils compatible with the requisite standard of viscosity or flexibility that the nature and composition of the pavement demands.

TAR PAVEMENTS *are satisfactory under the conditions stated here.*

It is recognized that under certain favorable conditions tar pavements are satisfactory. Those conditions are (1) light traffic, not too continuous, and (2) fine or dry weather. But a tar concrete can be made, which, if it is composed of a conglomerate, *i. e.*, stone broken to one and one-half inches, together with fine material, will withstand heavy vertical pressure, and, if the light oils are eliminated from the tar and only the heavy oils used with pitch (about 25 per cent. of the former with 75 per cent of the latter) or a carefully prepared tar mixture giving approximately the same consistency, a very strong tar concrete can be made which also may be reasonably flexible in cold weather and not too soft in hot weather; and, what is more important, it can be mixed and laid the same day.

Thus, the old macadam and a proportion of the fine material in the road to be resurfaced may be removed, roughly screened, heated so that all the moisture is eliminated, and immediately, and before the material is cold, the stone and fine material can be treated with the tar mixture and relaid in the road to a depth of about two and one-half inches, the section of which should give a very dense appearance. In this way the road foundation should not cost more than one shilling per superficial yard.

On the top of this composition, a bituminous composition should be laid, the thickness depending on the traffic; in no case, except by-streets, should it be less than one inch; where heavy traffic is the rule then the thickness should be increased to one and one-half inches.

THE QUALITY *of bitumen to be used is carefully and fully described.*

The bitumen to be used should be of such a character that it has recuperative powers; it should be adhesive and ductile; the viscosity should be observable at 32 degrees Fah., and it should not flow at 120 degrees Fah. Up to the present time the only bitumens that have these characteristics are given in general terms. It is, perhaps, not advisable in a paper of this nature to specify any individual bitumen, as it is possible that composite bitumens could be made to fulfill the conditions, or have such other advantages as to give favorable results. It is perhaps necessary to define or explain the reasons for the conditions. Recuperative power is necessary because, if a depression is made in the composition, and the bitumen has no capacity for recovery, the depression remains in the composition and will be a source of weakness, first, from the fact that it will retain moisture, which is a deteriorating factor for all bituminous compositions, and, secondly, because the depressions will increase in size, and the traffic has a tendency to increase them in number, as has already been explained. Also, if the material will not recover itself, every disturbance of the composition by frictional resistance, especially where a vehicle starts on its journey, will develop, and the material will show marked wearing effect. Adhesiveness is necessary without explanation, and similarly ductility is a self-evident requisite. The viscosity at low temperature is necessary because it indicates the ductility of the material, and if it has not a flowing point at 120 degrees Fah., it may be anticipated that little trouble will be experienced in the hot summer temperatures. If the bitumen has a high viscosity at high temperatures, less bitumen is required in the composition: if, on the other hand, the viscosity is low at high temperatures, it follows that an increased quantity of bitumen is required. It may therefore be found that an expensive bitumen is cheapest in the manufacture of a composition, and no comparison should therefore be made of the cost of bitumens, but in the quantities that are necessary to make the satisfactory road composition.

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BOTH *summer and winter conditions must be taken into account in preparing the bitumen for a pavement.*

The composition above described would be made up probably with local sand, the percentage of bitumen being dependent on the quality, the viscosity, and the district and atmospheric conditions to which the material is to be subjected, but the amount may vary from 12 per cent. to 18 per cent., and even a higher percentage may be necessary.

Hot weather on asphalt or bituminous compositions softens the bitumen in the mixture, especially if it has a high viscosity at high atmospheric temperatures, and is in excess. The percentage of bitumen must be sufficient to properly maintain the particles together in the winter, *i. e.*, at the time of greatest contraction. It must be a carefully selected quantity, and the viscosity of the bitumen must be so tempered that it is not too soft in the summer conditions, because the tendency of the traffic is to force the top layer, which is hottest, out of its original position, and in this manner a waviness is produced which will increase and form an objectionable surface.

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ARTIFICIAL *bituminous mixtures are more suitable for road construction than the natural rock asphalts obtainable in England.*

The synthetic mixtures are perhaps more suited to the new traffic conditions than the natural rock asphalts, which are in a somewhat unalterable condition, *i. e.*, as regards the bitumen. But there is no doubt that a careful inquiry into the composition of various rocks can be made, and a mixture obtained that would satisfy even the new conditions of traffic which are causing such serious displacements and to such an extent that the material is being condemned. Probably it will be found that instead of cement concrete for the foundation, a bituminous or tar concrete will be found to be effective in minimizing the creeping of rock asphalt, as then the asphalt and concrete would form part of the surface structure and thus prevent the sliding over the surface which occurs where the mixture is laid on a smooth cement concrete, to which rock asphalt makes no adhesion.

The difficulties in connection with tar macadam construction are similar to those in asphalte and bituminous compositions not properly made. The tar, having a low melting point, flows in hot weather, or is so soft that it loses both its ductility and its adhesiveness, and the traffic easily moves the stones about. Then, as the tar volatilizes, it becomes hard and brittle, and, although it may have ductility and adhesiveness in summer temperatures, both ductility and adhesiveness disappear in cold weather, and if the traffic is at all severe it breaks up or crumbles.

Volatilization also occurs where the tar is used in a plastic condition when cold, as, for example, it is in the case of the pitch grout systems, but in a degree dependent on the oils used. The pitch eventually becomes hard, is slippery, nonresilient, and has a tendency to crumble. The repair with the same material is not very satisfactory. This system, if applied in the road as a foundation for the bituminous surface coating would probably be satisfactory, although it is inclined to have too little resiliency.

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¶ ASPHALT MACADAM *by the mixing method is a standard in England.*

Another form of paving is called "asphalt macadam," and is, in principle, the method employed in ordinary waterbound macadam construction, but bitumen takes the place of moisture. This composition has been found to be satisfactory, and it is composed of thoroly heated stone, cubically broken to one and one-half inches, about 50 per cent. to 60 per cent., fine sand 20 per cent. to 25 per cent., and bitumen and fine dust about 15 per cent. Each portion is accurately and definitely measured, the bitumen being kept to a uniform standard. It is laid in a hot condition about three inches thick, and the surface grouted with bitumen. The surface grout itself will last at least two years, under heavy traffic. As the traffic keeps to the center of the roadway, the only part affected is the center half, and thus, if the worn area of the squeegee coat of bitumen is replaced, the road can be made to last an indefinite time, the cost of such squeegee coat being about 2d. (4 cents) per super yard actually covered. The difficulty has been to find a bitumen that can be squeegeed on to the surface. One method, however, is to spray the surface with a volatile oil so as to thoroly clean the dirt and dust from the existing surface, then the hot bitumen will make a good contact and not roll or peel off. Another method is to flux the bitumen with a light oil, and with this composition secure adhesion.

The objection to the latter is that it takes some time for the light oil to volatilize, and in hot weather the surface is soft and somewhat easily affected by the traffic; if, however, this inconvenience can be tolerated for a few days, the surface will become satisfactory.

The reason for this suggestion is due to the careful calculations that have been made that the traffic wear is at a rate of something between one and two millimeters per hundred tons of traffic per foot of width of road. Probably, on a rock asphalt pavement, it is even less than this rate, so that the wear is confined to the squeegee coat if it is placed on a satisfactory under-structure.

Another composition would be to mix about 60 per cent. bitumen and 40 per cent. of tar of a similar consistency to the bitumen with the material above mentioned. In this manner the bituminous portion of the composition is cheapened, and the preparation may be used in a similar manner as described above with every prospect of success. The material laid by the writer would indicate that the tar and the bitumen are improved by the mixture. The mixing of the tar and the bitumen has to be carefully made, a soft pitch (melting point 150 degrees Fah.) is fluxed with creosote oil so as to bring the specific gravity of the combination to 1.27. The bitumen is similarly fluxed to the same specific gravity, and when they are in a similar condition the mixture is made, the surface of both materials being free from bubbles when at a temperature of about 300 degrees Fah. The mixture should not be kept too long over a fire, as the consistency rapidly alters in composition at this high temperature.

The rolling of hot mixtures is a factor which must not be overlooked; too great a compression by over-rolling is likely to be detrimental because it removes the voids or spaces which are necessary for the bitumen to carry out its work. It should therefore be the case that the roller should not have a greater capacity than 20 to 25 cwt. per foot of width of the roll. The material would be benelited not only by rolling in the direction of the length of the road, but also by rolling across the width of the road, so that the stones are brought into contact with the bituminized particles from every direction. The hotter the weather the less should the mixture be rolled. All that is required is that the composition should be homogeneous, or rather, that all the particles should be in proper contact, and then the traffic allowed to do the rest of the work of consolidation and compression.

For less heavily trafficked roads, a tar concrete instead of bituminous concrete could be used, and instead of a squeegee coat of tar a squeegee coat of bitumen should be used to make up the surface; this form of construction is only applicable to the roads where light traffic prevails, as the squeegee coat could not save the tar concrete from being deteriorated by heavy traffic.

Thus a bitumized road is resilient, can be constructed to suit heavy traffic or light traffic, and its cost can be proportionate to the traffic which is placed upon it. Further, its maintenance will also be proportionate to the traffic upon it.

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¶ TAR-COATED ROADS *are good for certain kinds and amounts of traffic.*

From a careful examination of tar-painted roads, there is evidence to justify an experiment of considerable importance. During hot and dry weather the tar-coated macadam road, if the coating does not become worn thru to the macadam, presents an excellent resilient surface; its defect is that in the autumn and winter the cold and wet weather deteriorate its resilience to such an extent as to break it up, and, with heavy traffic, cause an objectionable mud to form on the surface. The writer made, about five years ago, an experiment of laying ordinary mastic asphalt about three-fourths of an inch thick on the surface of a macadam road; this section was laid where the traffic was very light, but no adverse effects from the weather have been noticed. The disadvantage of the process was that a considerable amount of labor was involved in laying the material, and the area covered was very small per day. An endeavor has been made to deal with it on a larger scale and to use a synthetic mixture.

The various kinds of mixtures that are possible by using different consistencies of bitumen are interesting, *e. g.*, if an aggregate is taken and the bitumen fluxed so as to be very soft, a small percentage of bitumen only is necessary, as has already been stated, and a much larger percentage of bitumen may be used more advantageously if it is fluxed, so as to have a low melting point. But there is a point when the softness of the bitumen is of great importance, as if it is too low the composition is very hard and brittle; if too soft, then in hot weather there is a tendency for the composition to be so soft as to allow the traffic to make depressions in the surface—altho the bitumen will not run, the traffic finds the surface very heavy.

These experiments were made with the idea of obtaining a very flexible material, somewhat similar to the summer condition of tar coating, and of such a thickness that it would last satisfactorily on the surface of the road already macadamized and brought to a good surface by consistent rolling with a heavy roller. The macadam under the tar coating would appear to remain satisfactory as long as the tar coating remained on the surface; immediately the tar coating became worn to the macadam, however, the latter rapidly ravelled. If the bituminous material could, therefore, be so highly filled with bitumen that the latter acted as the principal wearing agent and did not mark under traffic conditions, and similarly withstood the late autumn weather and traffic, the result would be of great benefit to roads where tar coating was now a success in the summer and a failure in the winter. A section has been laid, barely an inch thick, which consists of about 16 per cent. bitumen, and the cost will not be more than about 2s. to 2s. 6d. (25 to 35 cents) per superficial yard; the success of the material however, depends upon how it withstands weather and traffic conditions.

LAYING WOOD PAVING IN LONDON

By S. R. Church, Manager Research Department, Barrett Manufacturing Co., New York.

A careful study of wood block pavements and the methods of laying them in England showed the author of the paper from which this article is taken that the material differences from American practice are not in laying, but in relaying blocks after a pavement has been disturbed, and this is what he told the Wood Preservers' Association.

WE had an opportunity of carefully observing the construction of a wood pavement in Gracechurch street, London, and were greatly impressed with the good workmanship displayed. The street is in the heart of the old city, and is 34 feet wide. It was being paved for a distance of about six blocks. The contractors were allowed to shut the street off from traffic for a definite period of time, within which the work must be completed. The old asphalt pavement had been entirely removed, and a new cement-concrete foundation nine inches deep was put down. This concrete was put down in sections about 25 feet long, and the full width of the street. It was laid in one course, with a very wet mix, the metal being Thames gravel and sand. The concrete surface was finished to an absolutely true grade by means of a wood templet, and without the use of any mortar course. Sometimes a mortar course is used to make the surface smooth. In all cases the concrete is allowed to set six or seven days until perfectly hard, and the blocks are then laid directly on the hard, smooth concrete, without any cushion. This is universal practice, not only in London, but in Paris and Berlin, and all the engineers with whom I talked said that they were opposed to the use of a sand cushion or a soft cushion of any kind. The blocks were five inches deep by three inches wide by seven inches long. They were very uniform in length and exceedingly true in depth. They were laid fairly close, but not rammed. An expansion joint 1½ inches wide was provided along either curb, and two rows of blocks laid parallel to the curb, with a pitch-filled joint between these rows. The expansion joint along the curb was filled with clay to within one-half inch of the top. Before paving up to projections, such as manholes, pipe valves, etc., the blocks are fitted with great care around all these projections. Over the finished surface after the blocks are laid, a flush coat of hot coal tar pitch, of about 140 to 145 degrees Fah. melting point, was poured from hand buckets, and this was immediately squeegeed over the surface with rubber rollers, forcing it into all the joints. This was followed with a thin wash coat of cement grout, and finally a substantial layer of fine, brown, siliceous gravel, free from dust or loam, which was allowed to remain on the surface until pounded into the blocks by traffic.

The foregoing is typical of modern English practice. I have seen statements to the effect that spacing lath are commonly used in the joints, but this practice has been abandoned, except in the case of some hardwood pavements. The spacing strips are never used in London or Paris with softwood blocks. They are, however, used in Berlin. The flush coat of pitch over the surface is the universal practice in England, altho not used to any extent elsewhere. Longitudinal expansion joints are always provided, even on heavy traffic streets, but lateral expansion joints are not used. In London,

LAYING *five-inch creosoted deal blocks on concrete foundation in Grace Church street, London, showing all stages of handling blocks on the street.*

five-inch blocks are used on all important thoroughfares, and no blocks less than four inches deep are ever used.

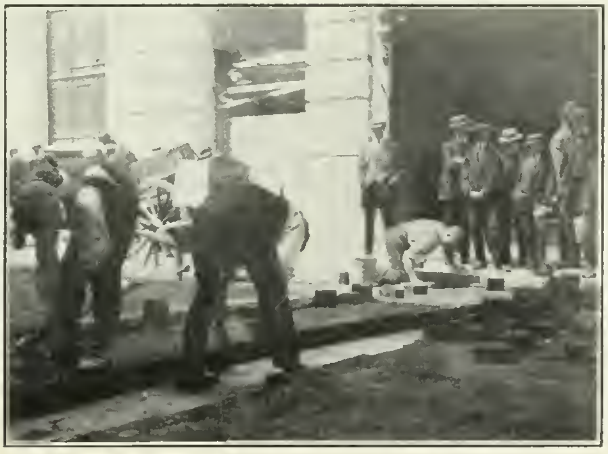
In most of the London paving the blocks are delivered just about as fast as they are required. They are seldom piled along the sides of the streets.

Pinus sylvestris is used almost exclusively under such names as Swedish pine, Baltic pine, yellow deal, red deal, etc. Block after block shows no noticeable difference in weight, size of rings, freedom from knots, shakes, etc. The manager of a creosoting company attributes the success of their pavements to the quality of the wood. Straight pressure treatment is used, London requiring 12 pounds of coal tar creosote oil per cubic foot and Westminster 10 pounds, of about 1.06 specific gravity. Plant methods are thoro and well regulated, but not mechanically equal to American works. There is much hand labor.

Creosoted wood block pavements are not slippery because the wood is soft enough to permit the pounding into the fiber under traffic of the gravel or coarse sand spread over the completed pavement. They do not present as attractive an appearance nor are they quite as noiseless as our creosoted yellow pine. The wear of blocks is ordinarily very uniform with some exceptions in the downtown streets of London proper, where traffic is heaviest.

It requires very close scrutiny of pavements to find replaced service cuts or places where the pavement has been patched. The great care with which this work is done is in marked contrast with

THE *blocks are placed carefully on the street, as seen at the right, and then laid in closely-fitting courses by the men at the left.*



SQUEEGEEING *the pitch flush coat applied to the surface of the blocks.*

the careless manner in which blocks are sometimes thrown into repairs in our city streets.

The hardwood blocks, ordinarily laid untreated, comprise Australian jarrah and karri, species of eucalyptus. They are going out of favor rapidly, their use having proved a failure.

Creosoted wood is, without question, the most highly esteemed paving material in the English cities. In ten of the twenty-eight boroughs constituting the City of London, and comprising the most thickly populated sections of the city, the total mileage of creosoted wood block in 1912 was 121, and of this total 40 miles was in the city of Westminster, that part of London containing the best retail business streets; the government buildings, theaters, museums, art galleries, etc., the social heart of the city. The streets of Westminster are important thorofares. The traffic is, however, very largely rubber-tired. In fact, the percentage of iron-tired traffic, if known, would probably be surprisingly low. There are a few exceptions, such as the Strand, where there is considerable mixed traffic, but, on the whole, the streets of Westminster and those of purely residential boroughs, such as St. Marylebone, Kensington and Wandsworth, which together contribute ninety miles to the total of London wood paving, carry a traffic comprising a tremendous number of vehicles, but of a very nondestructive character to pavement. The City of London proper contains only eight and one-half miles of wood paving. Here the traffic is, of course, intense in all respects.

APPLYING *pitch coat to blocks. In the background the pitch coat has been followed by a flush coat of cement grout.*

GOVERNMENT OF CITIES

COMMISSIONS AND DEPARTMENTS COMPARED AND CONTRASTED

By Nelson P. Lewis, Chief Engineer, Board of Estimate and Apportionment of New York City.

In this abstract of a lecture before the students in highway engineering at Columbia University, the chief engineering adviser of the great city of New York gives the results of his mature experience and observation of the two principal forms of administering the public works, especially of the larger cities, and his conclusions must be accepted as the highest authority.

MOST American cities have a department of public works. The organization of such a department and the precise field covered by it vary in almost every city. Generally such a department has control over the preparation of city maps; street surface improvements, including grading, paving, sidewalks, maintenance, repairs and renewals; street signs and house numbers; sewers and sewage treatment; water supply and distribution, including the care of watershed, filtration, etc.; street cleaning, including the collection and disposal of wastes; street lighting; public buildings; the construction and reconstruction of surface railway tracks in streets, and the elimination of railroad grade crossings.

In cities of moderate size, say 300,000 or less, this work is usually under the more or less complete control of the city engineer, although there are conspicuous exceptions. In very large cities the organization is more complex, sometimes jurisdiction over but one or several of these activities being under a single administrative head; again, a larger group or all are under one head, but under a number of different administrative units, each with limited geographical jurisdiction. An example of the first class is the organization provided by the Greater New York charter, under which commissioners of water supply, sewers, street cleaning, bridges, public buildings, lighting and supplies each had jurisdiction over the entire city, and together they form the board of public improvements, the president of which, a separate officer appointed like the others by the mayor, had control over all topographical work. This was the charter which took effect immediately after the consolidation act which created the greater city. Everything was new. No definite policies had been established, and the results were generally unsatisfactory, although a conclusion that these results were due to the organization, instead of the chaotic condition which resulted from the consolidation into one city of a score or more of cities and villages, might not be justified.

An example of the second class is that of Greater London, where there are thirty separate administrative units, which are practically independent cities, each administering its own local affairs and raising the money which they feel they can afford to spend on the street and other services. The City of London comprises 673 acres and has less than 20,000 population. Even here, however, the London County Council has jurisdiction over certain municipal functions which are essentially metropolitan, such as the water supply, the main drainage system, the surface railway lines traversing two or more boroughs, and certain street improvements which extend beyond the limits of a single borough and which are of great importance to the entire metropolitan district.

¶ BOTH *the department and the commission plans are in operation in New York City.*

In the present City of New York is found a combination of these two general plans. The head of each of the five boroughs has entire control of the mapping of its territory, the improvement of its streets, including the maintenance and renewal of pavements, the design, construction and maintenance of sewers, including sewage treatment plant, and of all public buildings and offices, and in two of the boroughs of street cleaning and the disposal of wastes. Other functions which necessarily relate to the entire city and where local jurisdiction would be unsatisfactory are under control of department heads appointed by the Mayor, and they have jurisdiction over the entire city. The chief borough officers, together with the Mayor, the comptroller and the president of the legislative body, form the Board of Estimate and Apportionment, which body has a pretty general control over all city activities, so that the City of New York comes nearer having a commission form of government than is generally realized. There always have been and there still are in the City of New York a number of special commissions. The Brooklyn Bridge was built and operated by such a commission when it was an inter-city bridge. The new East River Bridge, now known as the Williamsburg Bridge, was also built by a separate commission. Brooklyn has had the Atlantic Avenue Improvement Commission, the Shore Road Commission and the Brooklyn Grade Crossing Commission, while the greater city has the Metropolitan Sewerage Commission; the Board of Water Supply, having control of the development of the Catskill watershed, and the Public Service Commission for the First District. This last-named commission is a peculiar one. It was created by the State, and its members are appointed by the Governor, the city authorities having no voice in their selection, and, while the salaries of the commission and a few of the administrative staff are paid by the State, the expenses of the vast majority of the staff, amounting at the present time to nearly $2,000,000 annually, are paid by the city, and the chief function of the commission is to spend money raised exclusively by the City of New York without any contribution whatever from the State, which created the commission. Certain public or semi-public activities are carried on by organizations having no official connection with the city, but which are allotted certain funds for enterprises which would otherwise doubtless be conducted directly by the city. Among such bodies are the Trustees of the Metropolitan Museum of Art, the Trustees of the Museum of Natural History, the Brooklyn Institute of Arts and Sciences, the Trustees of the Public Library and its great number of branches, the New York Zoological Society, which maintains the Zoological Garden in a portion of Bronx Park, and the New York Botanical Society, which has the care and custody of the remainder of the same park. No enumeration of special bodies whose influence has been potent in varying degree would be complete without naming the Bureau of Municipal Research, the Citizens' Union, the City Club and a host of civic organizations, representatives of which give the city officials the benefit of their advice on almost every subject, but none of which exercises such influence and actual power as do the three first named. None of these organizations has any responsibility to the people of the city.

¶ CHICAGO, *Baltimore, Louisville and other cities put much work in the hands of special commissions.*

New York is not alone in working thru special commissions. Chicago's park system is managed thru a separate commission for each park district, and the results appear to have been most satisfactory. The City of Baltimore has lately established a Paving Commission, entirely distinct from the Department of Public Works or the city engineer's office.

¶ COMMISSION GOVERNMENT *for the entire city is the modern application of the plan.*

Then, there are the various forms of commission government, the commission in each city which has adopted this system having much latitude and the details consequently varying greatly. Perhaps the best and most efficient form of administration is that to be found in cities of moderate size, where one administrative head and the city engineer have virtually entire control. There is one serious defect which is the more pronounced in the smaller cities, and that is the practice, if not the right, of citizens to dictate to a certain degree what kind of improvements are to be made and their character. The town meeting method will answer very well for the village or the very small city, but, as the city grows, as its organization becomes more complex, there is more and more need for technical skill in the planning and execution of its public works, and, as the city grows, the general interests of the community and the particular interest of the property owner are likely to grow more and more apart. In the small town the individual and the property he represents form a much greater relative part of the population and of the physical city than is the case in the larger city. There is no field of municipal work where the engineer has the opportunity to develop greater versatility than in the moderate-sized city, corresponding, say, with cities of the second class in New York State. Here the city engineer, appointed by the Mayor, is a voting member both of the Board of Estimate and Apportionment and of the Board of Contract and Supply. He is called upon to exercise control over almost every kind of public work incidental to the modern city. The work may not be of the magnitude to be found in the greater cities, but its variety is far greater than that which comes to the engineer of cities of the first class, where jurisdiction and responsibilities are subdivided. Having less of a certain kind of work to do, he takes it very seriously, and it is often exceptionally well done. The practice of electing a city engineer by the Council or other legislative body, or, as is done in some cases, by popular vote, cannot be too strongly condemned. Past experience has given good ground for the general statement that no man should be selected to do professional or highly technical work by election, whether that election be by the general public or by a legislative body. Those who are called upon to vote for candidates for such an office have no means of knowing their peculiar qualifications or lack of qualifications, and better results will almost invariably be obtained if responsibility for the appointment of a man to do such work is vested in the chief executive of the city.

¶ DIVISION *of responsibility spells inefficiency in city administration.*

One of the most fertile sources of inefficient administration and of unsatisfactory results is a divided responsibility. In the City of New York the president of each borough is responsible for the care and condition of the public streets, and yet the Department of Water Supply, the Fire Department or the State-created Public Service Commission has the right to open the pavement for the purpose of installing the underground structures without the consent, and often without the knowledge, of the officer who is held responsible for the condition of the streets. The surface railway companies must secure permission from the Borough President to open the streets, but gas companies, electric light companies and telephone companies must also get permits from the Department of Water Supply, Gas and Electricity. In all these cases we have a dual responsibility which is inimical to proper control. An amusing instance of the lack of knowledge in one city department of what exists in city streets under the control of another department was afforded the speaker several years ago in the City of London.

Application was made to the authorities of the City of Westminster for the right to examine pipe galleries in Charing Cross road and Shaftesbury avenue. There was apparently no knowledge of the existence of such pipe subways, and, after extended inquiry, the speaker was told that there was no subway large enough for a man to enter. Upon application next day to the chief engineer of the London County Council, a member of the engineer's staff was immediately delegated to conduct the speaker through capacious pipe galleries in these two streets, while the Westminster authorities did not seem to be aware of their existence.

The following requisites are necessary in order to secure satisfactory results in highway administration:

1. Centralization of authority over and responsibility for all work relating to highways within the administrative district.

2. Such flexibility of organization as will permit a concentration of force on any work of pressing importance.

3. Administrative units sufficiently large to permit the utilization of an entire force and equipment all of the time, reducing overhead charges to a minimum consistent with efficiency and thoroness.

4. Get rid of the prevalent horror of a bureaucracy. If such a bureaucracy works well, it is a good thing. If it works badly, it is not because it is a bureaucracy, but because it is not well organized.

5. Direct and undivided responsibility for every part of the work, each head of a bureau or subdivision to be made to realize, however, that his own particular work should be so done as to help and not to hinder that of other bureaus or divisions.

6. Promotion to the headship of bureaus and departments to be made from within the organization when possible, not necessarily according to seniority, but by reason of peculiar fitness. When it is necessary to go outside of the organization to fill such a place, the appointee should be one who has already made good in similar work in some other place.

7. Permanent tenure of office for those in responsible charge, so that continuity of purpose and policy may be assured.

THE MORTON DENISON HULL PRIZE

The National Municipal League, thru the generosity of Hon. Morton Denison Hull, of Chicago, has established an annual prize of Two Hundred and Fifty Dollars, to be awarded for the best essay on a subject connected with municipal government. The competition is open to postgraduate students who are, or who have been within a year preceding the date of the competition, registered in any college or university of the United States offering distinct and independent instructions in city government. Subjects for 1914 are:

1. The history of municipal government in the United States during either one of the following periods: (a) from the Revolution to the Civil War; (b) from the Civil War to the present time.

2. The charter and the practical workings of government in any American city having a population of 50,000 or over.

3. The legal problems involved in the home-rule charter, with special reference to the experience of those states in which the system has been in operation.

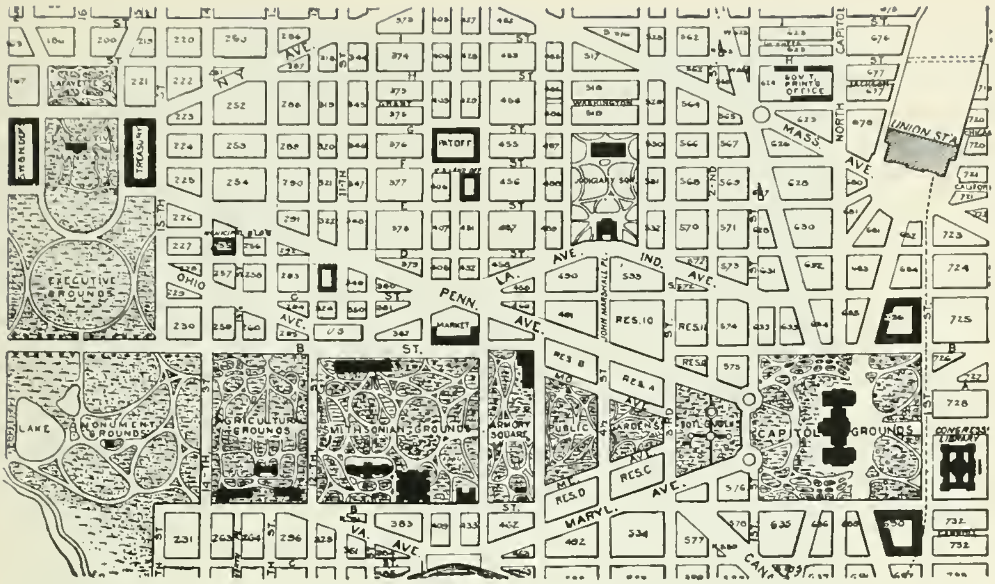
4. The actual operation of the following features in American municipal government: (a) the initiative and referendum; (b) the recall; (c) proportional and minority representation; (d) limited and preferential voting.

5. Public utilities' commissions, with special reference to the control of municipal public utilities in any state of the Union.

6. Municipal accounting and budget-making, with special reference to the actual results derived from the use of new and uniform methods.

7. The sources of municipal income in any state of the Union. (The study should deal with such matters as productiveness, cost of collection, and a general outline of each source. Competitors who think of choosing this subject should make sure that it has not been already covered by some published study, as, for example, in the case of Illinois).

8. The municipal charter system, whether general or special, in any state of the Union which contains at least two cities of more than 50,000 inhabitants.



ORNAMENTAL LIGHTING

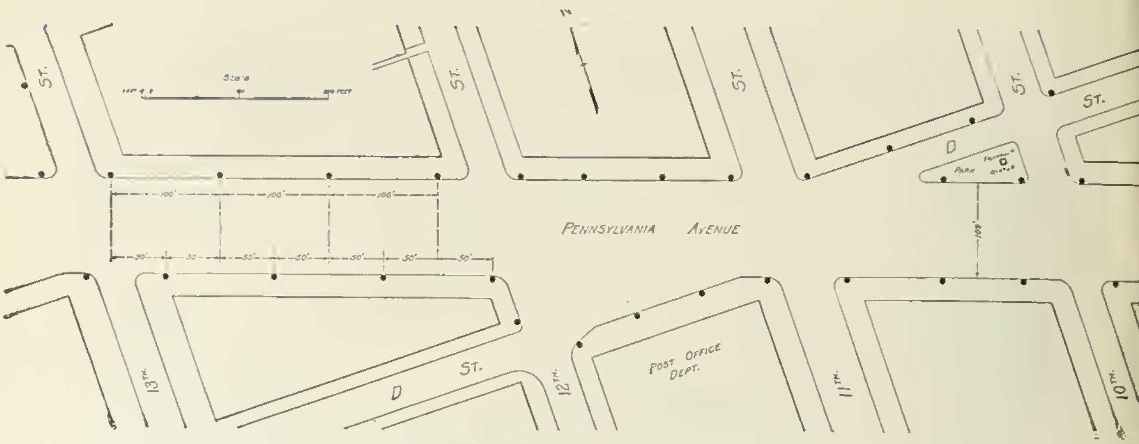
OF PENNSYLVANIA AVENUE, WASHINGTON, D. C.

PENNSYLVANIA AVENUE, in Washington, D. C., connecting the legislative and executive groups of public buildings, in the capital of the United States, is logically the proper street to be treated as the example of all that is imposing and beautiful in street planning and operation. For many years after the founding of the city this street was in darkness. According to Walter C. Allen, electrical engineer of the District of Columbia, in a paper published in the *General Electric Review*, the first appropriation for lighting the avenue was made in 1842, and it set apart $2,500 for this purpose to be used between the Capitol and the President's Square. Probably oil lamps were used because the first gas company began operations in 1848, and was authorized the same year to light Pennsylvania avenue, still at the expense of the United States Government. When the present form of government of the city was adopted, the lighting of the street was taken up by the Commissioners of the District. In 1886 there were 123 gas lamps on the street, costing $20 a year each, moonlight schedule, or $2,460.

After a few experiments in 1884 and 1885, a contract was let for lighting the street with twenty-four electric arc lamps at $248.20 each per year on all-night schedule, or $5,956.80 in all. The number of lamps increased later and they were supplanted by multiple inclosed arc lamps in 1902, which are now supplanted by the luminous arc lamps, the installation of which is described in the article referred to.

The map shows the commanding location of Pennsylvania avenue and the numerous widenings of view by open streets and grass plots at the intersections with the rectangular street system and with other diagonal avenues. It will be seen from this how ineffectual the early gas and electric lighting systems must have been.

The second of the accompanying drawings, showing the avenue between Tenth



PENNSYLVANIA AVENUE, *Washington, D. C., from Tenth to Thirteenth street, showing locations of ornamental lamps.*

and Thirteenth streets, will give some idea of the vastly greater illumination provided by the new system, and the location of the lamps around all the irregularities of the boundaries of the avenue and the street intersections and in the public places formed by them.

This installation requires for the entire 6,356 feet of the avenue, 123 lamps, the same as for the first gas installation. They cost $97.50 each, or $11,992.50 in all. The wonderful development in electric lighting, especially in reducing its cost, is seen by comparing the cost of operating this installation with that of the first installation of electric lights in 1886, the number of the new lights being more than five times the first and the annual cost being but twice as great.

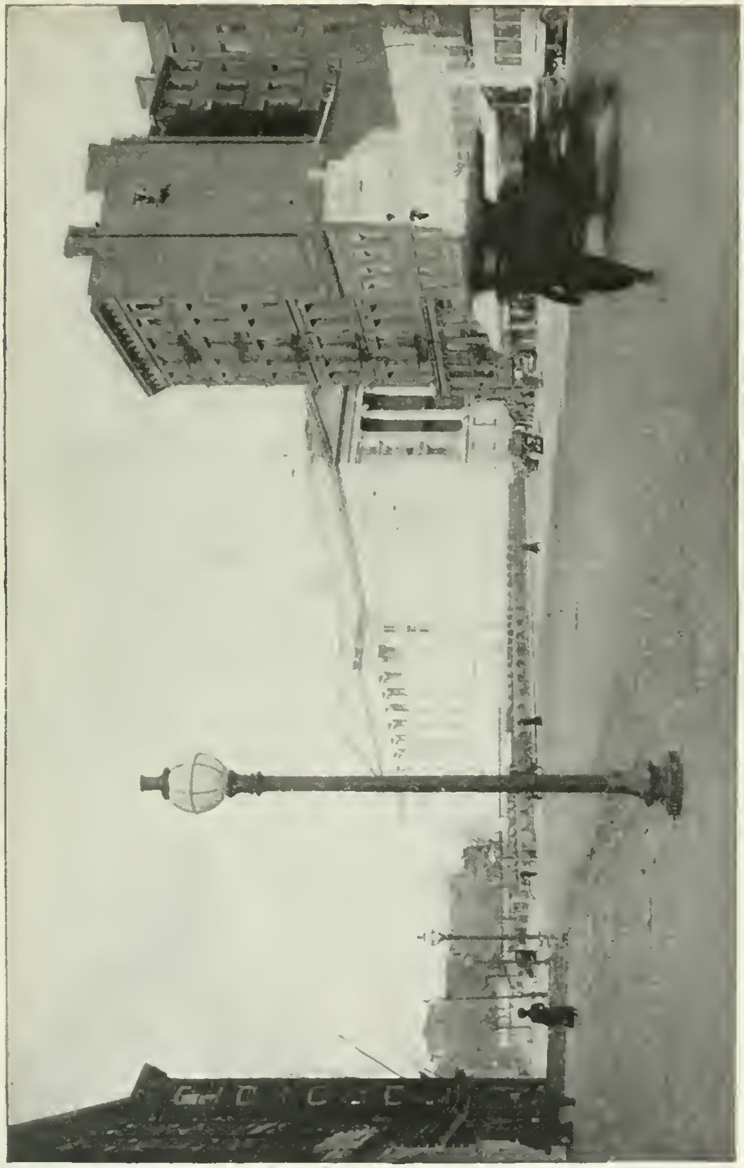
Two photographs of Pennsylvania avenue show the daylight appearance of the lamps on the street. One of these shows the east end of the street on the block between Fourteenth and Fifteenth streets and the other shows the same end, the photograph being taken from a point near Tenth street and showing a part of the lamps located in the second of the maps above referred to.

A drawing shows in detail the ornamental post and diffusing globe and a photograph gives a closer view of the globe with its ventilator and casing. Still another photograph gives a closer view of the lamp casing, opened to show the lamp mechanism.

This lamp is the standard 6.6-ampere 520-watt luminous arc lamp of the General Electric Company. There are some special features of the installation which are described by Mr. Allen.

The width of the roadway of the avenue proper is 109 feet between the curbs along which the lamps are placed, but there are numerous wider spaces, occasionally nearly doubling the width. The lines of posts are carried around these widened spaces as well as across some of them, keeping the average distance between posts about 100 feet. The area actually lighted is therefore materially greater than the 692,804 square feet in the roadway proper, including, as it does, the sidewalks, the intersecting streets for considerable distances and the triangular spaces, paved or parked, between these intersecting street lines.

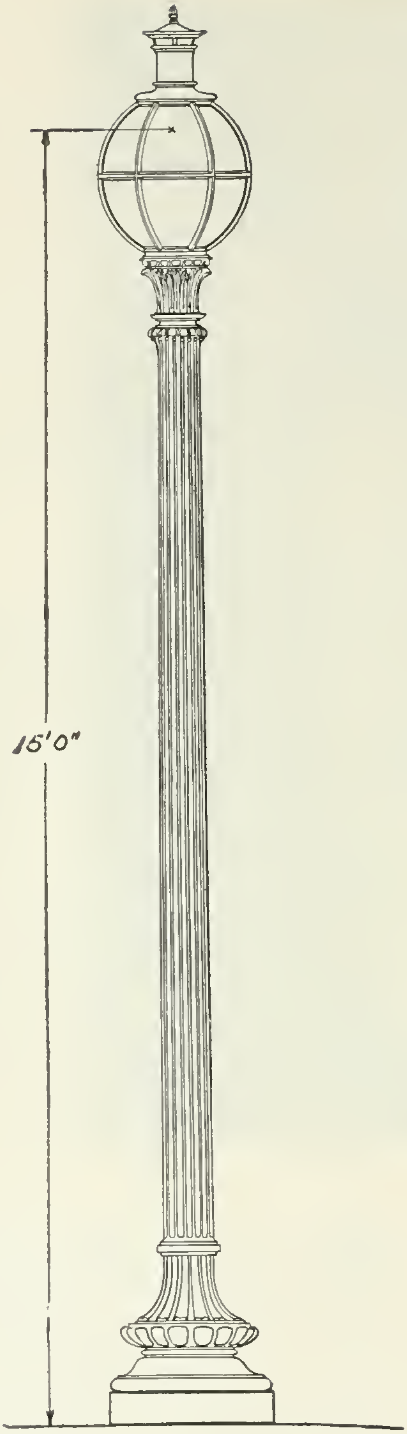
The lamps are served by cables in conduits laid many years ago in the roadway on both sides of the street, three feet from the curb line. The cables are single-conductor No. 8 B. & S.-gage copper, insulated with 8/32-inch varnished cambric and protected by 1/8-inch lead sheath. They are carried up the posts to the lamp terminals without breaking the lead covering, with no cut-out at the base of the post. Two circuits are used, connected with lamps so that after midnight one circuit can be cut out and the lamps on the other circuit will alternate



PENNSYLVANIA AVENUE, *Washington, D. C., near Fifteenth street, showing the new ornamental lighting posts and lamps and their locations.*

on the two sides of the street and thus make the illumination uniform, tho but half as great.

The posts were designed by James R. Marshall and Albert L. Harris, of the firm of Hornblower & Marshall, architects, of Washington, following the lines of the posts of their design used in the improved incandescent electric lighting system of the city. Full-size plaster models of posts with various designs of lamp casings and globes were made by John J. Early, sculptor, of Washington, and the final design was worked out from these models. Patterns were then made by the Union Foundry Company of Anniston, Ala., who secured the contract for the posts. They introduced an ingenious



method of locking the post to the base by a single turn of the shaft after inserting it in the top of the base, thus doing away with bolts or set-screws and greatly facilitating the erection of the posts.

The globe of the lamp is of special design. The cast ribbed frame is of aluminum, experiments showing that it gives the best results. It is in two hemispheres, upper and lower, being elongated about two inches in the vertical diameter. Polyclase alabaster glass is used, specially designed for use with luminous arc lamps by the Gleason-Tiebout Glass Company, of Broooklyn, N. Y. It was necessary to blow the glass as a sphere, about twenty-three inches in diameter, grind the top and bottom openings to size and then cut the globe into segments to fit the ribbed frame. This is accurately done, probably for the first time in the history of the art. The inner surfaces of the ribs are lined with felt and the glass is held against them by

THE LAMP *on its post in the drawing and the exterior of the lamp and casing in the photograph.*

PENNSYLVANIA AVENUE, *Washington, D. C., from point near Tenth street, looking northwest, showing the street in front of the postoffice, also shown in the drawing of this section of the street.*

equalizing spring fasteners, so designed that the pressure is distributed equally, besides providing for irregularities in thickness and allowing for expansion and contraction. The glass segments can be readily replaced by insertion from the inside of the frame while in position on the post.

"Medium" dense glass is used in the upper hemisphere and "light" in the lower half, both giving perfect diffusion with no shadows, no portion of the lamp mechanism or even the arc itself visible. The glass becomes a luminous surface emitting a powerful yet soft light without glare.

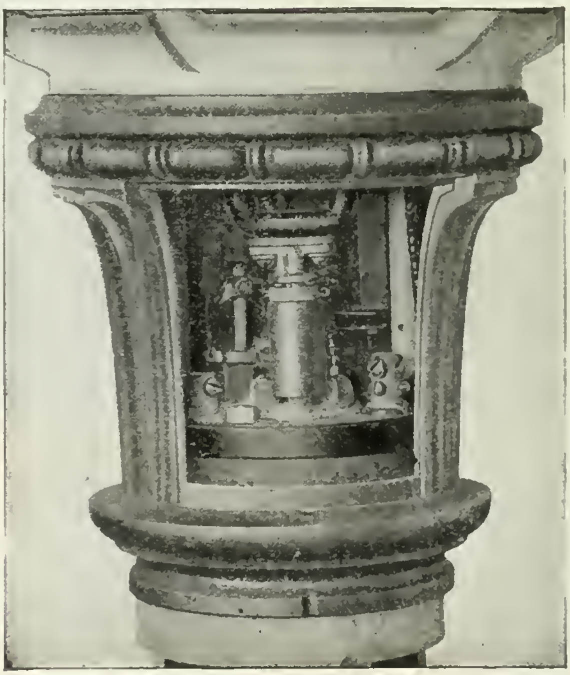
Insulators of special General Electric waterproof compound, instead of the standard glazed porcelain, are used between the lamp mechanism and the top of the cast-iron post, being inclosed in the ornamental cast-iron casing surrounding the mechanism. The insulators are tested at 20,000 and 25,000 volts. A specially shaped ring of the same composition on top of the aluminum frame insulates the metal ventilator and upper fume box from the post. A cylindrical lining of mica, the sides of which are 3/16-inch thick, is placed around the mechanism within the cast-iron casing.

Access to the lamps for trimming is obtained by removing the ventilator on top and raising the upper fume box and insulator on the specially constructed flat slide rod. The rod is so located that when the lamp is burning the shadow of the rod is thrown on one of the ribs, which is large enough to cover it. The globe can be cleaned and the upper parts of the mechanism adjusted thru the top. The terminals and lower coils are reached thru a door in the ornamental iron casing below the globe, as shown in one of the photographs. The whole upper half of the ribbed frame can be removed if necessary.

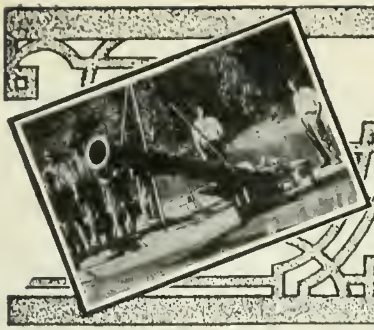
With 520-watt lamps every 100 feet on both sides of the street, the average watts per linear foot of street are 10.06, and with 109-foot width are 0.0923 per square foot. The cost per year for maintenance with lamps at $97.50 each is $1.886 per linear foot of street, and per square foot is $0.0173. If all the area of sidewalks and of the irregular spaces at street intersections were included, these averages would be materially reduced.

The cost of installation, including cables, setting of posts, etc., was borne by the lighting company and is estimated at $170 per unit. The posts, ribbed frames, glass and special parts of posts and lamps are furnished by the city and cost $67.40 per lamp, the post costing $26.90, the aluminum frame and glass $37.50 and special parts $3.00.

From the annual charge of $97.50 per lamp is deducted, by act of Congress, $4.40 per lamp as interest and depreciation on the posts and lamps owned by the city.



THE INTERIOR *of the casing at the base of the lamp and the mechanism for operating it.*



EDITORIAL

DEFECTS IN THE COMMISSION FORM OF MUNICIPAL GOVERNMENT

The New Jersey law providing the commission form of government for cities in that state has been in operation long enough to show the lines in which it is defective. These defects are stated in a recent number of the municipal paper of Atlantic City by an attorney, who has made special study of the subject. In brief, they are:

1. Directors or commissioners should be nominated for the particular position they are to fill and not elected in block, to be assigned to office by the commission as a whole after election.

2. The bureaus to be under the charge of each commissioner should be fixed by the law and not subject to changes of assignment as at present, so that three members of the commission can reduce the duties of any one or two to simple votes, without power or duty in any department or bureau.

3. Too small a minority (15 per cent. of vote) can start a proceeding to recall a commissioner and too soon after his election, tho he must have a majority of all the votes cast in order to be elected; and he should be accused with full authority of some nonfeasance or malfeasance in office before a recall petition can be carried thru.

4. In Atlantic City the highest five in the primary election have always been elected in the subsequent election, so that the double election is considered a useless expense.

Not every one will agree with the remedies hinted at in the above statement of defects. Some, for example, would select commissioners or a mayor and council at large to act as the legislative head of the city and require them to put the various departments in charge of appointed experts, who should be kept in their places as long as they are competent and can act in accord with the principles, plans and policies in the platform on which the commissioners were elected. Whether the departments shall be under one head with assistants responsible to him or under several heads responsible directly to the commission, or under boards responsible to them, are questions of local rather than general interest and should be left largely to the decision of the voters in each city, if the principle of home-rule is accepted.

Because Atlantic City has found the double election unnecessary up to this time, is no sign that it is not desirable elsewhere or will not be desirable in Atlantic City at another time. The defect may be in the method of putting candidates in nomination for the primary election rather than in the double election itself.

The second and third points seem to be very well taken and good remedies are suggested.

MODERN CONTRACTS WITH PUBLIC SERVICE CORPORATIONS

Few states as yet have Public Service Commissions which supervise the corporations, whether private or municipal, which render service to the public at large and to individuals under franchise or contract ordinance, but the work done by the commissions in existence and the publicity given to the results thereof are having their effect upon the contracts made by cities in other states with their own public service corporations.

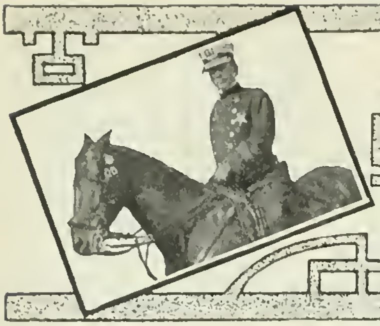
The profits of the corporations are no longer so surely considered the private business of those corporations but are recognized as the public business. The monopolies granted by the franchise contracts are recognized as subject properly to regulation as to rates as well as quality of service.

While many franchises are still considered perpetual even tho the companies operating under them are limited in life by the statutes, the companies must make contracts for public service at more or less frequent intervals. Whatever the length of these contracts may have been as at first granted, many of them are being renewed yearly, and there is an increasing tendency to limit profits to a reasonable figure, standardize rates so that every one will pay the same for the same service, and insist upon the best service available. When four gas, water, and electric light contracts come into a single office in one week for consideration there is indication of great activity in this direction.

Gas seems to be in particularly active condition at present. The experience of such companies as the Citizens Gas Company of Indianapolis, and the Consumers Gas Company of Toronto, has aroused an interest in the possibilities of good service at low rates, and several other cities have new gas contracts under consideration at this time.

ELECTRIC LIGHTING ADVANCE

The articles in this number of Municipal Engineering, including one on ornamental lighting, one on municipal management of an electric light and power plant and one on a recent contract for the lighting of a city by a private company, as well as the striking illumination of the tower of the Buffalo building of the General Electric Company, shown on the cover, show the enormous advances which the science of electric lighting has made in quality and quantity of light furnished and in reduction in cost. The latter is quite as noticeable as are the two former, and is shown in the articles referred to, which will well repay the time it will take to read them.



QUESTION DEPARTMENT

Best Contract Between Engineer and Municipality

I should be pleased to know what would be the most advantageous agreement for an engineer with a municipality; the stipulations of the agreement. R., ———, Can.

Will engineers who have satisfactory contracts of this sort other than straight salaries communicate their terms, for transmission to our correspondent, confidentially or for publication with or without names as they may prefer?

The principal difficulty in making an equitable contract is in estimating the time necessary to complete the contract fully. This depends first upon the actions of the council in starting the work, letting the contract, etc.; second, upon the diligence of the contractor in prosecuting the work, and third, upon the ease of making a settlement between the parties. The time of inspectors and to a certain extent the time of the engineers is affected by these chances for delay.

Probably the most satisfactory contract from the standpoint of the engineer is one made on a percentage basis, a certain percentage of the estimated total amount of the contract being due on presentation of the preliminary report, a certain additional percentage on the presentation of plans and specifications, a certain additional percentage on the completion of the work. The first payment, for the preliminary report, may be a lump sum. The percentage on completion of work should cover the engineering work upon the construction of the work and may or may not include the inspection. On account of the chances for delay referred to, over which the engineer has no control, it should be more satisfactory to both engineer and city to leave the payment for inspection out of the engineer's contract, the city paying the inspectors directly. However, if the engineer is to be properly responsible for the work he must control the appointment and length of service of the inspectors within reasonable limits.

This is a subject on which each engineer has his own opinions and discussion of the subject is invited.

Tractors for Hauling Road Materials

I would like full description of medium weight tractors for us in hauling road material, and of wagons used with them. We have seen no ten-ton outfit but what is not suited for the conditions under which we have to work. T., ———, Fla.

Names of manufacturers of traction engines and trucks will be found in the "Business Directory" published in each number of MUNICIPAL ENGINEERING under the headings "Automobiles," "Engines," "Motor Trucks," "Road Rollers," "Traction Engines," "Traction Engines (Oil or Kerosene),' "Trucks, Motor."

If some statement of the conditions were given it would be possible to give some idea of what machine would best suit them.

Can You See Thru a Wall?

Can you inform me of any way by which a person in one room, with closed doors, can see what is going on in an adjoining room?

I am very anxious for information bearing on this subject and willing to pay liberally for same. N., Chicago, Ill.

This is apparently a puzzle for the solution of which a prize is offered, tho the amount of the prize is not stated. The editor takes the liberty of barring holes and cracks in the wall or other obvious methods of observation of the next room.

Gas Works Builders and Gas Rates

Give us the names of companies who install gas plants, both large and small.

Also, such information as you may have concerning cost of producing gas and success of competing plants.

M., Atlanta, Ga.

Coke ovens from which gas is produced as a by-product, such as those used by the Citizens Gas Co., of Indianapolis, are the

United Otto of the United Coke and Gas Co., 17 Battery Place, New York, H. Koppers Co., 5 S. Wabash St., Chicago, Ill., and the Semet-Solvay of the Semet-Solvay Co., Syracuse, N. Y.

There are many manufacturers of gas works machinery and builders of plants of which the following may be considered representative:

Coal gas plants are constructed by the Gas Engineering Co., Trenton, N. J., American Coke and Gas Construction Co., Camden, N. J., Gas Machinery Co., Cleveland, O., Kerr-Murray Mfg. Co., Ft. Wayne, Ind., Bartlett Hayward Co., Baltimore, Md., United Gas Improvement Co., Broad and Arch Sts., Philadelphia, Pa., Western Gas Construction Co., Ft. Wayne, Ind., R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa.

Producer gas plants are made by many manufacturers among which are the De La Vergne Machine Co., E. 138th St., New York, Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill., Power and Mining Machinery Co., 115 Broadway, New York, Wellman-Seaver-Morgan Co., Cleveland, O., Westinghouse Machine Co., East Pittsburgh, Pa.

Water gas making machinery is installed by the Gas Machinery Co., Citizens Building, Cleveland, O., the United Gas Improvement Co., Philadelphia, Pa.

Acetylene gas plants are furnished by the Davis Acetylene Co., Elkhart, Ind., National Light and Heating Co., Freeport, O., A. Alexander Milburn Co., 1420 W. Baltimore St., Baltimore, Md., and many others.

Gasoline and naptha gas plants, small, are supplied by the Sun Co., Morris Bldg., Philadelphia, Pa., Gilbert & Barker Mfg. Co., Springfield, Mass.

The cost of producing gas is so much a factor of the quality of the gas and the use to be made of it and of the other products of the process that no figures of value can be made without full knowledge of the plans and of the materials to be used and of the business to be done.

To say that the gas made in the by-product coke ovens of the Citizens Gas Co., of Indianapolis, costs nothing or is put in the holder at a credit means nothing except that the coke business of the company is profitable even if the gas is wasted. Where the coke could not be sold at good prices this statement would not be true. The cost of distribution must be added, and the company is making good profits selling gas at 55 cents a thousand. The Birmingham Railway & Electric Light Co., recently offered that city by-product gas at 55 cents after three years at somewhat higher prices, but the quality of gas available seems to have been so poor that the city did not accept the offer. Again, a small water-gas plant was allowed a rate of $2.00 for small consumers because the commission thought this rate was necessary to pay proper return on the money invested. It is thus evident that a comparison of rates in different cities is of little or no value unless many details of conditions are fully known.

The question is one which should be put in the hands of an engineer not biassed in favor of any one system of manufacture, who knows the field and its possibilities for full study and report, after which and on the basis of which decisions as to plans general and detailed can be made.

Lists of rates in various cities will be found in Municipal Engineering, vol. xlv, pp. 49, 376, xli, pp. 225, 228, and a long list in towns of 5,000 to 10,000 population in vol. xl, pp. 38, 125, 220, 347.

Garbage Collection and Disposal for Minnesota City

This city is contemplating installing a system of garbage collection and disposal. They would like to correspond with other city officials in this matter, and if possible have them send any information they may have where such methods are now in use and are operated successfully. Also copies of ordinances relating to the same.

Can you give this some space in your magazine, making our wants known?

———, City Engineer.

This information will be of interest to many cities and our readers are requested to forward what they can to the editor, who will send it on to our correspondent and also use it in articles on the subject. There are many articles in the last six or eight volumes of Municipal Engineering which will be of interest in this connection.

Books on Water Analysis

Can you give us the name of a hand book or publication which would give complete instructions so as to enable us to analyze our water supply from time to time, with special reference to bacteriological analysis?

S., Kane, Pa.

Perhaps the fullest discussion of water analysis from the bacteriological standpoint is to be found in Prescott and Winslow's "Elements of Water Bacteriology with special reference to Sanitary Water Analysis." ($1.75.)

Whipple's "The Microscopy of Drinking Water" ($3.50) is devoted to the minute organic life in water other than bacteria.

Stock's "Water Analysis for Sanitary and Technical Purposes" ($1.50) is an English book giving methods of making chemical examinations of water.

Mason's "Examination of Water" ($1.25) is a small book giving brief and clear statements of methods of analysis, both chemical and bacteriological.

WORKERS IN THE FIELD

Comparison of Operations of Private and Municipal Electric Plants of Pasadena, Cal.

The Editor of MUNICIPAL ENGINEERING:

Sir—I note in *Public Service* of March, on pages 75 and 76, reference is made to Pasadena's municipal lighting plant. I thought this would be a good time to show the real comparison of the operation of a public service corporation and the municipal department of the City of Pasadena, both reports having been filed for the year ending December 31, 1913.

I have made a comparison of the two utilities, and I am sending you a copy, which you are free to use. In analyzing the report I wish to call your attention to the following facts:

You will note that the amount we received per k.w. hr. for our street lighting was 4.91 cents, while the amount we received for commercial and residence lighting was 4.95 cents, showing a higher average rate from the sale of electrical energy for commercial and residence lighting than that which we received for street lighting. This is just the reverse of what is claimed in the attacking article.

I wish to call your attention to the fact that the opposition company charged a 4-cent rate for nine months of the year as against our rate of 5 cents, and the reason that the opposition company had to raise their rates to the same as those charged by the city for electrical energy for lighting was that they had been running at a loss, and they would have been obliged to lower their rates in all of the other towns to which they supplied electrical energy to the same as those charged in Pasadena if they had not raised their rates to the same as those charged by this department in Pasadena.

	Edison.	City.
Number of kw. hr. generated for distribution and delivered for distribution by our competitor and this department	5,356,140	5,446,000
Percentage of current lost and unaccounted for	20	19
Total income	$146,066.47	$161,182.20
Total operating expense, including depreciation, but not including interest on investment	$155,000.53	$109,532.27
Average rate of depreciation (per cent)	5	4.44
Net receipts	....	$51,649.93
Deficit	$9,286.26	....
Net income and surplus	....	$30,298.25
Deficit	$46,904.72	....
Average rate received for light (cents per kw. hr.	3.89	4.95
Average rate received for power (cents per kw. hr.	3.49	1.87
Average rate received for street lighting cents per kw. hour)	....	4.91

It might be of interest to mention that the expense of our competitor for all of those items other than generation and distribution, applying to general expense, office expense, new business expense, etc., amounted to $49,610.45, as compared to this department's $17,881.67.

You will note that their loss in competition with the city was $46,904.72, figuring their interest rate on the investment that they claim at 4 per cent. This is a very interesting comparison and shows that the large corporation has overhead expenses beyond all reason, and when it comes to real competition they cannot compete with a municipality that runs its business according to business principles.

C. W. KOINER,
General Manager, Municipal Lighting Department, Pasadena, Cal.

COMPARISON OF OPERATING REVENUES AND EXPENSES OF PASADENA'S MUNICIPAL AND PRIVATELY OWNED ELECTRIC LIGHT AND POWER PLANTS.

	Edison City of Pasadena	M. L. D. City of Pasadena	Edison Outside of City	M. L. D. Outside of City	Edison Total	M. L. D. Total
OPERATING REVENUE—						
1. Municipal St. Ltg.—Arc	....	....	60,071.84	....	60,071.84	....
2. Municipal St. Ltg. Incan.	....	47,701.16	83,671.70	....	83,671.70	47,701.16
3. Municipal Ltg.—Misc.	....	....	14,175.58	....	14,175.58	....
4. Com'l Ltg—Flat.	....	....	11,357.50	....	11,357.50	....
5. Com'l Ltg. Met.	106,115.28	75,228.18	1,890,006.89	4,157.92	1,996,122.17	79,386.10
6. Total Lighting	106,115.28	122,929.34	2,059,283.51	4,157.92	2,165,398 79	127,087.26
7. Municipal Power.	14.34	....	93,382.31	....	93,396.65	....
8. Com'l Pow'r—Fl't	....	....	176.75	....	176.75	....
9. Com'l Power—M.	37,373.85	27,618.34	1,607,576.40	6,476.60	1,644,950 25	34,094.94
10. Railway Power..	....	....	377,150.16	....	135,758.98	....
11. Other Elec. Corp.	....	....	135,758.98	....	135,758.98	....
12. Misc. Power Rev.	....	....	280.83	....	280.83	....
13. Total Power ...	37,388.19	27,618.34	2,214,325.43	6,476.60	2,251,713.62	34,094.94
14. Total Light and Power (6+13)	143,503.47	150,547.68	4,273,608.94	10,634.52	4,417,112.41	161,182.20
15. Mdse. & Job. Rev.	2,558.00	....	47,471.37	....	50,029.37	....
16. Rent of Elec. Appl.	5.00	....	5,886.37	....	5,891.37	....
17. Total Op. Rev.	146,066.47	150,547.68	4,326,966.68	10,634.52	4,473,033.15	161,182.20
OPERATING EXPENSES—						
18. Pro. & Tran. Exp.	20,437.69	43,577.80	767,284.24	....	787,721.93	43,577.80
19. Distribution Exp.	35,846.82	22,608.75	515,583.33	....	551,430.15	22,608.75
20. Coml Exp.......	24,683.48	....	213,572.63	....	238,256.11	....
21. General Exp.....	24,927.17	17,881.67	399,357.39	....	424,284.56	17,881.67
22. Taxes	6,210.02	....	196,517.23	....	202,727.25	....
23. Total Op. Exp.	112,105.18	84,068.22	2,092,314.82	....	2,204,420.00	84,068.22
24. Add Depreciation	42,895.35	25,464.05				
25. Total. Op. Exp. & Dep.	155,000.53	109,532.27				
26. Balance (17-25).	8,934.06	51,649.93				
27. Less Uncollectible Bills	.352.20	*				
28. Net Op. Rev.....	9,286.26	51,649.93				
Interest on Bonds..........		11,659.38				
Interest on Floating Debt...		9,692.30				
Net Income		30,298.25				
Surplus at beginning of year.		24,661.59				
Surplus at close of year.....		54,959.84				

* Included in General Expense.

The main table accompanies, showing the operating revenues and operating expenses of the two plants, that of the municipal lighting department and that of the Edison Company, as taken from their reports:

Explanotion of City Proportion.

Gross Revenue—The amount shown as gross revenue, inside and outside of the City of Pasadena, represents the actual bills rendered to consumers inside and outside of the city.

Operating Expenses—Production and Transmission Expenses—"Capacity Expense" is apportioned on a basis of the average peaks inside and outside of the city. "Output Expense" is apportioned on a basis of kw. hrs. sold inside and outside of the city.

Distribution Expense—All of the items under Distribution Expenses are apportioned on the meter basis except Sub-Station Expenses (Sub-Station Reprs., Sub-Station Supplies and Expense, Reps. Sub-Station Buildings and Genl. Structures, Reps. Sub-Station Equipment), which are apportioned on the basis of the maximum demand on Station inside and outside city; Commercial Arc Lamp Expense (Commercial Arc Labor, Commercial Arc Supplies and Rep., Repairs Commercial Arc Lamps), which are apportioned on a basis of the number of Arc Lamps inside and outside of the city, respectively; Commercial Incandescent Lamp Installation and Renewals, is apportioned on a basis of the number of Incandescent Lamps inside and outside of the city respectively.

Commercial Expenses—All of the items under Commercial Expenses are apportioned on a basis of the number of meters inside and outside of the city.

General Expenses—All of the items under General Expenses, except General Office Expense Proportion, are apportioned on the meter basis; General Office Expense Proportion is apportioned on a basis of the Gross Earnings Light and Power, inside and outside of the city.

Taxes—Taxes are apportioned on a basis of the Gross Earnings inside and outside of the city.

The expense to the Municipal Lighting Department for furnishing current without the city limits is practically the same per kw. hr. as that for supplying it within the city for both light and power.

Other tables show the amount of current correspouding to each item in each line of the table of operating revenues; the details of the items of operating expenses, showing the differences in classifications of items in the two systems of bookkeeping; the account of materials and supplies passing thru stores and sales departments; and the cost of equipment and plant in detail.

The total value of the plant of the Edison Company is $22,560,686.98, of which only $914,615.79 is in Pasadena. This valuation is to be compared with that of the municipal plant for an output almost exactly the same, $656,807.23 at the end of the year, every cent of which has been fully accounted for. The principal differences in items are in real estate and buildings, about $60,000; transformers, $19,000; meters, $35,000; and about $145,000 in various items of transmission and distribution equipment, in which the company's plant exceeds the city's plant in cost.

The table giving the account of electric energy shows the almost exact equality in amount of business of the two companies, as follows:

Curent.	Edison Plant kw. hr.	Municipal Plant kw. hr.
Commercial lighting, metered	2,701,262	1,602,170
Used by co. or city	24,930	34,695
Municipal lighting	....	969,787
Total lighting	2,726,192	2,606,652
Commercial power, metered	1,558,718	1,820,303
Total accounted for	4,284,910	4,426,955
Lost and not accounted for	1,071,230†	1,039,045*
	5,356,140†	5,466,000*
Maximum demand in any one day in year	2,027	1,940
Minimum demand in one day	no data	250
Percentage of loss	20†	19*

*Actual, metered.
†Estimated.

The inventories show that the Edison Company prefers having about 70 per cent. of 40 and 45-foot poles and the city uses 80 per cent. of 35, 40 and 45-foot poles. The company has 4,852 poles, in 742 of which it has only part interest, and values them at $82,707.52, while the city has 5,504 poles, all its own except 26 in which it owns a half interest, and values them at $66,100.84.

The other inventories show mainly such differences as the methods and dates of building the plants and the demands of development and displacement of old equipment might explain in large degree.

The attempts to discredit the Pasadena municipal plant seem most of them to be ill advised, and they react to show or even possibly to exaggerate slightly the economies of its operation. They doubtless also have the effect of keeping the management and the employes always up to their best efforts, and are in this respect also of real benefit to the City of Pasadena.

Inspector's Handbook.

Referring to the inquiry for books on inspection, page 378, your April issue, and your answer thereto; it may be of interest of your correspondent to know that in the second edition of my little book on "Specifications for Street Roadway Pavements" (The McGraw-Hill Book Co. 1913, $1.00) will be found a carefully prepared set of "Instructions to Inspectors on Street Paving Work," occupying 25 pages.

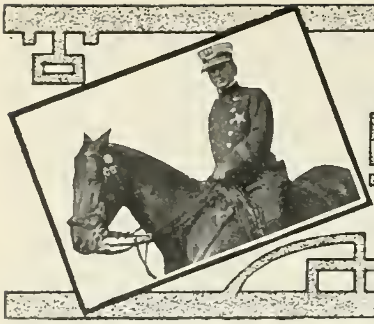
S. Whinery,
Civil Engineer, 95 Liberty street, New York.

Municipal Tour in Europe

Robert S. Binkerd, secretary of the City Club of New York, will lead a group of city officials in a tour of European cities for the purpose of studying and observing municipal government at first hand in Copenhagen, Berlin, Dresden, Munich, Ulm, Frankfort, Dusseldorf, Essen, Amsterdam, Brussels, Paris, London, Liverpool and others, covering all lines of municipal activity. He will have several assistants expert in various branches of municipal activity and in languages. The trip will occupy July and August.

Portland Cement Production in 1913

The final figures for the Portland cement industry in 1913, as obtained by the United States Geological Survey on March 16, show a production of 92,097,131 barrels, shipments of 88,689,377 barrels and stocks on hand, 11,220,328 barrels.



LEGAL DECISIONS

Decisions of Higher Courts of Interest to Municipalities

City's liability for insufficient water supply accrues only after failure to correct defective system. After a water main had been extended by the city to annexed territory, the board of health in December, 1911, notified the plaintiff to connect his premises with it, which he did in January, 1912, and it appeared, after trial, that the quantity of water on the second floor of plaintiff's house was not sufficient to flush his closets, and the supply was so diminished by other buildings being connected with the main that after about a month plaintiff had no water at all for his bathroom, which facts plaintiff reported to the authorities and suggested that his premises be connected with a standpipe intended to supply an adjoining district, which was refused on the ground that such diversion would render the supply of the persons in that district inadequate. A few days after July 18, 1912, plaintiff and others signed a petition requesting action by the city to remedy the defect in their water supply, and the authorities immediately directed that the main be connected with another pipe, which was done four days thereafter, and which gave plaintiff sufficient water. *Held*, that the city was not liable in damages for the insufficiency of plaintiff's water supply when the main was first connected with his property, in view of its subsequent action in making an adequate supply available. The adoption of a plan for supplying a part of a city with water involves the exercise of a delegated governmental power, so that the city is not liable in damages for an error of judgment as to the adequacy of the system as originally installed, though it may subsequently become liable after it is clearly demonstrated by experience that the system is inadequate or defective. Stansbury v. City of Richmond (Va.), 81 S. E., 26.

Eminent Domain Appurtenant only to Public Service Corporation—Where the charter of a water company gave it power to hold real estate, take water, pipe it, and sell the same to individuals or corporations, make contracts, etc., but contained no provisions requiring the power to be employed directly for a public use, or forbidding it from using all the water obtained by it for a purely private use, such as a manufacturing business, or from selling it all to one person, the water company did not have the right of eminent domain. That the Legislature has given a water company the right of eminent domain and the grant has been accepted will not confer such right on the company, where the charter does not make the company a public service corporation, since the Legislature cannot make a use public by declaring it so, but it is for the courts to determine whether the declared uses are in law public uses. If a water company's charter by its terms does not make it a public service corporation, that it had always performed a public service would not give it a right of eminent domain. Norfolk County Water Co. v. Wood (Va.) 81 S. E., p. 19.

General Sidewalk Ordinance sufficient to Validate Individual Sidewalk Construction by Resolution—A city of the second class had in force a general ordinance relating to sidewalks, prescribing the width, material, width of space reserved, the manner of construction, and the procedure incident to the ordering of a sidewalk and its construction, a section of which ordinance gave directions touching the petition, notice, and resolution required in order to construct a sidewalk. The required petition, notice, and resolution were presented, given, and adopted, and the tax to pay for the work was levied by the enactment of an ordinance. *Held*, that the city acted in substantial conformity with the requirement of section 1374 of the General Statutes of 1909; that such work be authorized by ordinance; and that the collection of the tax should not be enjoined on the ground that the city had proceeded not by ordinance but by resolution. Dargatz v. Pauley, county treasurer, (Kan.) 139 Pac., 419.

Paving Assessment Valid if Property Owner Knowingly Fails to Present Objections at Proper Time—Where jurisdiction is conferred upon a municipal body to provide for paving its streets, and charge the cost thereof against the property benefited, according to the method provided by law, a property owner who stands by while such work is being prosecuted, with full knowledge that large expenditures are being made for such improvements which will benefit his property, or, upon due notice, fails to appear at the proper time and before the tribunal prescribed by law, and present his objections, if he have any, will not, after the work is completed, be afforded relief by injunction against assessments levied against the property benefited to pay for such work. City of Bartlesville et al. v. Hohn et al. (Okla.), 139 Pac., 273.

Contract for Improvement Cannot be Modified by New Contract—A city could not, after having awarded a valid contract for a street improvement, thereafter by a second contract release the contractor from performance according to the specifications of the first contract, and the remedy of the property owner was, under the express provisions of Street Improvement Act an appeal to the city council, which could set aside the assessment and order the work done according to specifications. McIntyre v. City of Los Angeles (Cal.), 139 Pac., 240.

Natural Water Course—City not Liable for Water Damage from Grading Streets—A channel in which water never flowed except when the ground was frozen and snows melted in the late winter or early spring, and then as mere surface drainage over an entire tract, occasioned by unusual freshets, was not a "natural water course." Damages cannot be recovered for consequential injuries to private property occasioned by the original grading of streets and alleys, since their dedication implies an agreement of the dedicator and his successors that the city may improve. Surface water caused by the falling of rain or the melting of snow is to be regarded as an outlaw or common enemy against which every proprietor of land may defend himself, even if, in consequence thereof, injury results to others. A city which, in making an initial grade of streets, filled in an old dry channel where it intersected such streets and constructed culverts sufficient to have carried off the water running in the channel at certain seasons, but which were useless because private owners had filled in the channel on their lots, was not liable for casting surface water on plaintiff's property, since the filling in of the private lots was the proximate cause. Thorpe et ux. v. City of Spokane, 139 Pac., 221.

City Liable for Damage from Obstruction of Street Drainage—Before plaintiff's lot had been raised so as to be somewhat above the proposed street grade except in the rear, a ditch was dug along the street by another adjacent owner with the city's consent or acquiescence for the purpose of draining away the surface water, and thereafter the city engineer, merely in view of raising the street in the future and not for making a present improvement, dumped waste material in the street so as to make an embankment across the ditch and dam up the surface waters, which were thereby cast on plaintiff's land in a greater volume than they would have naturally flowed thereon. *Held*, that the city was guilty of an actionable wrong in thus impounding waters and casting them upon plaintiff's land. In an action against a city for damage to property by impounding surface water in a street and casting it upon plaintiff's property, the court instructed that the term "Act of God" applied only to events in nature so extraordinary that the history of climatic conditions in the locality afforded no reasonable warning of them, and liability for injury caused by floods cannot be avoided, on the ground that the flood was an act of God, where it might have been expected, though it occurred infrequently, and that even though the city had caused material to be dumped in the street, yet if the storm which caused the injury to plaintiff's property was so overwhelming in character that it would of itself produce the injury independently of the material, then the jury must find for defendant, and further instructed that, to give a body of water the character of an extraordinary flood, it is not necessary that it should be the greatest flood within memory, but its character should be tested by comparison with the usual volume of floods ordinarily occurring. *Held*, that the instruction as a whole was that, if the storm would have caused the injury to plaintiff's property independent of the obstruction placed in the street, plaintiff could not recover. City of Tucson v. Dunseath (Ariz.), 139 Pac., 177.

FIRE AND WATER

Water Works Machinery and Devices

By E. L. Loomis, Superintendent of Water Works, Elkhart, Ind.

The author of this paper, which is from one read before the Indiana Sanitary and Water Supply Asociation, is a practical operator of a water works plant and always presents something of value. This article shows what economies can be secured by the use of devices which are well known but are not as commonly in use in small plants as they should be.

MORE than four-fifths of all the water plants of the state of Indiana belong to the smaller classes whose daily pumpages probably average less than one million gallons. As compared with the larger systems, these enterprises have relatively few consumers, limited revenues, and proportionately much higher fixed charges and operating expenditures. Therefore, it is easy to realize that the problems confronting such utilities as to economy and efficiency are of paramount concern. And the smaller the utility, all the greater becomes the necessity for the closest scrutiny into its plant operations for the detection and stoppage of waste, and for the economical conduct of its affairs generally.

A visit to almost any of the larger plants of the state will disclose the fact that they are not only equipped with all sorts of devices and facilities for the economical conduct of their enterprises, but will convince us also that they have experienced and technically trained men to manage and supervise them as well. Many of the smaller concerns likewise exemplify a similar degree of thrift and skill. To any of us, a detailed study of these systems and of their various kinds of operations for plant economy would be well worth while, and would doubtless yield abundantly in returns if the information thus acquired were adapted and applied, so far as practicable, to our own needs.

Only a few items will be here considered, and chief of them may be cited the pumping machine. As illustrating an experience in pumping economy, you will permit me to state the conditions as existing in our plant at Valparaiso, and to make a comparison of the costs of operating each of our three different types of pumps.

Our pumpage approximates 1,000,000 gallons per day, pumping direct against a total head of 85 feet. Our principal pump for continuous operations is a cross-compound, condensing engine, with Meyer gear and attached air pumps. Upon acceptance test when we purchased this machine two years ago it showed a duty of 78.57 million foot pounds per 1,000 pounds of steam used, pumping against our usual head at normal load.

Assuming an apparent evaporation of 7 pounds of water to each pound of coal, and a total head of 100 feet, with a working duty of about 70 million foot pounds per 1,000 pounds of steam, this machine will pump and deliver 1,000,000 gallons of water each day for one month at a steam consumption of 358,071 pounds, thus requiring 25.57 tons of coal, which at $3.50 per ton in bin, costs us $89.49. With our No. 2 reserve pump, of the non-compound, condensing, crank and fly-wheel type, assuming a working duty of only 50 million foot pounds, which is really a trifle too high, for the same pumping operation 501,300 pounds of steam would be consumed, requiring 35.80 tons of coal at a cost of $124.30. With our third unit, a simple duplex pump, which, needless to state, is rarely placed in service, 752,129 pounds of steam would be used, or 53.71 tons of coal costing us $187.98.

Thus it is observed that by using our No. 1 pump, for each month we operate we show a saving of $34.81 over pump No. 2, while over pump No. 3 we effect a saving of $98.49, or in round numbers, almost at the rate of $1,200.00 per year.

Such a saving to any small plant in a comparatively short time would be sufficient to buy and install the very best and most economical type of pump which the market affords.

In our own case it is plainly apparent that from the standpoint of even ordinary business economy we had better consign both of our low duty pumps to the scrap-pile rather than place them in continuous operation. As auxiliary units, for temporary emergency purposes, however, they, of course, have their place and value.

A good, durable, dependable and economical pump for the particular service required, is the very heart of every water-works system, and no plant can reach its highest state of efficiency unless its pumping equipment combines all of these fundamental requirements.

The pumping machine for every plant should be designed so as to give the best possible economy at the normal load, but with ample capacity for the maximum requirements, such as the sudden opening of large connections, or where direct fire pressure is furnished at the hydrant nozzle. In almost all cases, operating economy should be considered in making a selection rather than the first cost. But the fixed charges on a high duty machine of the Corliss type, by reason of its higher first cost, the greater housing space required and its many complications, may sometimes more than counterbalance the saving over a simpler type, such as the Meyer gear.

While as heretofore noted, much saving may be effected by the use of properly designed pumping machines, likewise is the same degree of economy applicable to the boiler room. The kind of boilers, the character of fuel, and methods of firing are all-important questions in boiler room economies. For every plant the boilers should be in duplicate units, and like the pumps, of ample capacity for the peak load, tho not too large for the normal uses. As safeguards, the steam lines from the boilers to each pumping unit should be as nearly separate as possible. Obviously also should the boiler feed-water systems be entirely separate and independent.

In determining the kind of coal to be used, it has been our experience that dependence should not be placed upon the basis of heat units alone, but that the coals should be tried out, not merely for a few days under the most favorable firing conditions, but thoroly tested under the every-day working conditions of the plant just as they actually exist. Under such test, the coal evaporating the most water for the dollar manifestly should be the kind to adopt. Moreover, with propriety, and sometimes with profit as well, coal bought on contract may be tested from time to time as a check upon its continued good quality. For this purpose where the amount consumed will not warrant the purchase of a good bomb calorimeter, the lead-oxide reduction method may be used, such an outfit costing but a few dollars and the results being sufficiently satisfactory for purposes of comparison.

Where the coal storage room is located adjacent to railroad siding, if used in quantities sufficient to justify, coal conveying machinery may effect a substantial saving over the usual hand operations.

With good boilers, the right kind of pumping machine and the best kind of coal in stock for the purpose, there yet remains the continuous, all-important, every-day question of operations of fueling and of so conserving the fuel energy stored away in the coal as to utilize and transmit the same direct to the engine throttle in quantities as needed, rather than, as we too often observe, carried up the smoke stack only to be "wasted on the desert air." Fuel conservation is one of the most difficult of all perplexing problems confronting every power plant. Even the most careful firemen need every practicable facility with which we can surround them if the highest results are to be continuously maintained.

As aids in this work, involving as it does one of the most conspicuous items in operating costs, the best patterns of shaker and dumping grates, and also automatic damper regulators, may be used with profit. If the amount of coal consumed will not justify the purchase of a CO_2 recorder, a boiler efficiency meter with Orsat apparatus will be found to furnish a valuable guide.

Steam flow meters may be had at a small cost for attachment to the different steam lines, and when installed will furnish desirable information as to the amount of steam conveyed to the different units or heating systems. Another device of value, tho of much greater cost, is the Venturi meter, which, if placed on the pump discharge line as a check on the engine counter, will often reveal unsuspected pump slippages needing correction.

A common and often unconsidered source of loss in many small plants is leaky valves. A valve reseating machine should be in every power house and by its use every valve kept always in repair. Suitable equipments for the various repairs common to all plants from time to time are not only necessary but money-saving assets in times of their need.

Oiling arrangements frequently are not given the attention their importance would seem to deserve. The system employed should be such that the oils may be saved, refiltered and used again. With such saving they may be used more freely than otherwise, thus safeguarding against hot bearings from time to time with their consequent annoyance, or possible interruption to the service.

In connection with the operation of filtration systems a good serviceable laboratory would seem to be indispensable for the necessary tests. Cities without such systems and having water at times of questionable quality will find apparatus for the use of hypochlorite of lime to be inexpensive and of great value.

By the use of steam and water pressure-recording gages, if supplemented with accurate hourly notations of coal consumed and water pumped, the engineer and manager are afforded definite knowledge concerning the workings of the plant, and also furnished a permanent record of the same.

So well known is the value of the meter that it would seem to be superfluous to make mention of it here. And yet the fact remains that in Indiana there are a number of plants still operating almost, if not entirely, upon flat-rate basis. As a conserver of water this device is second to none, and its value is closely followed by the meter-testing machine. For leakage inspections in the distributing system the detectorphone and pitometer are both widely recommended.

For the office there are many devices worthy of adoption and use, such as the adding machine, the typewriter, addressograph, card indexes, filing apparatus, loose-leaf systems, etc. An accurate map showing definitely the location of all mains, valves and service boxes is of inestimable value and should be deemed an indispensable part of every system. A few well-selected technical books and the best waterworks journals will prove to be not only sources of information and pleasure but of actual profit as well. For articles of especial interest, should one wish to dispense with indexes, a scrapbook might be used to good purpose.

Treatment of Buffalo Water Supply with Chlorine Gas

Bids for furnishing and installing plants for treatment of the water supply of Buffalo, N. Y., by sterilization, were recently received by the city, and included one bid for a plant using hypochlorite of lime and two using chlorine gas, one applying the chlorine gas directly into the shaft at the intake pier and the other by first mixing it with water in tanks and applying the mixture into the shaft in the intake pier.

The following description of the two methods of applying the chlorine gas is taken from the report of Rudolph Hering upon the bids offered:

"There is no difference in the quality of the gas, but there is a difference in the mode of its application. In bid No. 1, made by Wallace & Tiernan Company ($3,300), the liquid chlorin gas is carried to about 40 feet below the lake level thru silver tubes and there released thru strainers made of carborundum, each to be four inches in diameter, so that the gas escapes vertically in myriads of minute globules over the central area of the shaft and gradually tends to ascend thru the downward flowing water until it is completely absorbed. While the globules tend to expand in their relative ascent, the greater velocity of the downward flowing water actually carries them down, reduces their size and increases the absorption under the increasing pressure. The conditions, therefore, appear favorable for a quick and thoro mixture and solution.

"In bid No. 2, made by Electro-Bleaching Gas Company ($3,325), the liquid chlorin gas is absorbed by a water spray within a tank resting over the shaft and discharged into the descending water 40 feet below lake level as a strong chlorin gas solution. Under otherwise equal conditions, as for instance under equal pressure, the absorption of gas by water is quicker, if water globules pass thru gas, as in bid No. 2, than if gas globules pass thru water and constantly diminish in size by absorption, as in bid No. 1. On the other hand, the absorption by the water will not be as rapid under atmospheric pressure (bid No. 2) as at a depth of 40 feet below the water surface (bid No. 1).

"In bid No. 2 the distribution of the chlorinated water is at six points from six arms about 2½ feet from the center line of the shaft, the discharge being horizontal and directed towards the periphery.

"I understand that a United States patent controls the absorption of the chlorin by water as applied in bid No. 2. I understand also that a United States patent controls the introduction of the liquid chlorin gas directly into the water as contemplated in bid No. 1. As regards the direct application of chlorin gas for sterilizing water, I am informed the patent was granted to Major Darnell, U. S. A.

"As regards the application of absorbed chlorin gas, it is stated, that this use has been made at colleges, notably at the Massachusetts Institute of Technology, some time before the patent was granted.

"I would suggest that your attorney examine into the validity of these patents, if thought advisable. The city should in both cases, of course, be protected in its contract against the additional payment of any royalty."

It may be added that chlorin gas was applied for the sterilization of sewage under Powers patents some twenty-five years ago.

ROADS AND PAVEMENTS

Melting Point Tests of Bituminous Materials

The test for melting point of bituminous materials was discussed before the American Association for the Advancement of Science by P. P. Sharples, chemist of the Barrett Manufacturing Company, and H. B. Pullar, consulting asphalt chemist, Detroit, Mich.

Mr. Pullar recounted the various methods of making the test of melting point and showed that the results obtained by one method are not comparable with those obtained by another. He prefers the cube method, recommended by a special committee on bituminous materials of the American Society of Civil Engineers and probably more generally used than any other. His second choice seems to be the ring and ball method used by a number of chemists, more extensively with tars than asphalts.

In his opinion, the melting point test, like other tests for bituminous materials, if properly used, is of considerable importance. The melting point test indicates in a large measure the lowest possible temperature at which a bituminous material must be heated before using; for instance, a blown oil product having a penetration of about 75 and having a melting point of 200 degrees F. will require heating to at least 350 degrees F. before using in a practical way, whereas an asphalt obtained by the direct distillation of oil having a penetration of 75 but a melting point of only 130 degrees F. would require a heat of not more than 250 degrees F. to 275 degrees F. to be the proper temperature for use, and at a higher heat would likely be injured.

The melting point also is of considerabel importance and value in identifying different bituminous materials or the different processes used in the production of these materials. This point is clearly brought out by Mr. Prevost Hubbard in his interpretation of the melting point test, which is as follows:

"A determination of the melting point of solid bitumens is mainly of value as a means of identification and for control work on the part of manufacturers. The melting point of a bitumen is directly related to its hardness and brittleness, but the relations are not the same for all classes. Thus, at normal temperature, a blown oil with a melting point of 50 degrees Centigrade is neither hard nor brittle, while a tar pitch is both. As the melting point rises, however, they both become harder and more brittle. The climate under which a bitumen is to serve as a road binder should be considered in connection with its melting point, and this is particularly true of tar products."

It must, however, be understood that the results obtained at the present time with this test are not comparable with the results obtained even a few years ago, and that in all cases where the melting point is given, the method of testing should be indicated.

Mr. Sharples shows the dependence of the viscosity of tars upon their melting points, with many apparent discrepancies in the tables of results given. He eliminates some discrepancies by using a standard method of testing, and suggests that others can be eliminated by taking more careful consideration of temperatures and the varying changes in viscosity of various materials with changes in temperature. The effect of free carbon on the relation between melting point and viscosity is shown in one table to be very marked. His conclusions are that the viscosity of tars of the same composition varies with the melting point, but not in a direct ratio and that in tars of the same melting point, but differing in free carbon content, the viscosity increases with the amount of free carbon.

Mr. Sharples thinks the inclusion of tests of melting point and viscosity in the physical examination of tars to be used as binders is warranted. One application of the information obtained regarding viscosity at 100 degrees C., as compared with the melting point, is as an indication of the behavior of the tar as to ease of securing uniformity of distribution and again as an indication of resistance to temperature changes when in place in the road wearing surface.

Concrete Road Construction in Indiana

The accompanying cut is a photograph of the concrete mixer at work on a one-course concrete roadway on the Elliston grade west of Bloomfield, Greene County, Indiana.

This road has an 18-foot driveway, concrete eight inches thick in the center and six inches at the edges, placed on a flat subgrade rolled with a 12-ton roller. The length of the contract is 4,636 feet.

The concrete is one part cement, two parts sand and three parts washed and screened gravel. Steel reinforcing triangular wire mesh was used, placed 2½ inches from the surface of the concrete. Baker joint protection plates and Elastite filler were used in ⅜-inch joints.

Water was furnished thru a mile of 2-inch pipe, connecting with a Bloomfield city hydrant. Sand came from a White River bar at Elliston and washed gravel was furnished by the Merom Sand and Gravel Company, at Merom, Ind. The mixer used was furnished by the Koehring Machine Company, Milwaukee, Wis.

The road was constructed by the county by day labor under Superintendent Frank Leavitt, of Bloomfield, Ind., at a cost of $1.45 per square yard, including grading. As shown by the photograph, the fill is rather deep and the hauling of materials was therefore quite high in cost. The grading cost 22 cents a square yard, leaving the road paving proper to cost $1.23. The road was opened to traffic in December, 1913.

CONCRETE MIXER *delivering concrete for base of brick pavement on the Elliston grade west of Bloomfield. Ind.*

Brick Pavements as an Investment

By W. T. Blackburn. C. E., Paris, Ill.

If you could convince the general taxpayer that for every dollar expended he would receive two, then loan him the one and guarantee the return of the two, I feel sure that he would accept the opportunity, and yet that seems to be the opportunity presented to the public, and the farmer and truck-gardener in particular, in the brick-paved highway. The little that the brick roads would cost you personally amounts to nothing compared with the amount that such roads would add to your yearly income, increase the value of your farm, and add in an untold measure to the happiness of your family. It has been estimated that 90 per cent of the criminals in the land originate in the city. You are spending immense sums for the building of court houses, jails and state prisons. If like sums should be spent in the improvement of your country highways and the general development of the resources of your country, giving employment to the unemployed in building of the splendid brick highways, instead of providing means for the employment of criminals from the prison, had we not better provide such employment as to eliminate the despondency of fathers and mothers and the discontent of the sons and daughters at the end of a mud road, by spending, if need be, greater sums in beautifying the lives and interest of the rural districts, thus reducing to the minimum the population of our asylums and prisons and making an investment that would do more for the uplifting of humanity than could be done if one-half of the wealth of the nation were spent in the persecution and confinement in prison of all the criminal classes. Invest your

money in eliminating the criminals rather than in their punishment.

As to your yearly income and increase in value of your farm lands, the following facts may help to make clear to you. I recently observed the revenue from two separate farms of 320 acres each, located in the corn belt of Illinois; one at the end of a four-mile brick-paved road, the other at the end of a four-mile mud road. These farms should produce under the ordinary rotation of crops annually 280 tons of corn, 80 tons of oats and 120 tons of hay, or 480 tons in the aggregate, to be delivered over four miles of roadway. On the brick road there has been delivered eleven tons of grain in one trip by one team, using five wagons, while on the earth road two tons were all that could be delivered by a similar team. The haul being four miles in both cases, and as they could make three trips a day, twenty-four miles team travel, the team on the earth road could deliver six tons per day at a cost for team and wagon of $4.50, thus making a cost of 75 cents per ton for the four-mile haul. On the brick road the delivery was 33 tons per day at a cost of 19.7 cents per ton on a four-mile haul. A difference of 55 cents per ton in the cost of delivery in favor of the brick road, or a difference in cost of $264 on the 480 tons delivered. This is only a small per cent of the actual loss to the farmer living on the earth road, as he has had to sell his grain at a time when the roads were in condition, without regard to the price of his product. From actual experience it has been demonstrated that this would represent a loss of $1.50 per ton on corn, $2.50 per ton on oats and $5 per ton on his hay, making a loss in the aggregate of $920 on account of not being able to deliver at the best market price. This with the loss in cost of delivering, makes $1,184, or 10 per cent on an investment of $11,840, an increase in value of $36 per acre on his 320-acre farm. This represents the investment in a nine-foot brick highway that has cost the tax payers of the township $10,000 a mile, or, if all of the principal highways of the township could be improved, would only represent a tax on all of the property of $10 per acre. These brick roads are not a liability—they are an asset. They don't cost you money—they make you money. It isn't a question of whether you can afford brick roads—the question is, how can you get money enough together to do without them. Bad roads cost like the mischief. The most expensive road is the one you cannot use.

The cost of a brick road 10 feet in width at $1,100 per foot in width per mile as compared with roads being built of other materials at a cost of $550 per foot in width per mile at the end of a twenty-year period has been demonstrated to be less expensive after adding to the original cost in each instance 5 per cent on original cost, together with the maintenance in either case for the twenty-year period. This does not take into account the expense and inconvenience due to the repairs and resurfacing of the cheaper roadway, nor does it give credit to the brick road for being in a serviceable condition at all times for the twenty-year period. Many brick streets are today in perfect condition that have withstood the traffic and the effect of the elements for more than twenty years.

The term permanent roadway is often misapplied. However, it has been said by a prominent authority that "the life of a well-constructed brick pavement cannot be estimated with any great degree of exactness; first, because the traffic conditions are constantly changing, and, second, because no brick pavement which has been constructed in accordance with the best modern practice has yet worn out. The amount of wear sustained by given pavements during comparatively long periods of years has been determined in several instances, but has usually been so small as to make the probable term of service appear almost indefinite." From such evidence we may conclude that the properly constructed brick road is entitled to a life of twenty years without repair, or a period long enough to allow us to forget that the original construction ever cost anything. The original cost is as far as many of us can see. Benefits are too seldom looked into. We are inclined to complain of taxation as a burden instead of a blessing, and the real foundation of our civilization.

The greatest assets of the most substantial nature are transportation and agriculture. Neither can be fully developed without the other.

The total tonnage drawn over the highway at this time may be quite small, but upon the improvement and development of the road and the resources of the country, the tonnage may be increased many times. While the requirements of today may be only ten to twenty tons, these improved conditions have caused this road to become a main highway, with from two hundred to three hundred vehicles per day, many of them three to six ton trucks. Not only should the improvement be made to care for the present traffic, but should be improved to provide for a far greater traffic, not only in the number of vehicles, but the character of the vehicles. The traffic which was once only local, confined to teams from a few of the neighboring towns and villages, has become interstate, and almost national in character.

The Principles of Scientific Management as Applied to Highway Engineering

By Frank B. Gilbreth, Consulting Engineer, New York City.

From a lecture delivered by Professor J. Ansel Brooks of Brown University before the graduate students in highway engineering at Columbia University on March 2, 1914.

It is a fortunate thing for engineers that from its very start scientific management has been understood to apply to the work of the engineer. It has been the custom for some years to associate the science of management especially with shop work and to believe that its principles are most successfully applied in manufacturing, but, as the breadth of the field of application of the principles of scientific management has become better understood, it has been realized that there is no field of activity to which the principles do not apply and that there is no type of work, office work, shop work, field work, manufacturing, constructing, selling, advertising, etc., which cannot be done better, if the theory of scientific management is understood and the practice of scientific management is applied. You, as engineers, recognize, then, that scientific management, starting in the engineering field must have a particular claim upon your attention and that you, as specialists, must translate its terms into your own vocabulary and apply them in your own field.

My task tonight is to outline for you these underlying principles of the science of management, leaving it to you to apply them to your own type of work. I can, perhaps, the better do this as your work is closely allied to work at which I spent many years of my life, construction work.

The principles of scientific management have been defined by Mr. Taylor in his book of that name as four:

1. A development of a science for each element of a man's work, which replaces the old rule of thumb method.
2. Scientific selection and training of the workmen.
3. Hearty co-operation between management and men.
4. An almost equal division of the work and the responsibility between the management and the workmen.

This order is that of the development of the science of management. For purposes of installation we might change the order a little, and say that we are to do four things:

1. To functionalize the work so that each member of the organization does that part of the work that he is best fitted to do.
2. To inculcate that spirit of co-operation that will make each member willing to do the work that is assigned to him.
3. To standardize.
4. To teach each member of the organization so that he can best perform his part of the work.

Our functional chart illustrates how the work is divided. This contains ten circles, five above and five below a horizontal line. This horizontal line is the line that divides the planning from the performing. The five circles above represent the divisions of the planning department and the five circles below the divisions of the performing department. Each of the ten circles represents a division of work and responsibility. Each circle of the ten is connected with every other circle, showing the inter-relation of the work and the inter-responsibility of the individuals doing it. Under each one of these divisions or functions of the work come sub-functions which are made on the same basis, that is, that each division shall cover the work which can best be done by a certain type of man, or, putting the emphasis on the human element, that each division shall provide the most suitable work possible for a certain type of man. The names of these various divisions symbolize more or less successfully the type of work which is to be done. If you are acquainted, as I presume you are, with the literature on the subject, it will not be necessary for me to go into any detail in describing the work of these various functional foremen. The worker, who might perhaps better be placed in the top than in the bottom circle, is helped and taught by each one of the functional foremen, who is a specialist teacher as well as a specialist worker. He occupies the position of a worker only as long as he is so untrained or so satisfied with that position that it is best for him to remain there. The moment he acquires enough training or enough desire to become a specialist, he is promoted into one of the functions, where there is a constant demand for trained men. The first thing you must do, then, is, upon paper at least, to lay out the functional chart of your particular line of work, and to visualize which of your men will best fit into the various positions.

Along with this you want to visualize your plant, or whatever your work place is. This we do by means of a route model, which is simply a small three-dimensional representation of the work place and the various parts of the working equipment, movable and immovable. The advantageous thing about this model is that the movable parts can be shifted as changes are planned or made, and the entire problem presented in a shape in which it can be seen and handled. Besides the route model we use a pin plan, and various other devices for moving the various parts as changes are made.

Having thoroly laid out the problem on the human side and on the material side, and laid out a method of attack to the desired result, it is necessary, before actually making any changes, to insure the hearty co-operation of every member of the organization. This is done by various methods.

1. By an educational campaign, by explaining so far as is desirable and desired the entire plan of scientific management and the plan of application to the line of work attempted.

2. By beginning the actual work so far as is possible on the management side. This for two reasons.

(1) The management side in the majority of cases needs the work most.

(2) The men will be much more willing to have the system applied to them, if they see it being applied to the management.

Co-operation, once secured, can be held by seeing that every step is made in the open and by seeing that every man receives a suitable, prompt, assured reward for everything that he does.

Having laid out your plant and secured the co-operation of your men, it is necessary to standardize. Standardization consists of two parts:

1. Securing a standard.
2. Applying the standard.

I will consider the application of the standards first as the subject is less technical, and as so many standards have been already established that you will be able to apply the result of the work of others in many cases before finding it necessary to take the actual measurements and find the actual standards for yourself. Devices, while they must in no way be confounded with the science of management, are excellent in applying the principles of standardization. According to the rule just given, that work should be done on the management side first, a few office standards may be easily established which will help the management and office force to visualize the problem of standardization. In themselves these devices are nothing; as showing the importance of the principle of standardization, they mean a great deal.

The cross-sectioned desk with its standardized equipment, and the arrangement of the various drawers for the various types of work will not only interest everyone about the plant, but will so substantially cut down the work of all using them as to insure sympathy with as well as interest in the work. More than this, in our personal experience they have inculcated a spirit of "thinking in least motions," a better method of attack, which has proved a most valuable asset. This same spirit has been the result of the installation of standard devices in the shop.

The bulletin board applies both to the planning and the performing department, the tool room, thhe tool stand and the assembling packet. The bulletin board is universal in its field of application. There is no one in the organization whose work may not be handled on the bulletin board. It thus serves as a unifying point as well as a standard method of handling work.

The tool room, while actually operated by but a few men, affects the work of the entire performing department and is an admirable object lesson as to the benefits of standardization. The assembly packet, while invented to cut down the motions of the assembler of a braider, illustrates a principle of so placing material that it can be handled with the greatest ease that is, as you can readily see, applicable to every type of work.

We will turn next to the derivation of these standards. They are the result of that accurate measurement that gives management its claim to be a true science. The methods of measurement, as you know, are time-study and motion-study. Time-study, the wonderful work of Dr. Frederick Winslow Taylor, upon which the science of measurement hangs, is a determination of the elementary unit times necessary to perform an operation. Motion-study is the determination of the proper elements to be timed. The two are parts of one whole, i. e., accurate measurement. This measurement may be done by a stop-watch or a set of stop-watches. It may be done with a cross-sectioned background, a clock and a motion picture machine. It may be done by means of the chronocyclegraph apparatus.

Lastly, but not least in importance, we come to the training or teaching of the men. This is done directly, thru instruction cards and thru the functional foremen, who are all specialist teachers, and indirectly, as you have doubtless noted in following this talk, thru the installation of scientific management itself. Everyone in the entire organization, management and men alike, if the installation has been properly done, becomes interested in the science of management and in the method of attack which it employs. This interest is the greatest educative force in scientific management, and, if you develop this interest in the subject, the application of the principles of the science of management to your specialty, highway engineering, is bound to result not only in success to you individually but to the profession to which you devote your lives.

Permanent Road Construction in the United States

Evidences increase that the need of more durable roads is beginning to be better appreciated by highway authorities. Commissioner Carlisle, of the New York State Highway Commission, plans for the construction of a largely increased mileage of brick and concrete roads.

In order to lessen the cost of brick, on which transportation charges are heavy when they have to be hauled long distances from other states, it is proposed to establish a brickmaking plant, to be operated by state convicts. A change in the maintenance system for macadam and bituminous roads is also contemplated. This consists in substituting for the present inefficient patrol system a gang system, each of the nine divisions of the state road system maintaining a repair crew provided with a portable repair outfit. This outfit consists of a motor truck or tractor designed especially to carry all the necessary equipment for making extensive repairs to bituminous macadam, as well as to water-bound macadam roads. Altho designed for a speed of fifteen miles an hour, the truck can be used as a road roller.

Another project of the commissioner is to assign a competent engineer to constantly investigate and study the most advanced methods and materials for road building in the different states, to insure that the many millions of dollars voted for highway improvement in New York are expended most judiciously.

Altho much progress has been made in the Middle West and far West in the building of cement-concrete roads, the East has only begun to experiment with this type. According to reports from some of the cement companies, about four miles of concrete road are soon to be built near Albany, and several miles will be built in Bergen county, New Jersey, on the Tea Neck and Fort Lee turnpikes. Numerous short pieces of experimental concrete road have been built in New Jersey, or are practically certain to be built in 1914. These are located at Glen Ridge, South Orange, Palisades Park, Red Bank and a stretch between Morristown and Dover. These are all near New York City and carry a large volume of mixed traffic. They are of the one-course type, like the Wayne county roads around Detroit, with no wearing coat on the surface.

Dr. Pritchard, chairman of the good roads committee of the Winona County Chamber of Commerce, at Winona, Minn., is authority for the statement that sixteen miles of concrete roads built in that county cost from $500 to $1,000 less per mile than bids on water-bound macadam roads in the same location. The actual average cost was $7,270 a mile for roads having a concrete surface 8 feet wide and 6 inches thick, with 6-foot shoulders of macadam on either side. Traffic is small in volume there, so that the 8-foot concrete surface is wide enough so long as there are good hard shoulders for turning out. The cost quoted includes preparation of the sub-base, culverts and all expenses except bridges. The higher bids for all-macadam roads were due to the distance that crushed stone has to be hauled, whereas clean gravel is used for the concrete.

Austin B. Fletcher, state highway engineer for California, reports that the California Highway Commission has adopted for a large portion of the 2,760 miles of trunk highways to be built under an $18,000,000 bond issue, a pavement having a portland cement concrete base not less than 4 inches thick and 15 feet wide, with 3-foot shoulders on either side. The concrete is covered with a wearing coat of stone screenings and asphaltic oil ⅜ to ½ inch thick. No expansion joints are provided, but when natural cracks occur, which they usually do at intervals of about 30 feet, they are filled with heavy bituminous material.

Nearly 200 miles of these roads have been built or contracted for, at an average cost of $6,394 per mile, exclusive of the cost of grading, culverts and administration. Bituminous macadam roads built by the commission cost $6,364 per mile and water-bound macadam $4,303. Asphalt on a macadam base costs $8,403 a mile, but roads of this construction are wider, so that the cost per square yard is practically the same as for concrete—71.6 cents, as compared with 71.2 cents. Bituminous macadam is 72.3 cents a yard and ordinary macadam 48.9 cents.

The report of the Illinois Highway Commission for the years 1910 to 1912, inclusive, gives some interesting data on the cost of construction of macadam and concrete roads, exclusive of contractors' profits, compiled from actual costs of 150 pieces of macadam road and five pieces of concrete road. The costs include shaping the roadbed and trimming the shoulders, figured in all cases at 3 cents per square yard. The construction costs may be compared as follows:

STANDARD 16-FOOT SURFACE.

Average haul of crushed stone, gravel and cement, 1.6 miles.

Water-bound macadam, 16 feet wide	$6,269
Bituminous macadam, 16 feet wide	7,985
Concrete, 10-foot concrete with 6-foot macadam	7,982
Concrete, 12-foot concrete with 4-foot macadam	8,402

Concrete, 16-foot concrete surface,
6 inches thick..................10,061
Concrete, 16-foot concrete surface,
7 inches thick..................11,472

It will be seen from this that a 10-foot concrete road with a 3-foot macadam shoulder on either side, or 6 feet on one side, costs less than an all-bituminous road of the same width, and only $1,713 a mile more than a 16-foot water-bound macadam road, while a 12-foot concrete road with 4 feet of macadam costs only one-third more than ordinary macadam 16 feet wide, and only $417 a mile more than bituminous macadam.

An elaborate traffic census taken by the State Highway Commission of Massachusetts shows that more than 63 per cent. of all the traffic on the state roads was self-propelled in 1912. Former Highway Commissioner Macdonald, of Connecticut, says that 65 per cent. of the travel in the Nutmeg State is by motor vehicle, and Commissioner Johnson, of Illinois, shows by a traffic census covering many of the roads of that state for the last six years that motor traffic has increased in various places from 2 and 4 per cent. in 1907 to 33, 50, 58, 63, and 66 per cent. in 1912. These percentages are averages of observations taken four days each in May, June, August and September. Commenting on these figures, the commissioner writes, in his fourth report to the Governor, recently issued:

"The conclusion can be drawn that any plan for systematic road work in many parts of the state must consider that a large majority of the traffic of the future will be motor traffic. In particular, there is a vast field for the development of motor truck traffic, a class of traffic that it has not been necessary heretofore to consider in plans for road improvement. It is believed that in many sections of the state the opportunity is big for the ultimate development of this class of traffic, and provision should be made in the future road building on a majority of the main roads for the 8 and 10-ton motor truck."

Prison Labor on Roads

The American Automobile Association is heartily in favor of the use of convicts in road work, as is evidenced by the following report from its National Committee on Prison Labor:

"Road building by convicts has stood the test of scientific investigation made for Columbia University, thru its graduate highway department, by Sidney Wilmot, a road engineer, recently an advanced student in that university, and attached to the staff of the National Committee on Prison Labor, which is also located at the university.

"The investigation into the costs of convict labor on the roads emphasizes clearly the economic advantage secured by this joining of the problem of the convict and the road. This advantage reverts to the taxpayer and also to the convict's family thru the wage which can be paid for his labor.

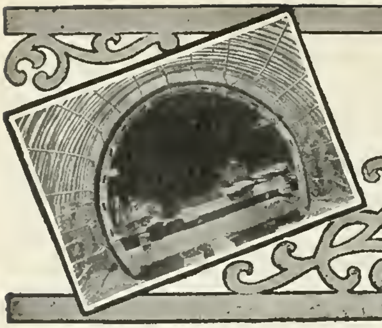
"The Academy of Political Science has undertaken to make this study available because of its broad social and political significance. When each state and county is engaged, as at present, in the reorganization of its prison system, and is endeavoring to do away with the crude methods of torture, scientific methods of successfully employing the convicts with advantage to all parties become of public interest.

"The findings of the investigation show that the work performed by the convicts in the different states ranges in value from $1.50 to $5.70 per day, with a profit to the state by the use of this labor of from 50 cents to $4.03 per day. In short, the contention is well sustained that there is a general and considerable profit at present going to the state by the use of convict labor for road work over the cost by other methods of construction, this saving being quite independent of locality and types of construction, altho influenced by the size of the gang used.

"An interesting feature of the study is the comparison of the cost of subsistence and of guarding. The average cost of subsistence is found to be 40 cents per man per day; while the expenditure for guarding in those cases where costs could be secured averaged 48 2-5 cents. Striking thing of these figures is that the expense of guarding adds to the cost of the work over 20 per cent. more than that of feeding. This throws into prominence the economic advantage of the "honor system." This substitution of a man's word and his conscience for a gun was, at the first, a makeshift, but has since become a necessity—a saving in every sense of the word.

"The prison and the highway departments should have joint supervision over this work; the representatives of the prison department having charge of the men and acting as foremen, while the engineers of the highway department are responsible for the construction work. This joint supervision has been found, according to the experience of the different states, to yield the most satisfactory results.

"The prisoner himself benefits most of all by his work on the roads. The healthful outdoor labor, the better food, the incentive of the honor system, and, above all, the wage increasing in proportion to the profits of the state, all combine to make him better fitted to re-enter society."



SANITATION

Disinfection of Sewage and its Success in a Small City

By Frank A. Nikirk, Consulting Engineer, San Jose, Cal.

This brief description of a system of disinfecting the effluent from an unsuccessful septic tank shows the difficulties in handling the plant satisfactorily and the simplicity of the plant required. It is from an address to the California League of Municipalities in response to a request for information on this subject.

THE College Park sanitary district which lies adjacent to the City of San Jose, Cal., was organized in 1905. The boundaries of the district were extended in 1907 to include Hanchett Park, an exclusive residential district, and now include an area of about 2.6 square miles. At present the population of the district is slightly over 2,000.

As originally constructed, the sewage disposal works consisted of a septic tank and two filter beds. The plant is located on the bank of the Guadalupe Creek, into which the effluent of the filters was conducted. The filters were built in a natural excavation; about two feet of creek gravel was placed in this. The filters were approximately 340 feet long; one was 12 and the other was 15 feet wide. The beds were not underdrained; for this reason and also the lack of depth of the filtering material, they were never very satisfactory. They were early abandoned and the effluent of the septic tank was discharged directly into the creek.

When water was plentiful in the Guadalupe Creek this effluent was not a nuisance. For the past two years, however, there have been no freshets to cleanse the channel, the growth of vegetation has been very rank and the amount of water flowing in the creek has been far below normal.

Under these conditions, with the water in the Guadalupe containing a relatively low percentage of dissolved oxygen, it can be readily seen that conditions are not very favorable for the disposal of sewage by dilution. The growth of vegetation checks the tendency toward re-aeration, and an unsanitary condition is apt to exist.

Under such circumstances it became necessary to treat the effluent of the septic tank before discharging it into the creek, therefore a temporary plant for treatment with chloride of lime was installed while the present plant was being constructed.

A treatment plant of this type requires a supply of water with which to mix the chloride of lime; consequently a windmill and tank were constructed over a well that existed at the end of the septic tank. The hypochlorite apparatus was located in the tank frame, which was inclosed to protect the plant from outside interference, as a constant and uniform action is required.

The apparatus consists of a mixing tank and two storage tanks, each holding about 275 gallons, and a fourth tank, in which are located the devices for regulating the flow. The tanks are arranged so that the flow is by gravity thruout the entire plant. Each tank is provided with an outlet thru which to draw the solids that settle out of the solution.

The chloride of lime is put into the mixing tank and the tank filled with water. During the filling the solution is thoroly mixed. The stirring device consists of a sort of propeller on a shaft, suspended from the top of the mixing tank. The shaft is revolved by a ratchet device operated by moving a lever backward and forward.

After mixing, the solution is allowed to stand sufficiently long to let the greater portion of the suspended matter settle. The clear liquid is then drawn off into the storage tanks thru an outlet six inches above the bottom, so as not to disturb the settled solids. More water is then turned into the mixing tank and the insoluble residue is stirred up and flushed into the outlet sewer. The operation is then repeated.

At the College Park plant three "batches" are mixed each morning for a twenty-four hour run. The third "batch" is drawn slowly from the mixing tank and into the storage tanks as the latter are being emptied. This method was adopted in order to use the maximum quantity of water, the greater flow being more easily regulated.

In small installations, irregular flow of the solution is common, due to the clogging of the measuring orifice by imperfectly settled solutions, or by flakes of calcium carbonate being formed in the solution tank by the absorption of carbon dioxide from the air.

In this particular installation the solution flows from the storage tanks to the regulation tank and is controlled by a float valve which keeps the liquid in the latter at a constant height. In the regulation tank is a half-inch brass tube extending from above the surface of the liquid down thru a large rubber stopper in the bottom of the tank. In the side of the tube is a three-sixteenth-inch hole which admits the solution. The rate of flow depends upon the head of water upon the orifice, and the desired rate may be obtained by raising or lowering the tube through the rubber stopper in the bottom of the tank.

From this tank the solution is carried thru a four-inch vitrified pipe line to the outfall sewer, where it mixes with the effluent of the septic tank.

The sterilizing action of chloride of lime is very ably set forth by Professor Charles Gilman Hyde in a paper presented before the fourteenth annual convention of the League of California Municipalities at Santa Barbara in 1911 and entitled, "The Sterilization of Water Supplies by the Use of Hypochlorites." While Professor Hyde's paper refers particularly to the protection of water supplies, the action of hypochlorites is analogous in the purification of water supplies and sewage effluents. In both cases hypochlorous acid is formed, which gives up its oxygen in the presence of organic matter.

In designing disinfecting apparatus one of the important factors to be dealt with is the fact that calcium hypochlorite exerts a very strong corrosive action upon wood and most metals. In some cases the tanks are lined with cement mortar laid on metal lath; in others a resistant paint is used. The pipes should be well galvanized and the valves should be bronze. The plant should be well ventilated, as the dust arising when the drums of chloride are opened, and during the making of the solution, is very irritating to the eyes and the membranes of the head.

Grades and Leakage in Intercepting Sewers

In a paper before the American Association for the Advancement of Science, J. N. Ambler, C. E., Winston-Salem, N. C., discusses the design and construction of intercepting sewers and their appurtenances. In that paper he has the following to say regarding the difficult questions of grades and construction of watertight sewers, which is based upon his extensive practical experience:

In spite of the view of many authorities that extremely flat grades are practicable, in sewers of this kind, because of the greater flow, and the fact that the sewage has become thoroly macerated by the time it reaches the intercepter, the writer is thoroly imbued with the belief that all the fall available should be obtained. This belief rests on his experience in cleaning out intercepting sewers after having been in use, and, of course, neglected, for many years.

All the sand, mud and illegitimate matter of all kinds which gets into the various closets, or thru the manholes in the streets, is pushed down the sewers of sharper grade, and finds a resting place in the intercepter.

The writer once removed some twelve or fifteen hundred bushels of such substances from about half a mile of old intercepter. Most of this was sand, but bottles, rags, straw hats, overalls, stones, wooden articles, etc., were also present, and the capacity of the sewer was greatly reduced.

Of course, hard and fast rules cannot be laid down, but the writer does not feel good in laying a grade as flat as 1 foot per 1,000. It is his endeavor, in the light of experience with cleaning, to get all fall possible.

From the very nature of the low, level intercepter, it is usually located where the ground is alluvial, and with the ground water level near the surface.

In many cases the ground to be traversed is marshy, and in nearly every instance the sewer is laid below ground water level.

These conditions are distinctive for the style of work and require special methods of treatment.

Unless the joints are laid very perfect, and so maintained at the flat grade as to utilize all the fall, without pockets, the infiltration of ground water will be so great as to greatly reduce the carrying capacity of the sewer, or even, in the case of a long line, to completely destroy its usefulness.

Settling of the joints will, of course, render the conditions worse, and may result in the inflow of quicksand until the sewer is put out of commission, as in a case which once came under the writer's charge for correction.

It is, therefore, of the utmost importance, not only to have perfect joints, reducing the inflow of the ground water to a minimum, but also to provide means to maintain the grade as a perfectly straight and rigid barrel, free from settlement.

The difficulties of meeting this last requirement are often very great, as usually the bottom of the trench is a water-soaked quagmire and frequently quicksand.

Considering, first, the question of perfection in the joints, the writer has specified a mortar of neat portland cement, on account of its density and imperviousness.

The shrinkage of neat cement mortar being considerable after the mortar is set, a wash of thick grout is used to fill the cracks.

The entire circumference of each joint is rigidly inspected by hand, and no imperfect joint is left on the work.

Special compounds, as melted sulphur, and the various elastic compounds from which it is claimed that perfect joints may be made, even in water, were not tried, either on account of the expense, or because there was doubt felt as to the durability of such substances.

Feeling the necessity of having some criterion upon which to base the engineer's acceptance of the work, so far as ground water is concerned, the writer read up all available data on ground water flows, and came to the conclusion that it is a subject about which too little is known, and what is known is conflicting.

There should, however, be some criterion to apply to work done by contract, and it seemed that nothing better could be done than to determine how much water the sewer might be allowed to carry without materially injuring its usefulness. The criterion should not be so severe as to greatly affect contractor's bids.

Such a criterion, it would seem, should be based upon the number and circumference of the joints.

The following clause appears in one of the writer's specifications, and is offered for what it is worth, until something better can be substituted. It, at least, has had the effect of securing some very careful work, and contractors were not disposed to regard it as severe when thoroughly explained to them.

The clause is as follows:

"It is the intent of these specifications that no more leakage of ground water into the sewer be allowed than is admissible with a first-class piece of work, in which care has been exercised to get as near as possible to a water-tight result.

"To determine the admissible amount of leakage, the length of a joint will be considered as the outside circumference of the spigot end of a pipe.

"Leakage not in excess of two gallons per day of 24 hours for each foot of circumference of every joint will be considered admissible, the amount of flow to be determined by the engineer's gaging in each section, by means of a notch board.

"The contractor agrees that for each 10,000 gallons per day of 24 hours by which the total flow of the sewer exceeds what the total flow should be, when figured on the basis already given, a deduction of $100 from the contract price will be made.

"This will not apply further than to a total flow resulting from three gallons per day of 24 hours, from each foot of joint length, beyond which figure the sewer will be regarded as not in compliance with this contract."

The writer's opinion is that the above requirement is a very mild one, as he once laid a mile of large sewer thru exceedingly swampy land, passing under several streams, etc., with a result that not more than a stream one-fourth inch deep was flowing in the bottom of the pipe at the lower end on completion.

However mild the criterion may be, it has had a powerful deterrent effect against bad work.

It is extremely important that the manholes should not leak. To prevent this, the best hard bricks are used, each being dipped in a pail of water, as handed to the mason.

The brick work rests on a cement bottom 12 inches thick, with a solid cement invert and the contact of the pipe with the masonry is an object of especial care.

Manholes are built up sufficiently high above the meadow to prevent being stopped by floods.

The caps are secured to the covers by two set screws to prevent malicious persons from placing foreign substances in the sewer.

The handling of water in the trench during construction is usually less serious than the inexperienced are apt to imagine. A diaphragm pump connected to a small gasoline engine is the cheapest and best way known to the writer for removing the water. A small trench is excavated along the side wall of the main trench which conducts all accumulated water to a pump, where it is promptly removed by pumps, without being allowed to rise on the freshly constructed sewer line.

The writer has used the pile and platform method of founding, and finds it of very general application, of moderate cost to handle, and very satisfactory in result.

Two piles, 4 by 4 inches, bluntly sharpened, are driven opposite each other in the trench.

Two more piles are driven at a distance of $2\frac{1}{2}$ feet up the trench, and so on, wherever a thoroly firm bearing for the sewer cannot be found.

Across the heads of these piles a 1 by 4-inch batten is spiked, and a platform of two $1\frac{1}{2}$-inch planks is laid on and spiked to the various battens over each pair of piles.

Piles are driven to practical refusal by means of a rammer, consisting of a cast iron disc 8 inches in diameter, 3 inches thick, into the center of which a 2-inch iron rod is screwed. This makes a very heavy rammer, resembling the piston rod and head of a steam engine. It takes three or four strong men to operate it, but it is the quickest and most economical way the writer has been able to find for this work.

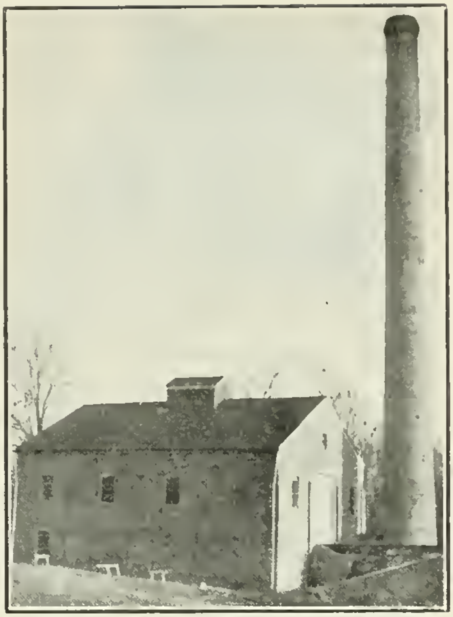
The piles vary in length from 18 inches to 9 feet. Even where the short ones are used, the ground being tolerably firm, a far superior foundation results than is to be had by laying loose planks in the bottom of the trench.

The platform was laid to a more or less regular grade about 3/10 of a foot below the flow grade of the sewer, the pipe being supported in a cradle of two wedges cut from $1\frac{1}{2}$-inch plank, and driven under the pipe from opposite sides until the flow line was precisely at grade.

The wedges were then spiked to the platform to hold them in position, and about half a gallon of concrete was placed behind them to prevent a tendency for the back-fill to crush the pipe.

Garbage Disposal at Erie, Pa.

After many months of difficulty over the location of its new garbage incineration plant the city of Erie, Pa., finally located it several miles outside the city on a farm purchased as a site. The plant was completed and fires were started in the furnaces October 16, 1913, and, beginning on the 18th from 10 to 20 wagonloads of garbage were delivered to the plant daily and disposed of in 3 to 5 hours. After the 2 months of operation by the contractor, provided for in the contract, a test was called for under the contract. The city has 20 garbage wagons and 40 wagon bodies so that but 20 are available for collection at one time and the same number for transportation on train to the incinerator. There is but one train a day on this branch of the Pennsylvania railroad which will take the garbage to the plant so only 20 loads a day can be delivered. The contract calls for a test on a 3 days' run at about 0.6 the capacity of the plant or more, so that the city has not been able to supply enough garbage for the test run.



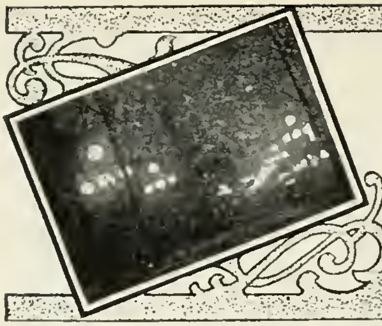
MORSE-BOULGER *garbage incinerator at Erie, Pa.*

By saving garbage for two days, 40 loads were burned one day, starting with a cold furnace at 8 o'clock in the morning and burning $27\frac{1}{4}$ tons of garbage completely by 6 p. m., by the use of 3,600 pounds of coal.

As the contract calls for the drivers unloading their own loads, half the wages of the man at the top was charged to the cost of disposing of the garbage. Two men at the furnaces below were charged in full. The cost for this run from cold furnace to start with for labor as above and coal was 33 cents a ton, apparently a low figure under the circumstances, and the further fact that only garbage has been delivered to the plant, tho the contract provides for the delivery of a mixture of garbage with one-fifth of combustible miscellaneous waste, which would furnish almost enough fuel to burn the garbage.

The board of health has prescribed wrapping garbage in paper before depositing it in the cans and a large proportion of the garbage is so wrapped, but the paper is wet and the amount is small in proportion so that it is practically as hard to burn as the garbage is.

The Morse-Boulger Company, New York, were the builders of the plant.



Lighting

New Street Lighting Contract in Indianapolis, Ind.

The city of Indianapolis, Ind., received bids on April 20 for its street lighting for ten years, beginning April 1, 1915, on all-night schedule upon full specifications prepared by B. J. T. Jeup, city engineer. The contract was open practically only to the two electric light companies doing business in Indianapolis, and bids were received from both of them.

The specifications provide that the minimum number of arc lights shall be 2,000 and of incandescent lights, single or in clusters, 500; that preparations shall be begun at once and the entire plant be ready to begin use on April 1, 1915, with a forfeit of $500 a day thereafter, less allowance for more than thirty days delay of City Council in approving contract.

In the general specifications repairs, replacements of defective apparatus, location and relocation of lines, conduits, replacement of pavements, etc., are placed under supervision of Board of Public Works, inspectors of such work at $75 a month to be paid by the company. Posts, guy stubs and the like once located by the board will be changed at the expense of the party requesting the change, as the board may determine. Lights may be changed, added to or discontinued above the minimum as the board may order. Fair provisions for requiring improvements with the advances in the art of electric lighting are made. The 5 per cent. of gross receipts paid by all holders of recent franchises to the city is required on this contract.

In specifications for work to be done, the lighting time is stated as from half-hour after sunset to half-hour before sunrise, and full schedule of times for every day is given. Lights in subways under railroads may be kept lighted during the day. Minimum current to be used per year by the city for all street lighting is 80,000 kw.

Company must patrol system for outages as required by the board, and broken globes or reflectors are counted as outages. Police are to make daily reports of outages. The deduction from contract price is $1 a day for each lamp.

City engineer will make tests of current and company must give room for recording meters furnished by the city, and opportunity for attaching and maintaining ammeters, volt meters or other measuring instruments on any or all circuits. If city engineer's tests show less current than contract requires, the price for the month the test is made will be reduced proportionately for all lights on the circuit so found deficient, representative of company to be given opportunity to observe tests. Engineer may remove lamps for test and make tests of them while in service, any lamp showing less than contract power to have proportionate deduction from price.

Arc lamps are to be connected not more than 100 in series in a circuit, of specified appearance and quality; of the differentially wound flame type with superimposed electrodes and focusing arc; double globes not requiring external reflector. Details of general construction, globe and electrode holder mechanism and globes are specified in full, also details of operation results. The mean lower hemispherical candle power must be at least 1,400, using clean inner and outer globes.

Incandescent lamps are to be latest improved series tungsten 100-watt and 60-watt, and over or under bridges when necessary carbon filament multiple lamps of light equal to 100-watt series tungstens may be ordered. Lamps are to be removed when candle power reduces below 90 per cent. of rated.

Outside the underground district arc lamps are to be supported on wooden poles with iron brackets of design shown in drawings unless ordered by the board to be other forms of brackets or suspension mounting. Incandescent lamps on Meridian street almost its whole length are to be three-lamp clusters, two at each street intersection, one at intersecting street and at least one single lamp intermediate between streets, to be supported on specified ornamental street lamp posts with underground connections, except one mile in the center now partly supplied, which is not definitely specified. Incandescent lamps outside the underground district are to have radial wave reflectors of design specified and cluster lamp reflectors are specified.

The underground district is defined in which nothing is above ground but the posts holding the lamps. Conduits and their construction are specified in detail.

Arc lamps are to be 14 to 25 feet above street surface and incandescent lamps 12 to 14 feet high, except as specially ordered.

Lamp supports in underground district are to be iron posts set in concrete, with lamps on poles or brackets as ordered, from designs furnished in the bids, posts to be located as ordered by the board and subject to their change of location.

Pole lines in overhead circuits are fully specified in detail. Maps of circuits must be approved before construction. Joint use of poles by other wires is provided for. Electrolysis must be provided against reasonably.

One interesting provision is that street signs must be placed and maintained on each lamp, post or pole at a street intersection, which shall be satisfactory to the board or selected by it. Signs must be placed or painted on globes of incandescent cluster lights. Red glass rims one to two inches wide are to be put near top of globes at or near railroad crossings and at such street railroad crossings as the board may designate.

Meters on city building lines must be placed beyond the transformers or converters, so as to measure the rectified current.

Replacing of pavements, furnishing of plans and specifications for work to be done, quality of material and workmanship and of buildings are all covered.

Bids were received from (1) The Indianapolis Light and Heat Company, who hold the present contract, and from (2) The Merchants Heat and Light Company, with the following figures under the specifications, the latter being the low bidders and receiving the contract:

	(1)	(2)
Each 10-amp. A. C. enclosed flame carbon arc per year	$60.90	$41.98
Each 100-watt series tungsten incandescent, except as specified for certain lights in underground district	31.50	17.83
Each 100-watt series tungsten incandescent lamp to be used as top lamp of 3 or 5-lamp cluster with underground service	32.60	8.92
Each 100-watt series tungsten lamp for lighting Meridian street and other underground service	32.60	27.71
Cluster of 3 100-watt tungstens	51.95	40.35
Cluster of 1 100-watt and 4 60-watt tungstens	60.95	45.18
Current for light and power in public buildings and places except those under Park Department	*	†

*Published schedule.
†1.95c per kw. hr.

The Indianapolis Light and Heat Company bid also on 460-watt 115-volt D. C. magnetite multiple arc lamps at $60.90. The company also proposed some modifications of specifications which would permit them to use some of their present installation to better advantage and bid thereunder $52.64 for 9.6-amp. D. C. flame arc lamps. But the bids of the Merchants Heat and Light Company were lower in every respect.

It was considered that the bid of the latter company was within the power of the company to make under the law establishing the State Public Service Commission, and that the rates thus established would be validated by filing them in regular form with the commission and the contract with that company has been approved by the Mayor and Board of Public Works and is now to be presented to the City Council for its action.

Gas for Light and Heat at the San Francisco Exposition

Gas is to be an important and versatile factor in the success of the Panama-Pacific International Exposition. To gas falls the duty of driving the chill from the great buildings at night and cooking the food required by hungry visitors. Added to these will be spectacular light effects in various courts.

The system by which the 635 acres of ground are piped for the demands that are to be made in 1915 is a testimonial to the great advance that has been made in gas distribution science.

St. Louis gas engineers engaged in solving the problem of gas supply in 1904 found it removed from the center of gas distribution with no large gas feeders. They depended on low pressure from the St. Louis mains. Since 1904 there have been rapid strides in the development of high pressure gas distribution, both for direct service and for boosting or reinforcing low pressure systems.

The Panama-Pacific International Exposition grounds are fortunately situated as far as gas delivery is concerned by being located directly on a high power loop extending from the gas works at the south end of the city almost around San Francisco to the north beach holder station. This loop is a 16-inch steel main and its approach to the north beach is thru Webster street, which is almost the spine of the exhibition grounds.

From this 16-inch main is taken an 8-inch steel loop extending completely around the grounds. Another loop of 4-inch steel pipe circles the state and pavilion sites. The portion of the exposition grounds east of Webster street, including the amusement concessions, will be supplied from an 8-inch steel loop.

A high pressure system is installed at the 1915 exposition grounds. The gas is delivered into steel mains of smaller size under pressure measured by pounds to the square inch and the pressure is reduced by a regulator at each consumer's meter to a pressure in inches of water necessary to give the best results for the particular purpose for which the gas is to be used. For instance, for ordinary incandescent gas light a pressure of from four to six inches is most satisfactory, while for industrial uses pressure to as high as one pound may be employed with greater satisfaction and economy; and for the latest installations of high power lamps for street lighting, such as are now used in London, Paris and Berlin only, and which will be used for lighting the amusement streets at the exposition, a pressure of two pounds applied directly to the mantle gives the greatest lighting efficiency.

Another advantage of high pressure over low pressure is the ability to increase the supply of gas by increasing the initial pressure.

The Pacific Gas and Electric Company has installed for the exposition a loop system of more than nine miles of pipe within the fence which is without joints. All the steel tubes are welded together by the oxy-acetylene torch, using rods of Norway iron for the welding material. These welds are actually stronger than any other section of the great steel pipe, and the mains when finished consist of an endless welded tube without leaks. They are tested for leaks under a pressure of 100 pounds to the square inch, and will be absolutely tight under the maximum working pressure of 40 pounds to the square inch. The average pressure will be nearer 30 pounds. On Geary street, San Francisco, the first strip of welded steel pipe ever laid for high pressure was installed only a few months ago and the exposition test will be of great value in demonstrating the advantages of the new plan.

In the matter of measuring the gas supply for the exposition two of the latest meters will be used and scientific men will be able to watch this invention in an unusual test. Two Thomas electric gas meters will be used to record the flow of high-pressure gas. The gas that passes thru the meter is heated by means of an electric current and careful measurements of the quantity of electricity employed and the rise in temperature of the gas, taken with the known specific gravity of oil-gas, supply the factors for determining the exact quantity of gas used.

The gas that will be used is made from the California crude petroleum by a process which is itself Californian. It is produced from the oil with practically no by-products, such as result from coal gas mauufacture. The gas is remarkably free from sulphur and other impurities. Its illuminating power is about 19 candle power and it has a heat capacity always in excess of 600 British thermal units per cubic foot. It is expected to provide an ideal fuel for heating, cooking, illuminating and all other purposes within the fair grounds, coupled with convenience and safety which are not enjoyed when solid or liquid fuels are used.

A part of the exposition lighting system will be an exhibition of high-pressure gas lamps, which will be used in this country for the first time. They will be placed in the section of the grounds occupied by the state and foreign pavilions and on the concession streets. They will stand on bronze uprights and will be attractive even when not lighted.

In the Court of Abundance gas will have its greatest part in the spectacular features of the exposition. The theme is the creation and development of the earth, and the history of man in symbol will be presented. Here the high-pressure gas will be used in great flaring flambeaux surrounding the lagoon in the center and outlined against the fireproof walls of the court. By the use of minerals distributed in the gas varied colors will be produced.

But important to the exposition and to the scientific world as these uses of gas are to be, its use in heating promises to excel all others. "Surface combustion" is something new in the scientific world, and this development of the use of gas will be given a complete test. This is the use of heat from gas without flame. The essential feature of this process is a homogeneous explosive mixture of gas and air, in the proper proportions for complete combustion, caused to burn without flame in contact with a granular incandescent solid, whereby a large proportion of the potential energy of the gas is immediately converted into the form of radiant heat. The combustion is greatly accelerated by the incandescent surface, and may be concentrated where the heat is desired. High temperatures are possible without the aid of elaborate regenerative devices; and there is a claim of twice the heat at half the cost.

Instead of requiring expensive heating

apparatus for the various concessionaries these radiant heaters will be sold or rented to them. They will also be installed in the Palace of Fine Arts and Festival Hall.

Gas will be used for patrol purposes and the grounds will be so well equipped with gas lighting that a complete suspension of electric power would leave the grounds well lighted. After the closing hours each night for the ten months gas will be used until daybreak.

Boston Street Lighting

Total lamps, January 10, 1914, 18,493; i. e., 4,718 arc, 3,507 tungsten incandescent, 10,268 gas. Increase over 1913, 380 arc lamps, 1,364 tungsten incandescent, and a decrease of 1,506 gas lamps. Cost of electric lighting for year 1913, $513,165, or $41,983 more than in 1912; of gas lighting, $264,682, or $15,748 less than in 1912.

Methods of Obtaining Salary Increases

As a result of an investigation of the employment of counsel by city employes and of possibly illegal payment of sums of money by clubs of employes for the purpose of influencing the City Council and the departments and Mayor to increase their salaries, the Finance Commission of the city of Boston, Mass., has made the following recommendations:

1. That increases of salary should be considered at the beginning of the fiscal year, and should be provided for in the budget, and not be made a matter of maneuvering at the close of one administration or near the end of a fiscal year, so as to embarrass the succeeding administration.

2. That the effect of using outside influence, as shown by the furtive and apparently unlawful means of effecting changes in the attempted appropriation of $400 by the Russell Fire Club of the Fire Department for the purpose of changing the meal hours, should be referred to the Fire and Police Commissioners for further inquiry and for action on their part.

3. That the Mayor take such action as is necessary to prevent the employment of counsel in the future on matters that are within the province of the Mayor and the heads of departments on one side and the men on the other to settle, except in the case of hearings on charges, etc.

4. That rule 5, paragraph 3, of the Police Department Regulations, which states that "members of the force desiring promotion, transfers or assignments to particular duties are free to make their desires known thru the proper channels; and at suitable times members in person will be received by the commissioner at his office. But should a member cause a person not his superior in the force to intervene or to make representation in his behalf to the commissioner or to any superior officer, personally, or by letter, or by petition, he shall be deemed guilty of conduct unbecoming an officer," be so amended as to prevent the employment of counsel in departmental matters, between the Mayor, the Police Commissioner and the members of the force.

5. That in all departments a rule, whether existing now or not, permitting the men to interview the head of the department on any question of grievance, should be made a reality. Grievance committees of the men and the men individually should be welcome at all times to lay their requests and grievances before the heads of the several departments and the Mayor.

Motor Truck Service and the Public Roads

Ten years ago the motor truck gave little promise of becoming a great factor in the movement of commerce. The comparatively few in use at that time, which were at all reliable and could really be depended on to deliver the goods, were the electric-driven. It did not seem probable that the gasoline-driven motor truck on the public road would ever come into such general use as ever having to be reckoned with in all matters pertaining to road construction. But the year 1913 saw over 36,000 motor trucks built in this country and the public highways under construction today must be constructed to stand up under this ever-growing number of commerce-bearing vehicles. Road foundations and road surfacings, heavier bridges and permanent culvert construction are all now very carefully looked after by the engineer to meet these new conditions.

Even the country roads leading off from main thorofares are affected by these changes, for they, too, must have culverts of unquestioned strength to replace the dangerous small bridges. There has been much thoughtless talk of the increased cost of road building, but what was once done in a most haphazard way is now done with a view to permanence. This in the long run makes for fewer bond issues and lower taxes.

MISCELLANEOUS

Paul E. Kressly

The first city manager of Inglewood, Cal., under the ordinance creating that office, which was published in the April number of MUNICIPAL ENGINEERING, is given the duties of that office, in addition to those of city engineer, which he has been performing for two years.

Mr. Kressly has been in the active practice of civil engineering for twelve years, tho only 32 years old. For about nine years of that time he was located at South Bethlehem, Pa., acting also as boro engineer of Nazareth, Fountain Hill and Freemansburg, Pa. Three years ago he went to Inglewood and was in due time appointed city engineer, where there has been full exercise of his activity, as the city is spending more money for improvements than any other city of the same class in the State. In 1912 there was expended for street improvements alone $178,996.98, and in 1913 $202,304.20. That these expenditures have been made to the satisfaction of the Council, under Mr. Kressly's supervision, is shown by his advancement to the new position with materially greater responsibilities.

Personal Notes

Isham Randolph, consulting engineer, has moved his office to 1827 Continental and Commercial National Bank Bldg., Chicago, Ill.

J. E. Greiner, Consulting Engineer, has associated Ezra B. Whitman with him and they have offices at 1308 Fidelity Bldg., Baltimore, Md.

Philip H. Dater has been appointed city engineer of Portland, Ore.

H. R. Carter is the new State Highway Engineer of Arkansas.

E. A. Kingsley, former State Highway Engineer of Aakansas, has been appointed engineer of road construction about Temple, Tex., the present work in sight amounting to about $600,000. Mr. Kingsley retains his office in Little Rock, Ark., and will also have an office in Temple, Tex.

Julian Kendrick has been appointed city engineer of Birmingham, Ala.

Electrolysis of Water Pipe in Appleton, Wis.

The Editor of MUNICIPAL ENGINEERING:

Sir—In your recent issue of April, I notice a letter from C. H. Vinal, City Engineer of Appleton, Wisconsin, asking "Is this a case of Electrolysis?"

From the location of the pipe and the condition which unquestionably existed, it is electrolysis. The fact that there was no indication on the voltmeter, shows but little, unless the voltmeter was one having a scale reading of not over 5 volts. I have personally found many locations where serious damage has occurred where the voltage was not over half as a maximum, and frequently ran at lower than one-half a volt. All that is required is a favorable condition for the passage of the electric current, for decomposition of iron by the electric current can take place at a very low voltage, and frequently does.

Mr. Vinal does not state where the car was at the time the test was made for voltage. Much would depend on this, for as it is an interurban line with probably cars at infrequent intervals, if the car was not at a point beyond the break from the powerhouse, there would be very small voltage and probably a comparatively small flow of current. The spark might readily come from the slight induction that exists in the discharge from an iron pipe. ,

Another factor of importance, too, would be the condition of the ground, which might make it possible to have a very heavy flow of current at a very low voltage.

I would recommend Mr. Vinal inserting a low reading voltmeter between the pipe and the rail, taking a reading and then short circuiting the voltmeter by means of a heavy wire, and see if there is any material drop in voltage under these conditions. This would give a very strong indication as to what was going on, for, if the insertion of the heavy wire did not make a marked change in the voltage, it would indicate that the ground itself was a very good conductor.

HENRY D. JACKSON,
Consulting Engineer, Boston, Mass.

Civil Service Examinations

The United States Civil Service Commission will hold examinations at the usual places as follows:

May 11: Associate physicist qualified in engineering, especially in fire-proof materials, in Bureau of Standards, Pittsburg, Pa., at $2,200 to $2,700, and at Washington, D. C., at $2,200 to $3,500 a year.

May 20: Junior railway signal engineer, punior mechanical engineer, junior electrical engineer, junior structural engineer, under the Interstate Commerce Commission at $1,080 to $1,500 a year.

Technical Associations

The forty-sixth convention of the American Society of Civil Engineers will be held in Baltimore, Md., June 2-5. The program includes a reception on the evening of June 1; social and business features on the 2d, including consideration of a proposed code of ethics; an excursion to graduation week at Annapolis on the 3d; brief addresses on features of Baltimore by city officials and others under the headings "City Planning and Paving," "Drainage and Sewerage," "Harbor Work," "Water Supply and Filtration" on the 4th with excursions to see the improvements described and a reception and ball in the evening; and excursions to Sparrows Point and Fort Howard on the 5th, with a smoker in the evening.

The National Old Trails Road Association holds its convention at the Claypool Hotel, Indianapolis, Ind., on May 7-9, the last day being Indiana Day with a business meeting of the Indiana Good Roads Association.

The Sixth National Conference on City Planning will be held at Toronto, Ont., May 25-27. Aside from the general discussions of city planning and its relations to other functions of city government, the subjects discussed include rapid transit, including the auto bus, garden cities and suburbs, water fronts, recreation facilities, etc.

A snow removal conference was held in Philadelphia April 16 and 17 in which the directors of public works, street cleaning commissioners, etc., of New York, Boston, Philadelphia, Scranton, Pa., Portland, Ore., Newark, N. J., and Washington, D. C., took part.

The Record of the National Fire Prevention Convention has been printed, 600 pp., and can be obtained of Merchant & Evans Co., Philadelphia, at 85 cents in paper and $1 in cloth.

The fourth American Road Congress to be held under the auspices of the American Highway Association will be held at Atlanta, Ga., Nov. 9-14, 1914. Charles P. Light, business manager, Colorado, Bldg., Washington, D. C. The 1914 Good Roads Year Book of this Association has just been issued bound in cloth, and is worth may times the dollar charged for it to any one interested in good roads and their construction.

The fourth annual convention of the Tri-State Water and Light Association of the Carolinas and Georgia was held in Atlanta, Ga., April 16 and 17. M. A. Stubbs, secretary.

The American Water Works Association holds its 34th annual convention at the Bellevue-Stratford hotel, Philadelphia, Pa., May 11-15. John M. Diven, secretary, Troy, N. Y.

Technical Schools

The Iowa State College at Ames has published Bulletin 33 of the Engineering Experiment station on "House Heating and Fuel Tests," which compares the efficiency and economy of various Iowa and Illinois coals, Tennessee smokeless, gas house and process coke, anthracite and peat at the prices prevalent in Iowa. It should be of great value to all interested in the subject, because the results can be applied anywhere, tho prices are those of Iowa.

"The Mortar-Making Qualities of Illinois Sands," by C. C. Wiley of the Department of Civil Engineering of the University of Illinois, has just been issued as Bulletin No. 70 by the Engineering Experiment Station of that university. This bulletin discusses the effect of the characteristics of the sand upon the quality of mortar. The results of a series of tests on thirty-two representative Illinois sands are given in tabular form and discussed. A classification of different sands is then proposed and specifications for each class suggested. Copies of Bulletin No. 70 may be obtained upon application to C. R. Richards, Acting Director of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

Throop College of Technology, Pasadena, Cal., publishes a program of a competition with cash prizes of $200, $100 and $50 and honorable mentions, for a scheme of development of four corners each 200 feet square at the intersection of two 70-foot streets. Drawings are to be filed with Geo. A. Damon, Dean of Engineering, Sept. 1, 1914, who will give further information on the subject.

Publications Received

Report of the Chief of Engineers, U. S. Army, for 1912. Paper, 1,349 pp. W. H. Bixby, Chief of Engineers, Washington, D. C.

The Ohio Valley Flood of March-April, 1913, including comparisons with some earlier floods. By A. H. Horton and H. J. Jackson. Paper, 96 pp. Water Supply Paper No. 334 of the U. S. Geological Survey, Department of the Interior. George Otis Smith, director, Washington, D. C.

Engineering and Architectural Jurisprudence: A presentation of the law of construction for engineers, architects, contractors, builders, public officers and attorneys at law. By John Cassan Wait, M. C. E., LL. B., attorney and counselor at law and consulting engineer. Cloth, 905 pp., $6. John Wiley & Sons, New York City.

Report of the Board of Water Commissioners of East Orange, N. J., for 1912. Paper, 36 pp. Arthur A. Reimer, engineer.

The Economic Cost of the Smoke Nuisance to Pittsburg. By John J. O'Connor, Jr., A. B. Paper, 46 pp., 25 cents. Smoke Investigation Bulletin No. 4 of the Mellon Institute of Industrial Research and School of Specific Industries, University of Pittsburg, Pa.

Pure Iron vs. Copper-Bearing Steel: A brief for the plaintiff, with historical data bearing upon the development of the rust-resistant metals in the United States. By Allerton S. Cushman, Ph. D., Director. Paper, 47 pp. Bulletin No. 5 of the Institute of Industrial Research, Washington, D. C.

South Philadelphia: The abolishment of grade crossings and the creation of opportunities for commercial and industrial development. Paper, 72 pp. Department of Public Works, Philadelphia, Pa.

The Strength of I-Beams in Flexure. By Herbert F. Moore. Paper, 40 pp., 20 cents. Bulletin No. 68 of the Engineering Experiment Station, University of Illinois, Urbana, Ill.

Sixth Annual Report of Pasadena's Municipal Lighting Works Department, for year ending June 30, 1913. Paper, 32 pp. C. W. Koiner, electrical engineer and general manager, Pasadena, Cal.

General Statistics of Cities, 1909: Including statistics of sewers and sewage disposal, refuse collection and disposal, street cleaning, dust prevention, highways, and the general highway service of cities having a population of over 30,000. Cloth, 197 pp. Prepared under the supervision of LeGrand Powers, chief statistician for finance and municipal statistics, Bureau of the Census, U. S. Department of Commerce, Washington, D. C.

Annual Report of Department of Street Cleaning of New York City for 1912. Paper, 23 pp. William H. Edwards, commissioner of street cleaning.

Road Laws of West Virginia, 1913. Compiled by State Road Bureau, A. Dennis Williams, chief road engineer, Morgantown. Paper, 122 pp. Issued by department of agriculture, Howard E. Williams, commissioner, Charleston, W. Va.

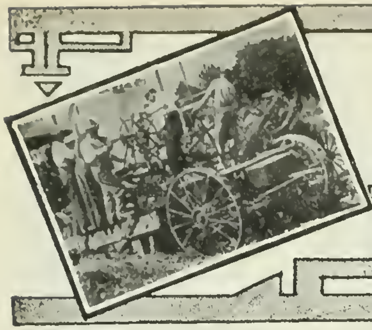
Report of Public Service Commission for the first district of New York. Vol. III. Statistics of Gas and Electric Companies in New York City. Cloth, 527 pp. O. F. Weber, chief statistician.

Sanitation at Mining Villages in the Birmingham District, Alabama. By Dwight E. Woodbridge. Paper. 27 pp. Technical Paper No. 33 of the Bureau of Mines, Department of the Interior, Washington, D. C.

Trade Waste Waters: Their Nature and Disposal. By H. Maclean Wilson, M. D., B. Sc., chief inspector, West Riding of Yorkshire Rivers Board, and H. T. Calvert, M. Sc., Ph. D., F. I. C., chief chemical assistant. Cloth, 340 pp. J. B. Lippincott & Co., Philadelphia, Pa.

The Elements of Specification Writing: A text-book for students in civil engineering. By Richard Shelton Kirby, C. E., professor of civil engineering, Pennsylvania College. Cloth, 125 pp., $1.25 net. John Wiley & Sons, New York City.

Annual Report of the City Engineer of Cambridge, Mass., for year ending March 31, 1913. Paper, 18 pp. L. M. Hastings, city engineer.



MACHINERY AND SUPPLIES

Trinidad Asphalt For Maple Road, Indianapolis

The Board of Park Commissioners of Indianapolis, Ind., has awarded to the Marion County Construction Co., the contract for the improvement of the boulevard on Thirty-eighth street, hereafter to be known as Maple Road, and they will use Trinidad asphalt in the work.

The width of the entire improvement is 100 feet and there are the usual specifications for grading, preparing sub-grade of roadway, lawns, and house connections to sewer, sewer extensions, inlets, catch-basins, manholes, concrete combined curb and gutter, cement sidewalks, etc.

The roadway is to be paved with an asphaltic concrete wearing surface laid on a concrete foundation, using Trinidad asphalt in the top.

The mineral aggregate of the wearing surface is to be a mixture with sand and in some cases a small quantity of stone dust or portland cement, and any sound durable stone, either trap rock, limestone, or granite, usually considered suitable for macadam, broken as nearly cubical as practicable, not showing distinct planes of cleavage or crystalline faces and not readily crushing or splitting under the roller. The size is crusher run passing a ¾-inch screen and held on a 10-mesh screen, dust or fine screenings being removed. The sand is to pass a ¼-inch screen and not over 5 per cent. pass a 200-mesh screen, and not over 30 per cent. held on a 10-mesh screen. Not over 4 per cent. by weight of portland cement or ground limestone is to be added to the mixture, the resulting aggregate mixture not to contain over 10 per cent. of materials passing 200-mesh.

The specifications for the bituminous material conform with those of the American Society of Municipal Improvements with two or three minor exceptions.

The proportions of materials are 3 parts of stone, 2 parts of sand and 7 to 10 per cent. by weight of bitumen, the stone dust, if any, not exceeding the above 10 per cent. by weight passing a 200-mesh screen.

After mixing hot according to standard specifications a thin coat of the asphaltic cement is spread uniformly over the concrete at a temperature of 300 to 325 deg. F. on which, while still hot the paving mixture is spread thick enough to roll down to 2 inches.

A seal coat of asphaltic cement, of consistency to be flexible when cold, is spread over the surface at proper temperature between 200 and 300 degrees and evenly spread with rubber squeegees without excess over amount necessary to fill voids, on which immediately is spread a top dressing of ¼ to ⅛-inch Wisconsin red granite chips, with a small surplus to be worn in by the traffic.

The pavement is about 1½ miles long, with 41,956 square yards of asphaltic concrete and 1,140 square yards of concrete pavement. The estimated total cost is $119,898.45.

The Squeegee Cleaning Indianapolis Streets

The Street and Sewer Committee, of the Indianapolis Chamber of Commerce, recently reported its observation of the operation of new street cleaning machines on the streets of the city and commends the present city government for this effort to improve the cleanliness of the streets, a matter which has been sadly neglected for several months. The machines work on the same principle as the rubber squeegee for cleaning windows and other smooth surfaces. The strips of rubber are arranged in parallel spiral lines around a cylinder which is revolved in opposite direction to the motion of the wagon by proper conection with the axles of the wagon wheels, and as the wagon moves along they scrape the pavement clean. The cylinder is set at a slight angle so that the dirt is swept towards the gutter. On the wagon is a water tank which supplies the small amount of water necessary for the cleaning operation, thru a horizontal perforated pipe immediately in front of the revolving cylinder.

The test of the efficiency of such apparatus is the removal of horse droppings which have been flattened onto the pavement by wheels running over them. Judged by this criterion the machine is much more efficient than the ordinary broom street sweeper, and it raises no dust.

The city had a couple of these machines several years ago, but on some change of administration they were set aside by some street superintendent who had other interests, but the present administration seems to have recognized their merits and starts in with two new machines.

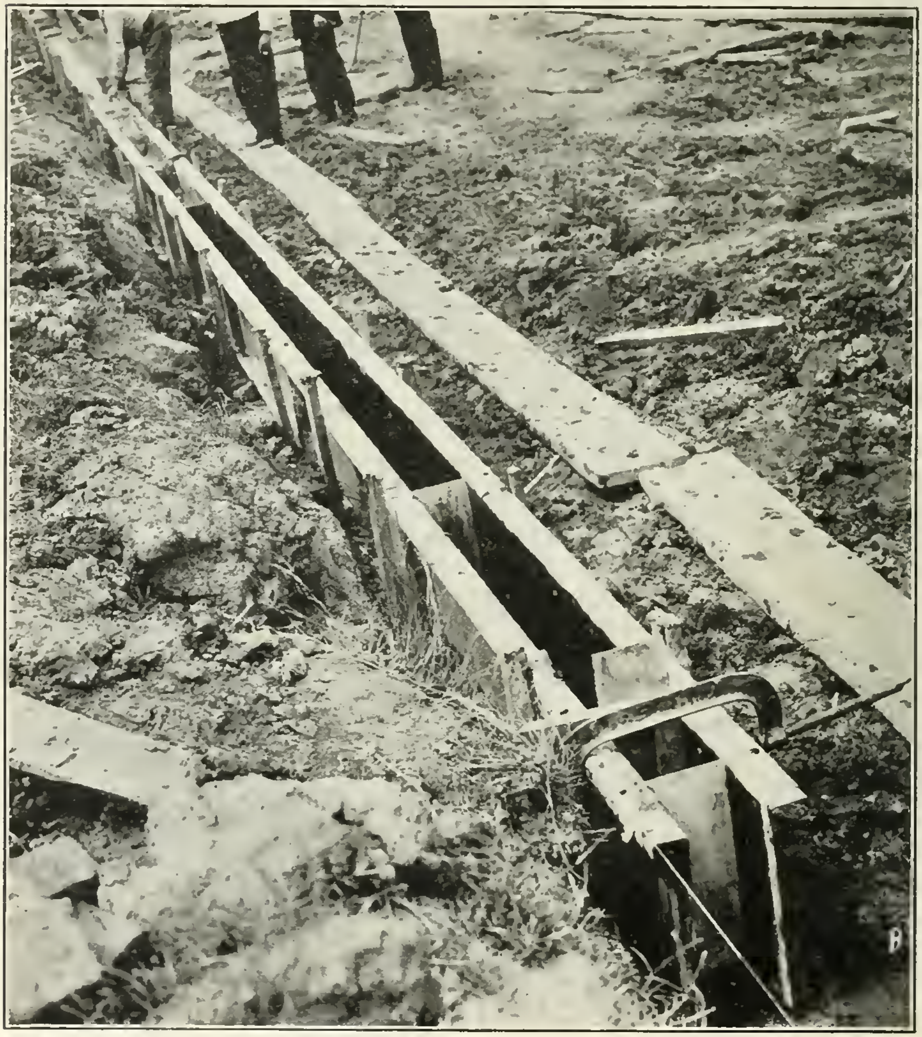
The machine referred to is made by the Kindling Mfg. Co., of Milwaukee, Wis., who issue a catalog fully descriptive of its operation.

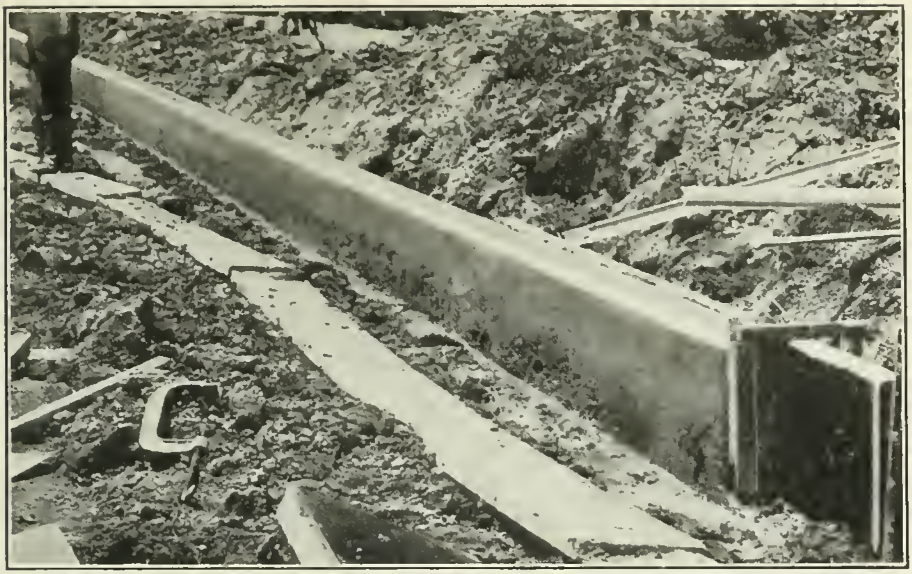
Reinforced Concrete Curb in Detroit

A method of protecting the corner of concrete curb with a steel bar has been developed by the Trussed Concrete Steel Co., of Detroit, Mich., which is shown in the accompanying photographs.

The first photograph shows the entire operation of laying the curb, on Crane avenue, Detroit, Mich. In the immediate foreground is the line for locating the curb exactly for grade and alinement,

LAYING REINFORCED CONCRETE CURB *in Detroit. Steel forms in foreground, filled with concrete farther back. Putting corner bar in place and finishing top in background.*





and steel forms are shown in place with the stakes for holding them rigid, the joint plates and the clamp for keeping the forms in exact position with respect to each other. Farther in the rear the concrete has been filled into the form and the first workman seen removes the joint plates and is seen placing the curb bar, which he does by forcing it into the wet

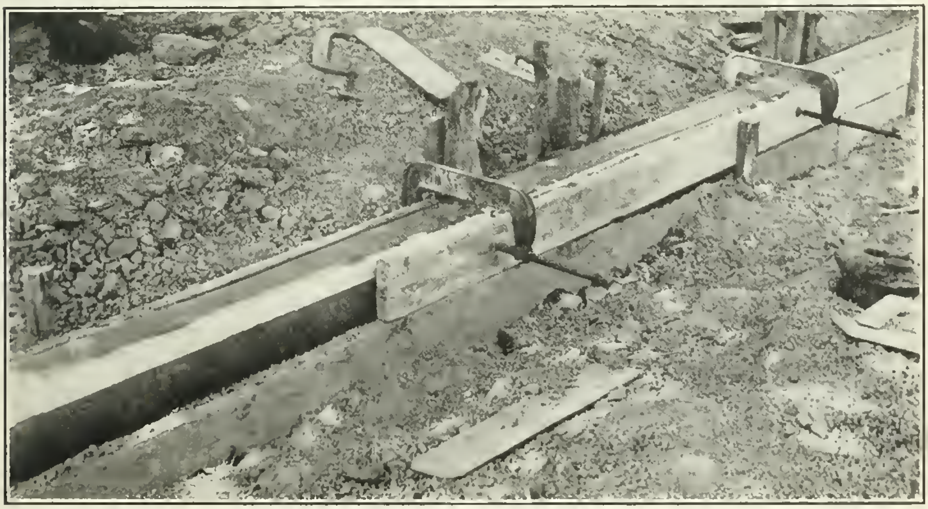
REINFORCED CONCRETE CURB *made in wooden forms, which are partly removed to finish surface, and show steel corner curb bar.*

REINFORCED CONCRETE CURB *with steel forms removed. Note rounded steel protected corner.*

concrete so that its anchoring parts are thoroly surrounded by the concrete and it is held completely and immovably by the concrete when it has set. The workman in the background is finishing the top surface of the curb.

The second photograph shows the curb with the forms removed.

The third photograph shows the curb



laid on Bewick Ave., St. Clair Heights, Mich., using wooden forms. Part of the form has been removed, showing part of the face as well as the top of the curb and the Trus-Con Curb Bar No. 1, which gives the rounded appearance to the curb corner.

In all the cases shown but particularly with the wood forms, the front surface of the curb is carefully smoothed and finished with a steel trowel, the forms being removed early enough so that this can be done.

The materials used in the curb are 1 part cement, 2 parts washed sand and 3 parts washed gravel.

Water Meters in Houston, Tex.

The city of Houston, Texas, is operating its water supply system on a meter basis, having made the change since 1907. In that year the average daily consumption per capita was 147 gallons. Today with an increase of 50 per cent. in population the average is 51 gallons. This is the summary of the showing that the unmetered consumer wastes much more water than the metered consumer.

The present stock of meters includes 7,801 Trident, 49 Trident-Crest, 196 Crown, 340 Empire, 1,666 Lambert, 19 Gem, and 27 miscellaneous. David Fitzgerald, water commissioner, is highly in favor of the meter system.

Aztec Asphalt

With the advent of the automobile a crying necessity was occasioned for something to apply to suburban and rural roadways, which would prevent dust and disintegration. The roadway development has caused an enormous increase in the production and use of asphalt. The consumption of asphalt has approximately trebled in the past five years.

Particularly for paving and road building purposes, the asphalt selected should be one that combines high cementing value, ductility and a low susceptibility to extremes of temperature. With these qualities combined in an asphalt it is ideal for paving and road making purposes.

Aztec asphalt possesses these vital elements and consequently is recognized by asphalt chemists, engineers and contractors as one of the best asphalts on the market. It is produced from a maltha (fluid bitumen or liquid asphalt). The maltha is found in the State of Vera Cruz, Mexico (the land of the Aztecs). The deposits are situated some little distance inland, approximately between the ports of Tampico and Tuxpam on the Gulf of Mexico. The maltha is conveyed by pipe lines to a seaport and thence shipped by tank steamers to the refinery of The United States Asphalt Refining Company at East Brooklyn, on Chesapeake Bay, ten miles from the City of Baltimore, Md.

The maltha is refined expressly for the asphaltic contents. It is distilled carefully and gradually at a temperature that will not crack or coke the bitumen, so that it will not be rendered lifeless and inert as a cementing agent.

Every device of science, together with a perfect system of control, have been installed at the refinery. The result is the production of an asphalt that is uniform in character, possessing all the vital essentials of a perfect bituminous paving material.

This material is placed on the market by the U. S. Asphalt Refining Co., 90 West St., New York City.

Creosoted Wood Block Paving in Jersey City

Jersey City, N. J., has 66,000 square yards of creosoted wood block paving, of which 9,500 square yards was laid in 1913. About 5,000 square yards will be laid in 1914. The average cost of the pavement is $2.77 a square yard. On medium traffic streets, where wood is mainly used, there is slight indication of wear and there has been some buckling which is attributed by the city's engineers to laying the blocks too close together.

The lack of dust is given as one of the advantages of wood block pavement, tho slipperiness is prevented by sprinkling sand on the surface of the street.

A 2 per cent. grade or less is preferred. The blocks used are 3½ inches in depth and they are laid on a bed of mortar 1 inch in depth. An expansion joint 1¾ inches thick at top edge and ½ inch at bottom is constructed along each curb. The joints between blocks are filled with portland cement grout, spread in scoop shovels.

Southern long-leaf yellow pine is the wood specified, not less than 90 per cent. heart-wood. A 20-pound treatment with creosote oil of 1.03 to 1.10 specific gravity at 38 deg. C. is prescribed, the oil to be a pure coal-tar product or in proportion of ½ coal-tar and ½ water gas tar, free from adulteration, petroleum oil or any of its products, and containing less than 5 per cent. of matter insoluble in benzol.

The Best Solution of the Smoke Problem

By W. C. Kirkpatrick, Chicago, Ill.

Quite often we are reminded of the fact that we have the cart before the hourse and the way in which the remark is usually made is suggestive of the fact that we are not properly hooked up for good work, and it is under these conditions that I see the many organizations working that claim to be trying to solve the smoke nuisance question and work out methods that are practical for the abatement of same.

They are employing expert scientific men and consuming millions of dollars as well as unlimited energy in trying to gather data showing how many tons of soot, or gallons of sulphuric acid are produced and distributed over a square mile, or trying to estimate how many millions of dollars worth of property is destroyed each year by the great volumes of smoke produced from our wilful, wasteful method of consuming coal.

Yet there is not a school boy or girl ten years of age who cannot tell that the great volume of smoke polluted air they breathe is a detriment, that the soot damages their toys, books, cards, etc., and the expensive data gathered by scientific men, do not prove a single thing of material value that cannot be established by every man, woman and child in the large city.

Then again, we find the same condition existing with other organizations and individuals, but they are endeavoring to work out some scientific and practical plan of consuming smoke, or a method whereby our high volatile coals can be utilized and eliminate the result of the smoke.

Millions of dollars per year are spent in this pursuit and a great amount of valuable energy is constantly being consumed in trying to successfully destroy the effects of liberating the millions of tons of volatile constituents in the bituminous coals.

But the real loss, a loss amounting to over five billion dollars per year directly due to the almost universal method of permitting the valuable by-products contained in high volatile coal to be destroyed, is the loss that really affects the individual and national welfare.

The output of the high volatile coal mines of the whole world exceeds one billion tons per year, and if distillation plants were erected at the mines so that all coal for domestic purposes would be distilled, and if all raw coal transported from the mine would be run thru distillation plants located in connection with manufacturing plants, then the volatile constituents would be subjected to destructive distillation under simple scientific conditions that would obtain a maximum yield of all valuable by-products.

Should the method be universally employed, we would obtain approximately 12½ million tons of ammonia sulphate, having a commercial value of over seven hundred and fifty million dollars, and ten billion gallons of tar having a commercial value of over three hundred million dollars, or these two items alone which unfortunately in our wilful, wasteful methods we convert into smoke, have a commercial value of our one billion dollars. This shows the direct loss only, and does not show the great profits that could be made by the use of the ammonia sulphate in agriculture.

Distilled coal is smokeless, and not necessarily coked, but semi-coked, containing just enough of the hydrocarbons to make it hold a fire readily and burn without a heavy draft. When distilled it is free from volatile and moisture and runs high in carbon, hence you pay the freight on that part of the coal that produces the greatest number of heat units per pound, and consume it in the most efficient manner, entirely eliminating smoke.

I almost forgot one of the constituents or products produced in the distillation process, and a rather important one, the gas. In the distillation of our billion tons of high volatile coal we would produce approximately 20 trillion feet of 300 B. t. u. gas that would generate 400 billion kw. hrs, and at one cent per kw. would have a commercial value of four billion dollars, making a total commercial direct loss to the world of over five billion dollars per year under the present system.

I know this is correct, also that the cart is before the horse, and if all the great trained minds, the scientific men who are chasing undisputed well known facts, will concentrate their minds upon the distillation of coal, if the great organizations and foundations, etc., will spend their millions along efficient lines and concentrate their energy upon the subject of simple low temperature distillation together with simple inexpensive recoveries, we will soon subdue the great smoke nuisance of the world in a simple way, by distilling the coal, leaving the carbon free from volatile combustible matter or a smokeless coal.

Then when it is a well established fact that it can be done in a practical, simple, inexpensive way (and it can), enact laws, not to prosecute a manufacturer for creating smoke, but for wasting natural resources, and enact laws making it unlawful to use raw fuel. I heartily endorse Professor Armstrong and his letter read before the British Association for the Advancement of Science held in Birmingham, England, Sept. 10-13, 1913, upon that subject, and believe that before we can accomplish the desired result, laws will have to be made which render it illegal to use raw fuel.

Reverse the method of trying to produce the result, and instead of trying to work against nature assist and co-operate with nature in order to produce the result in an economical, simple, natural way.

No chemical engineer who is honest with himself and actually having in mind the solving of an analytical problem will persistently try to work against nature. He will try to combine natural elements in a manner intended to aid and assist nature to produce certain other compounds or results.

Having this thought in mind I shall ask all who are interested in the smokeless city, the smokeless village and I may say the smokeless universe to consider the subject right end to, and concentrate their efforts to the production of a smokeless fuel and saving the tremendous values contained in the volatile combustible matter which at present escapes thru the chimney, pollutes the atmosphere, causing ill health, filth, damage to property, all deplorable conditions.

The M-C Paving Mixer

The M-C paving mixer justly attracts the careful attention of all who have to do with the building of country roads or city streets. The following brief description is presented to bring clearly to contractors and road builders reasons why this paver should be given consideration.

The mixer drum will hold 11 cubic feet of wet mixed concrete, or about 16 cubic feet of unmixed sand, stone and cement per batch. A 2-bag batch of 1-3-5 concrete can be mixed without slopping.

The machine may be operated by either steam or gasoline power. The gasoline engine furnished is a 12-h.p. double opposed cylinder New-Way engine, of the air cooled type. The steam power consists of 10-h.p. steam engine with 12-h.p. steam boiler. Power as great as 10-h.p. is not, of course, necessary to operate the mixer drum and loading hopper. As a matter of fact, a 6 or 7-h.p. engine is sufficient. The surplus power is provided to handle properly the traction feature while moving on bad or hilly roads.

Like the traction engine and the automobile, the M-C paver is equipped with both a high and a low running gear. The low speed (½ mile per hour) is more satisfactory while laying concrete. It is likewise desirable when the machine is operated on planks for the protection of the grade, as it is desirable, when moving only a few feet at a time, to move slowly. Further, when traveling to or from a job, if the road is rough, the paver should be run at low speed to prevent excessive vibration of the mechanism. Or, if the roads are muddy or there is an up grade, the low gear is desirable, as it enables the operator to pull out of situations that would be impossible at a higher speed.

The high speed (1¾ miles per hour), enables the operator, when the condition of the road permits, to travel quickly from place to place.

It is never necessary to load this paver on a wagon. It can get there under its own power.

A band brake, gripping a rim on each traction wheel, and patterned after the brakes on an automobile, insures safety while the machine is going down hill.

Further to facilitate traveling on bad roads, and to enable the machine to round corners without straining, a differential gear is furnished in the traction drive. This is a very important detail that has been adopted by manufacturers of all high grade traction equipment and should never be omitted from a paving mixer.

The steering is controlled by a hand wheel at the operator's platform. The operator has a clear view both ahead and to the rear. There is no difficulty in guiding the machine when traveling on either the high or low gear. Steering chains are provided with heavy springs for the important purpose of relieving the mechanism of all shock.

The wheels are extra large and heavy. The driving wheels are 36-inch diameter by 10-inch face, fitted, if desired, with cleats. The steering wheels are 30 inches in diameter by 8-inch face. The traveling qualities of the outfit are entirely satisfactory because of the size of these wheels.

For spreading concrete on wide streets the M-C delivery boom is unique. It consists of an open trough in which a mixing conveyor constantly revolves. In effect this is a continuous mixer, giving the concrete an extra "turn-over" after it leaves the main mixer drum.

The trough is fitted with three gates, dividing its length into four sections, each approximately 4 feet long. The concrete can be spread therefore, at a radius of 4, 8, 12 or 16 feet from the mixer.

The type of delivery boom has the following advantages, and there is no other boom that has so many:

1. It gives the concrete an extra mixing.

2. It is open for its entire length and, therefore, readily cleaned and kept in repair.

3. It delivers the concrete at four different distances from the mixer, making it necessary to move the machine only every 16 or 18 feet as the work progresses.

4. The machinery required to operate is reduced to a minimum. No engineer must handle it, as one of the labor gang can open or shut the gates when necessary.

5. The trough is always ready to receive a batch from the mixer, and there is no waiting for a bucket or car to come into position before a batch may be discharged.

6. This type of boom has less tendency to overturn the mixer than any other, because it is hung so low that its leverage is reduced to a minimum. And because, too, the weight of the apparatus is never concentrated at the end of the boom, as is the case when a dump bucket carries an extra batch of concrete to the end of the track on which it runs.

On roads up to 18 or 20 feet wide the M-C chute for spreading the concrete is recommended. This chute swings in a semi-circle, delivering the concrete either at the end, or by folding it back at a 4-foot radius.

The loading hopper is of the pivoted type, opened on the back and rounded on the edge so barrels may be wheeled into it from an angle and easily dumped.

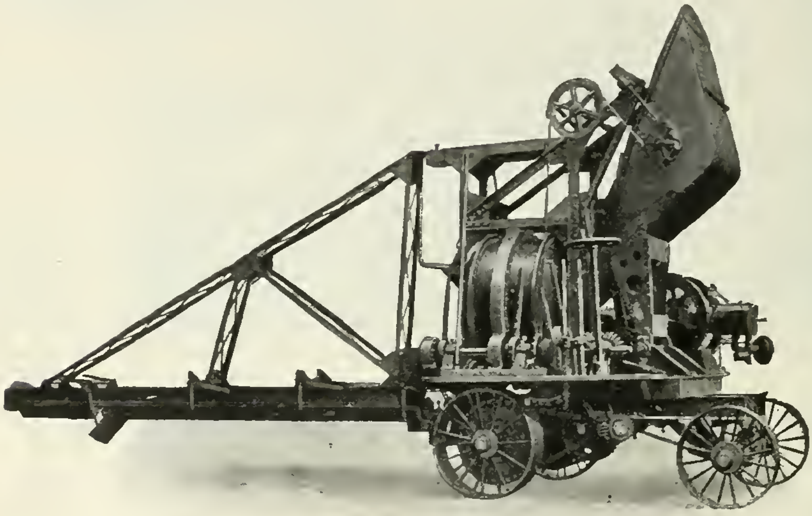
The hopper bottom and sides are so steep when discharging into the mixer, and the throat of the hopper is so large, there is no choking of the material. The hopper always clears itself, and not even a grain of sand is spilled.

All levers are banked on one side of the machine, so one man can conveniently control every operation of the mixer and of the traction from the one position. The platform is of checkered floor plate, providing the best kind of a footing for the operator.

The gasoline driven machine, without delivery boom, weighs approximately 10,000 pounds, and the steam driven outfit about 10,500 pounds. The extra weight of delivery boom is about 1,000 pounds or of the delivery chute about 300 pounds, including all attachments.

Clutches are provided so no shafts nor gearing for one operation are running idle while another operation is being performed. The drum does not turn while the traction gearing is moving the machine, and vice versa. Power, therefore, is concentrated where it is required.

The slogan of the mixer is "Most Mixing—Least Fixing."



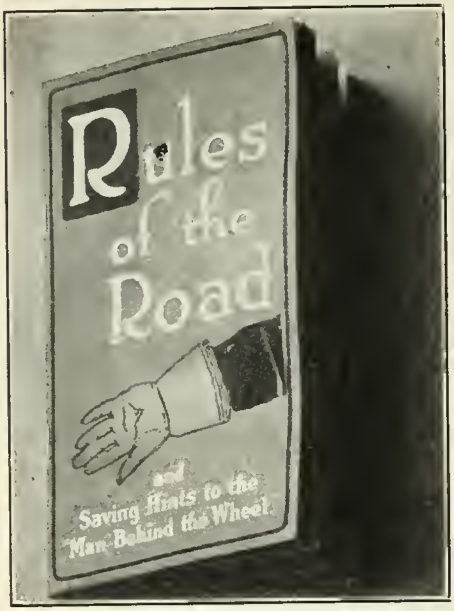
THE MARSH-CAPRON CONCRETE PAVING MIXER. *Note loading device and mixing delivery chute, which can discharge concrete at four points four feet apart.*

Cement-Finished Floors

The Trus-Con Laboratories, Detroit, Mich., have issued a valuable booklet giving full and concise specifications for producing cement-finished floors that will not continually dust under light traffic and rapidly wear away under heavy service by the use of Trus-Con floor hardener, a very simple method that any experienced workman can apply without the attention of any special superintendent.

Rules of the Road

In line with their policy of supplying motorists service, the B. F. Goodrich Company have recently issued a booklet, "Rules of the Road." The purpose is to help further the safety-first movement by putting valuable hints in such concrete shape that they can be quickly mastered by the man behind the wheel.



Both new and experienced drivers will appreciate the information contained in "Rules of the Road." It tells in clear, concise manner many regulations which new drivers must usually acquire from costly and embarrassing experience. It gives rules governing street traffic, such as passing, turning, stopping and starting. Also data on precedence on right of way, speed laws, respective rights and duties of drivers and pedestrians, lights, etc.

Then follow chapters on care of tires, how to make repairs, how to secure the Goodrich touring service, road marking service, good roads, and how to secure the benefits from Goodrich service stations

Co-operation of Towns in Fire Fighting with Auto Apparatus

At the spectacular Wellesley College fire a few weeks ago there occurred an interesting occurrence not generally known but of great significance as illustrating the modern method of co-operation between fire departments which have motor-driven apparatus.

As the local Wellesley department was poorly equipped for fighting a large fire of this character aid was called for from the nearby towns and cities. The City of Newton responded promptly by sending its Knox pumping engine and Knox-Martin tractor with hook and ladder truck, two pieces which it has put in service within the last few months.

On account of the confusion attendant at the fire the Newton department did not get the call until some time after the fire had started, but made a splendid run over the intervening six miles in a very few minutes, although the road was foggy and very slippery in spots.

The building was practically doomed when the Newton apparatus arrived, but the pump immediately coupled up to a hydrant and pumped steadily for over three hours and a half, with two lines out, saving the right wing of the building. The pump was handicapped on account of water, but, in spite of this, gave a splendid performance, making the first real hard test which it has had since it was installed a few months ago.

Had the motor apparatus been called a little more promptly and had the other neighboring towns been able to send any similar motor equipment, the Wellesley fire disaster would have been a very different story, for the effective work performed by the Knox pump under its severe handicap shows what would have been possible with a little more of the same effective kind of co-operation.

As the various cities and towns, particularly in a locality where they are so close together as in Eastern New England, become better equipped with motor apparatus, the outlook is very promising for some splendid work along these lines, and it would even appear as tho the time would eventually arrive when a serious conflagration would be almost an impossibility, on account of the prompt and powerful co-operation thus made possible by modern motor equipment.

Cushion Tires for Trucks and Fire Department Service

Motor truck operators are becoming more far-sighted every day according to C. W. Martin, Jr., manager of the Motor Truck Tire Department of the Goodyear Tire & Rubber Co.

Martin says in part: "The great majority of truck owners are thru with the penny wise and pound foolish idea. They realize that a slightly increased expenditure in the beginning generally means a big saving in the end and especially is thus true in buying tires.

"Take for instance the Goodyear Cushion Demountable tire. After it had proven itself so thoroly in fire department service we put it on the market for commercial use with the result that the tire was immediately and widely demanded in spite of the fact that the initial cost was slightly higher than that of the ordinary solid tire.

"The reason truck owners were willing to do this is very apparent. A little study showed at once that the saving in upkeep especially in the renewal of engine and

chassis parts in a year's time amounted to quite an item.

"The jolts and shocks a truck receives under ordinary operating conditions will react without appreciably lessened force on the mechanical parts to an extent that is bound to result in a certain amount ot injury or wear. This means just so much tacked on to the yearly repair and overhauling bill that a Cushion tire could reduce to a minimum.

"Truck owners who have adopted Goodyear Cushion Demountable tires for equipment have without exception reordered for the saving in this particular item of expense alone."

Tandem Motor Roller

The Austin-Western Road Machinery Co., Karpen Bldg., Chicago, Illl., have issued the "first fully descriptive catalog of the first successful tandem roller built in the United States" and will send it on request to any one interested in road and pavement construction and machinery.

Trade Notes

The Curtis-Ward Co., general contractors, 28 E. Jackson St., Chicago, Ill., have been awarded contract for equipping Park Ridge, Ill., with 200 street signs and standards similar to those erected by them in Chicago. The signs which are being used in Park Ridge are comparatively inexpensive and cost much less than those used in Chicago. They are, however, handsome in design and attractive in appearance.

The city of Chicago has ordered 500 additional street signs from the Curtis-Ward Co., 28 E. Jackson St., Chicago, Ill., to be installed on the boulevard systems, they already having with the city the largest contract for street signs ever awarded.

Owing to increased business the Raymond W. Dull Co., Chicago, Ill., have found new quarters at 1910 Conway Bldg., 111 W. Washington St.

The Chicago mixer which was formerly sold by The Chicago Concrete Machinery Co., has been taken over entirely by the T. L. Smith Company, 3122 Hadley St., Milwaukee, Wis., and will form a part of their regular line. It has been entirely re-designed and will be known as the Smith-Chicago mixer.

The MacArthur Concrete Pile & Foundation Co., New York City, has been awarded the contract for the concrete pile foundations of the three-story reinforced concrete factory building and power house for the Willys-Overland Co., automobile manufacturers, Toledo, Ohio; of a retaining wall to be constructed between 138th and 141st Streets, the Bronx, New York City, by the New York Connecting Railway; and of two large storehouses to be erected by the United States Government at Ft. Mason, San Francisco, Cal.

Dunn's wire-cut-lug blocks are in use as paving material for yards, factories and warehouses by many industrial concerns such as the Yale and Towne Co., Eastman Kodak Co., Niagara Falls Power Co., etc.

Trade Publications

One of the handsomest catalogs received lately is catalog No. 19 of the Koehring Machine Company, Milwaukee, Wis., devoted to their line of concrete machinery. It is not only handsome but useful, as it is difficult to find a question about any of their machinery which is not answered in full in the book.

The Conley Incinerator System, patented by Joe Conley, of Oklahoma City, is described in a pamphlet issued from the San Francisco office, Monadnock building. One form is a combination latrine and incinerator for camp and army use, which is modified for school and institution use.

The Turner combination drag line ditcher and shovel is described in a booklet of the United Iron Works Company, Springfield, Mo.

A booklet of the Northwestern Expanded Metal Company, Chicago, on concrete culverts shows a number of photographs of culverts reinforced with their Econo expanded metal.

A booklet describing the Stickney siphon spillway and automatic crest for dams is issued by the Hydraulic Specialties Co., Albany, N. Y.

"Culverts" is the title of a booklet issued by the Pennsylvania Metal Culvert Co., Warren, Pa.

The Trus-Con Laboratories, Detroit, Mich., issue a circular descriptive of Trus-Con waterproofing paste, under the title, "What It Has Done and Where It Has Been Used."

The "National Bulletin" is devoted to the characteristics of "National Pipe" of the National Tube Co., Pittsburg, Pa.

CONTRACTING NEWS

AUTOMOBILES—FIRE APPARATUS.

BIDS REQUESTED.

Clinton, Iowa—May 12, until 8 p. m., for one motor tractor for hook and ladder truck; truck weighs about 7,000 lbs. Certified check 10 per cent. of bid. Frank W. Leedham, city clerk.

Yankton, S. D.—May 11, until 8 p. m., for one combination hose, ladder and chemical motor-driven fire truck. Photographs and complete specifications of the complete equipment and truck must accompany all bids. Dr. E. M. Doyle, chairman of joint committee of city commissioners.

CONTEMPLATED WORK.

Madison, Wis.—An auto truck for No. 3 fire station and a runabout for fire chief. O. S. Norsman, city clerk.

Moline, Ill.—Motorization of fire department. Bond issue, $34,500. John Q. Hawk, fire chief.

Nashua, N. H.—Combination motor truck, supply wagon for fire department, and an ambulance, all motor driven. Appropriation, $10,000.

Omaha, Neb.—Bids to be asked for an automobile for health commissioner. Thos. J. Flynn, city clerk.

BRIDGES.

BIDS REQUESTED.

Independence, Mo.—May 14, until 11 a. m. for constructing following drains on Marty road: Six-foot masonry arch culvert, head walls and wings to be raised; 6-foot masonry arch culvert to be lengthened and masonry head walls built; 3-foot by 3-foot concrete box culvert to be lengthened; 4-foot by 4-foot concrete box culvert; 30-inch concrete box culvert; 2-foot by 2-foot concrete box culvert. Certified check, $100.00. Roland T. Proctor, county surveyor.

Marion, Ohio—May 26, until noon, for substructure for bridge across Scioto River at Green Camp. Certified check, $200.00. V. Perle Garfield, clerk, board of Marion County commissioners.

Piqua, Ohio—May 26, until 10 a. m., for reinforced concrete bridge on Union street in Piqua. Certified check, 5 per cent. of bid, made payable to county auditor. L. P. Knopp, county surveyor.

Salisbury, Md.—May 19, until noon, for two lift bridges, including substructure and superstructure, of 40-foot clear span, roadway 18 feet with two sidewalks each 5 feet, over South Prong of Wicomico River at Camden avenue and South Division street crossings. Certified check, $200.00. H. M. Clark, roads engineer, Wicomico County.

Tiffin, Ohio—Until May 23, for three concrete arch bridges over Sandusky River in this city. Robert H. Lee, engineer, Williamson Building, Cleveland, Ohio.

Troy, Ohio—May 15, until 10 a. m., for reinforced concrete bridge in Union street, Piqua, Ohio; for substructure of Landman bridge two miles north of Piqua; for steel superstructure for Landman bridge; for substructure and steel superstructure of Buck Neck bridge, two miles south of Bradford, Ohio. Certified check, 5 per cent. of bid, made payable to M. T. Staley, auditor, Miami County.

Vernon, Ind.—Until May' 21, for concrete brdige across Big Creek. G. J. Bernhart, auditor, Jennings County.

Westmoreland, Kans.—May 22, until noon, for bridge over Blue River between Riley and Pottawatomie Counties. Geo. Hungerford, county clerk, Manhattan, Kans.

Winchester, Ill.—May 16, until noon, for reinforced concrete bridge known as Knapp bridge in North Winchester Township, Scott County. Estimated cost, $2,200. Geo. H. Vannier, county superintendent of highways, Bluffs, Ill.

Kokomo, Ind.—May 23, until 10 a. m., for following bridges: Ohio street in Kokomo over Wildcat Creek, and an additional span to McCann street bridge over Wildcat Creek; the O'Dowd Ford bridge over Wildcat Creek on Center and Harrison Township line; the Barber road bridge in Ervin Township. E. B. Swift, auditor, Howard County.

CONTRACTS AWARDED.

Big Timber, Mont.—To Security Bridge Co., Billings, Mont., bridge across Yellow Stone River at $14,995.

Davenport, Iowa—To March Engineering Co., Des Moines, contract for six bridges and steel concrete substructures of two steel bridges at $8,050; to Clinton Bridge Co., contract for superstructure of three steel bridges and concrete substructure of 40-foot steel truss bridge at $8,080.

Hamilton, Ohio—To A. J. Yawger & Co., Indianapolis, for 475-foot concrete bridge over Miami River, High street, Hamilton, at $142,440.90; to Hackedorn Contracting Co., Indianapolis, Ind., three-section concrete bridge and two-section viaduct at Middletown, Ohio, over Miami River, at $252,718.30.

Havre, Mont.—To O. C. Peppard Bridge Co., Missoula, Mont., three bridges in Hill County at $30,000.

Massillon, Ohio—To Riverside Bridge Co., Martins Ferry, viaduct in Massillon over Tuscarawas River, Ohio Canal and several railroad tracks, length 705 feet, contract price $28,100.

Ogdensburg, N. Y.—To Kirk, Raleigh & Co., Syracuse, N. Y., reinforced concrete bridge across Oswegatchie River at $68,500.

Oskaloosa, Iowa—To Koss Construction Co., Des Moines, for 34 bridges and culverts in Mahaska County at $13,588.

Thermopolis, Wyo.—To Monarch Engineering Co, Falls City, Neb, for bridge across Big Horn River at $8,012.

Wentworth, N. C.—To Vincennes Bridge Co., Vincennes, Ind., bridge across Dam River near Draper, N. C., at $14,890.

CONTEMPLATED WORK.

Beaufort, N. C.—Bond issue of $80,000 voted for construction of concrete bridge across Beaufort river from Beaufort to St. Helena Island, length 1,600 feet. J. B. Walker, chairman bridge commission.

Butte, Mont.—Plans submitted for bridge over Big Hole River by County Surveyor W. T. George. Bids will be asked for shortly. Estimated cost, $15,000.

BUILDINGS.

BIDS REQUESTED.

Tampa, Fla.—May 12, until 2 p. m., for City Hall and police headquarters. Certified check, 2 per cent. of bid, made payable to Board of Public Works. D. B. McKay, chairman of board.

Waterbury, Conn.—Until May 29, bids will be received for municipal building at Grand and Field streets; four stories, 144x200 feet,

Cleaning Railway Cars by Vacuum

is being done in **many cities** with our **Vacuum Pumps.** A **powerful** suction can **draw out** the **dust** from **all** crevices and keep the cars **clean** and **sanitary,** and they look **like new** always. **Trolley cars** and **automobiles** are also **cleaned** in **this** way. We can supply a **big** machine with power enough to operate **two tools** at once for **far less** than you could buy one of the many **little portable** outfits.

This machine is made for **hard, strenuous** work, and will **last** a **lifetime.** It can be placed on a **hand truck** or **automobile** and **100** or **200** feet of **hose** used so that an entire **school** building, **theatre,** or in fact **any** structure may be **quickly** and **easily** cleaned. It can **also** be used as a **blower** for **many** other purposes, such as **burning out** stumps, **renewing** school **blackboards, brazing,** etc.

Catalog No. B 4 AL

LEIMAN BROS.

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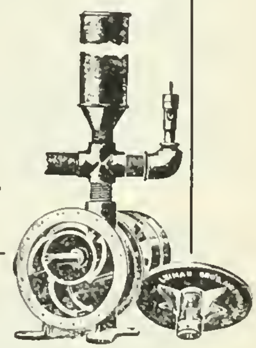


brick and limestone. Estimated cost, $600,000. Cass Gilbert, architect, 11 West Twenty-fourth street, New York City. Wm. H. Sandland, 111 West Main street, Waterbury, clerk of committee.

CONTRACTS AWARDED.

Dillon, Mont.—To Wm. G. Rreed, city, two-story and basement and reinforced concrete City Hall at $27,930.

Negaunee, Mich.—To Ford E. King, Hancock, Mich., City Hall, at $49,192; to Swanson Bros., city, plumbing and heating at $9,986.

CONTEMPLATED WORK.

Dothan, Ala.—Plans to be prepared by Morris & Morris of Atlanta, Ga., City Hall, cost $40,000.

Indianapolis, Ind.—Public Library Building, plans being prepared by Paul P. Cret, Borie, Zantzinger & Medary, Philadelphia. Estimated cost, $427,500.

Sandusky, Ohio—City Hall at cost, of $50,000 or $60,000; and police station on East Market Square, at cost of $40,000 to $50,000. Jacob Dietz, mayor.

GARBAGE DISPOSAL.

BIDS REQUESTED.

South Orange, N. J.—May 15, until 8 p. m., for collection, removal and disposal of ashes, rubbish, paper and garbage. Certified check, $500.00. M. A. Fitzsimmons, village clerk.

LIGHTING.

Brockton, Mass.—Removal of 80 arc lamps in street lighting system and substitution of about 300 incandescent lamps is planned. Jas. Hayes, Jr., city engineer.

Butler, N. J.—$35,000 bond issue will be voted shortly for installation of municipal electric light plant.

Conway, Ark.—White Way lighting system will be installed shortly. Estimated cost, $3,000. E. V. Leverett, superintendent of city lighting.

Earlville, Iowa—Erection of municipal electric light plant is being considered. Bond issue, $10,000. Mr. Vanfleet, mayor.

Franklin, Texas—$17,500 bonds voted for municipal electric light plant and water works.

Indianapolis Ind.—Contract awarded Merchants Heat and Light Co., city, at $41.98 per year for street electric arc lights—10-year contract. B. J. T. Jeup, city engineer.

Oak Harbor, Ohio—Contract awarded Gangle-Harbaugh Co., Akron, Ohio, for general construction of municipal electric light system at $7,169.75; to W. G. Nagel, of Toledo, Ohio, switchboard, at $1,302; to Joseph Skeldon Engineering Co., Toledo, pumps, at $1,340.

Pompton Lakes, N. J.—$20,000 bonds voted April 11 for municipal electric light plant. J. Frank Cornelius, boro clerk.

Pasadena, Cal.—Contract awarded Woodill & Hulse Co., Third and Main streets, Los Angeles, for installation of ornamental lighting system on Colorado street at $18,500.

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Albany, N. Y.—May 11, until 1 p. m., for LeRoy-Caledonia road, length 3.24 miles. Certified check, 5 per cent. of bid. John N. Carlisle, state highway commissioner.

Cincinnati, Ohio—May 15, until noon, for improving Ohio pike, repair of Springfield pike and Cheviot road. Certified checks, $500.00, $500.00, $1,000.00 respectively. Fred E. Wessellmann, president, county commissioners.

Elgin, Ill.—About June 15, for 30,033 square yards asphaltic concrete pavement on Center street, Hill avenue and Addison street. Morgan H. Brightman, engineer.

Elgin, Ill.—Until May 12, for 10,696 square yards brick pavement on South State street; 15,953 square yards asphaltic concrete on Park street; 2,450 square yards asphaltic concrete curb and gutter in certain streets. yards asphaltic concrete on Commonwealth avenue. Morgan H. Brightman, engineer.

Evansville, Ind.—May 18, until 10 a. m., for grading, draining and paving with brick Henderson road, in Pigeon Township, Vanderburgh County. C. P. Beard, auditor.

Fort Dodge, Iowa—May 11, until 9 a. m., for paving and constructing Portland cement concrete curb and gutter ,in certain streets. Certified check, 10 per cent. W. L. Tang, city clerk.

London, Ohio—May 12, until noon, for grading and paving North Main street with vitrified paving brick or asphalt block, or creosoted or kreodone wood blocks. Certified check, $1,000. J. W. Byers, village clerk.

Murray City, Ohio—May 12, until noon, for grading, curbing and paving with brick, Locust street. Certified check, $800.00. Oscar Albaugh, village clerk.

New Lexington, Ohio—May 25, until noon, for excavating, grading and paving with brick, constructing concrete curbs on both sides of Brown street from High street to Toledo & Ohio Central Railway tracks. Certified check, $500.00. Thad B. Skinner, village clerk.

Philadelphia, Pa.—May 15, until noon, for 601 cubic yards grading, 6,290 cubic yards pavement on ooncrete base, 45,300 square yards bituminous pavement, 35,800 square yards waterbound macadam, 8,800 square yards vitrified and stone block gutters, 3,040 lineal feet concrete curbing, five concrete arch bridges, 14,000 lineal feet piling, and 50,000 cubic yards grading for islands in League Island Park. M. L. Cook, director, public service, Room 225, City Hall.

Rawson, Ohio—May 25, until noon, for pavement on South Main street. Certified check, $200.00. Chas. H. Fetzer, village clerk.

San Antonio, Texas—Until May 16, for 78 miles gravel road and 2,700 cubic yards concrete culvert work. V. H. Howard, uditor, Bexar County.

St. Clairsville, Ohio—Until May 15, for paving Old National pike; work will be let in three sections; estimated cost $100,000. Address Belmont County commisioners.

Sullivan, Ind.—May 16th, until noon, for 23,330 feet stone road in Jefferson Township, 5,307 feet in Cass Township, and 19,123 feet gravel road in Gill Township. Wm. S. Bicknell, auditor, Sullivan County.

York, Pa.—May 15, until noon, for paving portions of various streets; work includes grading, laying of concrete base and about 70,000 square yards vitrified brick, sheet asphalt, bitulithic or wood block. Certified check, 5 per cent. Calvin A. Boyer, superintendent of streets and public improvements. Geo. A. Warner, city engineer.

CONTRACTS AWARDED.

Aurora, Ill.—To J. E. Salfisberg & Co., city, contract (sub-leased by McCarthy Improvement Co) for paving portion of Garfield and Calumet avenues and Le Grande boulevard.

Baltimore, Md.—To D. M. Andrews Co., city, resurfacing 4 5 miles of Emmitsburg road at $24,068.70; to Bamberger-Chapman Co., resurfacing 4 4 miles of National pike from Middletown to Washington County at $26,237.35.

Carrolton, Wash.—To Jeffery & Bufton, Portland, Ore., 3 miles highway north of Carrollton at $22,732.

Chariton, Iowa—To H. J. Cathroe, Omaha, Neb., Division "B," alley paving, cement concrete, at $11,855.30; to J. W. Turner Improvement Co., Des Moines, Ia., Division "A," street paving, brick, at $77,171.

Clarinda, Iowa—To J. S. McLaughlin & Son, Red Oak, 31,063 square yards concrete pavement at $54,161.

Conway, Ark.—To McCullough & Halter, Conway, concrete paving in business district at $20,000.

Delevan, Ill.—To H. K. Rhoades, of Lincoln, Ill., for 22 blocks of pavement at bid of $47,626.60.

Desplaines, Ill.—To Standard Paving Co., Grand boulevard paving at $16,502.45.

Hamilton, Ala.—To Jordan & Phillips, Aberdeen, Miss., 18 miles of pike road at $42,000.

Harlan, Ind.—To John H. Zimmerman, Harlan, stone road in Springfield Township, Allen County, at $22,745.

Hoopeston, Ill.—To H. C. Finley, city, West Main street paving at $12,980.34.

Huntington Beach, Cal.—To Frank Oswald, Los Angeles, concrete pavement with oiled macadam wearing surface on Seventeenth street at $24,570.

Indianapolis, Ind.—To Marion County Struction Co., city, asphaltic concrete paving Thirty-eighth street from Capitol avenue to Fall Creek at $11,925.

Kingston, Pa.—To B. G. Coon, Union street, Dorranceton, Pa., for 5,500 square yards brick paving and 2,100 lineal feet curbing at $17,200.

Kokomo, Ind.—To William & Edw. Mahoney, Lafayette, stone roads and brick pavements in city at $50,000.

Lake Charles, La.—To Southland Company of Lake Charles, Southland Company of Meridian, and Healy Construction Co. of Jackson, Miss., contracts for 45 miles of new highway amounting to $150,000.

Lake Geneva, Wis.—To D. A. Thatcher, River Forest, Ill., for 21,288 square yards creosoted wood block pavement at $2.14 per square yard; 5,875 lineal feet cement curbing, 36 cents; 682 lineal feet gutters at 65 cents and 390 lineal feet protection curbing at 10 cents. Total cost, $48,154.

Los Angeles, Cal.—To B. F. Ford and F. H. Stout, city improvement of Avenue 20 at $28,623; to F. W. Whittier, 1146 Title Insurance Building, improvement of Childs avenue between Fountain and Effie streets at $7,219.

Painesville, Ohio—To Lesher & Roess, Oil City, Pa., for South Ridge road, brick or concrete at $68,309.

Racine, Wis.—To Delta Constructing Co., Escanaba, Mich., for concrete road in town of Caledonia at $20,836.64; to Birdsall-Griffith Construction Co., Racine, for concrete road work in town of Mount Pleasant at $10,525.11.

Raleigh, N. C.—To R. G. Lassiter, Oxford, for street paving to be done during 1915.

Sacramento, Cal.—To John W. McDonald, San Jose, asphalt surface on State Highway between San Jose and Mulia at $15,869; to Berry Mackie & Co., San Francisco, 4.5 miles cement concrete highway in Humboldt County at $45,097; to Lynn S. Atkinson, Los Angeles, for 12.4 miles cement concrete work from Dearborn to North Line of Kern County at $48,110; to Tieslau Bros., San Francisco, highway from Hayward to Valla Vista school house at $19,538; to W. A. Perry, Los Angeles, for 11.5 miles Portland cement concrete in San Diego County, at $69,395; to C. L. Hyde Construction Co., San Diego, 2 miles Portland cement concrete, San Diego County, at $11,741.90; to Ransome-Crummey Co., Oakland, 5.1 miles asphaltic concrete work in in Alameda County, at $53,263; to Hard Bros., Sacramento, 5 miles of grading in Mendocino County at $51,381.

Salem, Ohio—To J. D. Paxon, Salem, at $20,799, Kane & Smith, Youngstown, at $11,849 and $6,036 improvement of roads with slag macadam.

Salt Lake City, Utah—To J. W. Mellen, city, 20,000 square yards asphaltic pavement at $132,260.

Sandy Lake, Pa.—To Vetter Construction Co., Meadville, Pa., West Main street paving at $16,488.30.

Seattle, Wash.—To Washington Paving Co., Savage-Schofield Building, Tacoma, Wash., grading and graveling H. H. Howard road at about $38,000.

Sharpsville, Pa.—To Turner & Olson, Youngstown, Ohio, 12,000 square yards brick pavement on Seventh street and Ridge avenue at $1.77 per square yard.

Shelbyville, Ill.—To File & Alexander, of Decatur, Ill., for paving various streets at $56,421.77.

South Bend, Ind.—To Rankert & Eggleston, city, asphaltic concrete paving on Cedar street at $18,741.94.

Tacoma, Wash.—To Joseph Water, Sr., city, South Ninth street, paving, asphalt, at $18,725.

Tama, Iowa—To Thos. Carey & Sons Co., Clinton, for paving business district at $32,540 with brick.

Transcona, Man.—To the Cusson Lumber Co., St. Boniface, Man., 14 miles plank sidewalks at $22,722.

Troy, N. Y.—To John W. Davitt, city, for paving Tibbits avenue and Peoples avenue at $33,522 and $19,951.50, respectively, with bitulithic paving.

Urbana, Ohio—To Andrew Asphalt Paving Co., Hamilton, for Scioto paving at $10,161.50; to J. O. Shoup & Co., Dayton, for paving various streets at total bid of $36,980.

CONTEMPLATED WORK.

Pittsburg, Pa.—County commisioners plan to expend $322,475 on roads. A. B. Hay, county solicitor.

Newark, Ohio—Construction of new sidewalks on sixty streets has been approved by street committee. Charles Wells, City engineer.

Bozeman, Mont.—About 22 blocks of paving, probably bitulithic, at estimated cost of $70,450.67. Carl Widner, city engineer.

Gridley, Ill.—To Driscol & O'Brien, Decatur, Ill., sanitary sewer system. Estimated cost $10,000.

SEWERS.

BIDS REQUESTED.

Albany, N. Y.—May 18, until 3 p. m., for an intercepting sewer and sewage disposal plant. Certified check, $20,000 for each. Isidore Wachsman, secretary board of contract and supply.

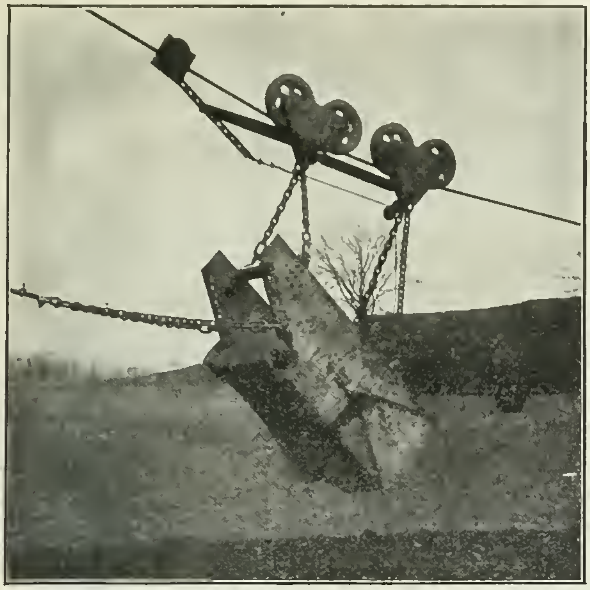
Chicago, Ill.—May 21, until noon, for excavation and collateral work on Section 12. Deposit required, $20,000 with each proposal. Thomas A. Smyth, president, board of trustees, Sanitary District, Room No. 700, 910 South Michigan avenue.

Dexter, Mo.—May 18, until 8 p. m., for sewerage system, including 7½ miles 6 to 12 inch pipe, 62 manholes, 25 flush tanks, and Imhoff tank. Webb Watkins, mayor.

Goshen, N. Y.—May 15, until 1:30 p. m., for system of sewers and sewage disposal plant. Certified check, $3,000, made payable to trustees of village. Geo. F. Gregg, president of village.

Indianapolis, Ind.—May 11, until 10 a. m., for reinforced concrete drain for carrying waters of Pogue's Run from New York street to White River as part of track elevation resolution No. 7. Certified check, 2½ per cent. Jos. A. Rink, president board of public works.

New Orleans, La.—June 17, until noon, for



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See descriptive article this issue.

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to discriminating cement buyers—to those who put standardized high quality first—the men at the top of the architectural and engineering professions are using Atlas constantly and have for twenty years.

drainage system as follows: Contract 62-D, one 15-ton hand operated crane; contract 63-D, underground conduit; contracts 65-66-D lined and covered drainage canals. Certified checks, $50.00, $200.00, $1,000.00 and $3,000.00, respectively. Geo. G. Earl, general superintendent of sewerage and water board, Room 508 City Hall Annex.

Struthers, Ohio—May 20, until noon, for storm and sanitary sewer with house connections in Broad street from Bridge street to village limits. Jonah Richards, village clerk.

York, Pa.—May 15, until noon, for sanitary and storm sewers in a number of streets. G. A. Warner, city engineer.

CONTRACTS AWARDED.

Angola, Ind.—To VanDerwelle Bros., Grand Rapids, Mich., at $22,679, and Moritz & Lybarger, city, at $12,490, for about 21,000 lineal feet of pipe sewer.

Antwerp, Ohio—Installation of sanitary sewer system at cost of $30,000 is contemplated. Wm. P. Reid, mayor.

Boston, Mass.—Contract awarded Anthony Baruffaldi, Boston, for sewer construction in Section No. 3, South End sewer improvement, at $31,556.

Chesterton, Ind.—To Sela A. Smith, of Lake County, sewer system, at $19,000.

Connersville, Ind.—Construction of vitrified tile sewers is contemplated. W. L. Schaeffer, city clerk.

Fenton, Mich.—Installation of trunk sewer system is being considered. McFadden & Bergin, Flint, Mich., engineers. Mr. Olk, president of council.

Fort Lupton, Colo.—To Gordon Taylor Construction Co., Denver, installation sewer system, at $13,790.

Hamilton, Ohio—Plans have been presented for East Hamilton. Trunk line of storm sewer to cost about $64,000. Frank Weaver, city engineer.

Joliet, Ill.—Bids will be advertised for at once for construction of Third Ward sewer system. Estimated cost, $55,000. C. D. O'Callahan, city engineer.

Memphis, Tenn.—To V. Noll Construction Co., Chattanooga, Tenn., West Side storm sewer at $58,326.96.

Mount Rainier, Md.—Installation of sewerage and water systems and electric lighting plant being considered. Bond issue, $125,000.00.

Newark, N. J.—To Carrington Construction Co., Jersey City, for sewer section No. 13 of flume in Passaic, at $252,202.50.

Rochester, N. Y.—To Myers & McWilliams, Pittsford, sewage disposal plant in Irondequoit at $333,855.

Urbana, Ohio—To Cook & Cook, Clintonville, for sewage disposal plant at $3,707.05.

STREET SIGNS.

BIDS REQUESTED.

Chicago, Ill.—May 11, until 11 a. m., for installing about 500 street sign posts on concrete foundations and furnishing name plates for same. Certified check, 5 per cent. Ray Palmer, commissioner of gas and electricity.

Orlando, Fla.—Until May 28, for 110 white reinforced concrete street sign posts, height 8 feet 6 inches, supplied with iron rods near top for attaching four signs. On same date bids will also be received for ten white cement posts for "White Way" system on Orange avenue, from Lake Lucerne to Lake Ivanhoe. G. R. Ramsey, city engineer.

WATER WORKS.

BIDS REQUESTED.

Bruning, Neb.—May 12, until 7 p. m., for water works system and light plant to cost $11,778 and $7,308, respectively. C. G. Bruckert, clerk. Grant & Fulton, engineers, Lincoln, Neb.

Dexter, Mo.—May 18, until 8 p. m., for water works system, including 10-inch deep well and pumping station, 70,000-gallon tower tank, 6 miles 4 to 8 inch cast iron water pipe, 34 hydrants and 24 valve boxes. Certified check, $200.00. J. I. Moore, city clerk. Frank Wilcox, engineer, Syndicate Trust Building, St. Louis, Mo.

CONTRACTS AWARDED.

Allendale, N. J.—To Melrose Construction Co., 147 East 125th street, New York City, water works system to cost $37,300.

Boswell, Okla.—Contract will be awarded about May 13 for construction of water works system to cost $36,000. J. E. Davis, engineer, Caddo, Okla.

Carpentersville, Ill.—To Logan & Giertz Construction Co., Elgin, Ill., water works system at $19,467.

Jacksonville, Fla.—Contract for remodeling water works plant awarded F. W. Long, city, at about $35,000.00.

CONTEMPLATED WORK.

Averyville, Ill.—Installation of a water works system is being considered at cost of $30,000. Address board of local improvements.

Colfax, Wis.—Bond issue of $14,000 has been voted for installation of water works system. A. F. Thompson, engineer, Chippewa Falls, Wis.

Duxbury, Mass.—Plans are to be prepared at once for water supply, including driven wells, pumping station, stand pipe or reservoir, and about 14 miles of main. Engineer to be appointed shortly. Charles S. Clark, commissioner, advises he will be glad to receive suggestions from anyone interested in doing the work or furnishing supplies.

Morris, Okla.—Plans being prepared by Benham Engineering Co., Oklahoma City, Okla., for installation of water works system, bond issue $42,500. Bids will be received shortly.

Peoria Heights, Ill.—Plans being considered for installation of water works system to cost $50,000.

MISCELLANEOUS.

BIDS REQUESTED.

Akron, Ohio—May 15, until noon, for furnishing and erecting garbage reduction equipment. Certified check, $5,000. Ira A. Priest, clerk, city council. R. Winthrop Pratt, consulting engineer, Hippodrome Building, Cleveland, Ohio.

Boston, Mass.—June 15, until noon, for dry dock on South Boston Flats. Certified check, $10,000.00. Frank W. Hodgeon, chief engineer, directors of port, Boston.

Council Bluffs, Iowa—Bids will be advertised at once for street flusher and several new dump carts. Charles J. Duff, city clerk.

Idaville, Ind.—May 16, until 1 p. m., for heating and ventilating plant in new school building. Geo. B. Tam, trustee, Jackson Township, White County.

Little Rock, Ark.—Until May 12, for equipment for asphalt repairs and other repairs. Second-hand plants will be considered. Fletcher Chenault, clerk, board of public affairs.

Shippensburg, Pa.—John E. Coffey, clerk of boro, desires quotations on 18,000 to 20,000 feet of iron or wood 10-inch pipe for laying water mains.

St. Johns, Newfoundland. Installation of telephone service in St. John's is being considered. Further information can he obtained by addressing T. A. Hall, government engineer, St. John's.

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

PLAYGROUND FOR CHILDREN, OAKLAND, CAL.

VOL. XLVI. JUNE, 1914. NO. 6.

Everywhere in human society two principles have been and are at work, principles antagonistic to one another, yet equally essential to the well-being of civil society. These are the principle of Obedience and the principle of Independence—the submission of the individual will to other wills and the assertion of that will against other wills. The reasonable mean between, or an adjustment to one another of these two principles, creates what we call Free or Popular government, in which a relatively large number of individual wills agree to form a collective will of the community, and to obey that will cheerfully because each individual has borne a part in forming it.

—James Bryce.

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SUBURBAN STREET LIGHTING

VAN NUYS LIGHTING DISTRICT, CALIFORNIA

Two articles from opposite ends of the United States show methods of lighting sparsely settled roads and boulevards in suburban districts where ornamental lighting is an attraction rather than an absolute necessity. The first system is from the neighborhood of Los Angeles, Cal., where a State law provides a method of establishing lighting systems in unincorporated towns, villages and country districts.

THE Van Nuys Highway Lighting District was organized August 10, 1912, under the California act providing for the highway lighting of unincorporated towns and villages and country sections. The Van Nuys District, which is 16 miles long and 8 miles wide, embraces about 52,000 acres in the southwestern part of the San Fernando Valley. It is located fifteen miles northwest of the center of Los Angeles city, and covers all of the 47,500-acre Van Nuys-Lankershim tract, developed during the past three years by the Los Angeles Suburban Homes Company of Los Angeles, the 4,500-acre Encino ranch, owned and operated by the Amestoy Estate Company of Los Angeles, and the townsites of Van Nuys, Owensmouth and Marian.

Most of the lands included are as level as a prairie, with deep rich silt soil and only three years ago were used exclusively for raising grain and pasturing cattle and horses. Today, however, this has been transformed. A double boulevard costing $500,000 built thru the center from one end to the other is parked on both sides 40 feet back with ornamental trees, shrubbery and choice roses. One side of the boulevard is for the exclusive use of automobiles, the other side for teams and trucks. Between the roadways are the tracks of the Pacific Electric Railway, giving communication with Los Angeles.

Along the entire southern part of the district and skirting the foothills, the State of California has about completed a stretch of the State Coast highway, leading from Los Angeles thru Santa Barbara to San Francisco, which is expected to be finished the entire distance in time for the opening of the Panama-Pacific International Exposition in 1915.

At least twenty-five miles more of improved highways have been built within the district besides the two above mentioned main arteries of travel.

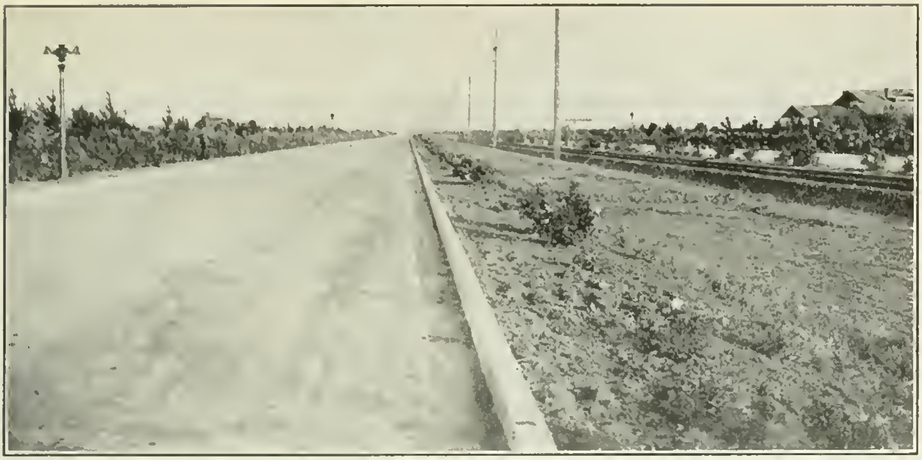
Van Nuys, the first town established, was opened February 22, 1911, and is now one of the most flourishing new settlements near Los Angeles.

Owensmouth was opened in the west end of the tract in March, 1912, and is also making phenomenal advancement.

The site of Marian is located on the boulevard, midway between Van Nuys and Owensmouth, and will be opened soon.

It was to light these highways that the Van Nuys Lighting District was organized. It is the most comprehensive in the state, and no such extensive system of ornamental street lighting outside of large cities has ever been undertaken, probably, in the world.

The votes creating the district came from the new settlers. Sixty votes were recorded for and and eighteen against. The small vote was due to the fact that the majority of people living in the tract came from other states and were not elig-



SHERMAN WAY *in the Van Nuys, Cal., rural lighting district. The white area on the extreme right is the driveway parallel with that on the left, the two forming the boulevard, with the electric railway line between, track and pole line being seen in the photograph. The beginning of the planting scheme for beautifying the boulevard is seen parallel with the curbs on both sides of both driveways. The ornamental lamp posts are also seen at regular 660-foot intervals on the outside of each driveway.*

ible to vote on account of not having been in California the required year.

Under the act creating highway lighting districts, the board of county supervisors of the county in which any district is located is ex-officio the board of supervisors of the district.

The supervisors of Los Angeles County have adopted a method of government for lighting districts under their control, whereby a local committee is appointed to pass on and approve all matters pertaining to the district before they are acted upon by their board. The duties of these local committees include recommending extensions and amounts necessary for yearly maintenance, passing on all bills, looking after proper maintenance and providing repairs where not covered by maintenance contracts. The Van Nuys committee is composed of four members, selected from different parts of the district, and meets once a month.

The first lighting undertaken by the district was along Sherman Way, the 16-mile boulevard extending thru the tract. A sum of $75,000 was recommended for this purpose, which was included in the 1912 taxes of the district, and the entire amount was raised in that year.

After looking over the various systems of street and highway lighting in Los Angeles and surrounding cities, the committee decided on cast-iron electroliers with three-light clusters for use along the boulevard outside the townsites, one 60-watt lamp upright and two 40-watt lamps pendant. Cast-iron posts were selected on account of their strength and durability. The electroliers were located 330 feet apart staggered, or 660 feet apart on each side of the boulevard, which is about 100 feet wide.

In the three townsites, five-light clusters were used thru the main parts, four electroliers to every street intersection. On these five-light posts, one 60-watt lamp was upright and four 40-watt lamps pendant, and they were placed through the main parts of the towns, four electroliers to every street intersection.

Conduit was used for the secondaries in the three-mile installation east of Van Nuys and in all the townsites. On the other parts of the system the secondaries were carried on the poles of the Southern California Edison Company, except 2¾ miles, from Owensmouth to the State Highway, where the district put in its own pole line and all primary and secondary circuits. This last section is the only place where the district has its own primary line. The system called for a transformer furnished by the Edison company, to be placed for approximately each mile of installation. These units are controlled by time switches furnished by the district.

The first contracts, for the installation of 253 three-light and 49 five-light electroliers along the boulevard and for one year's maintenance, were awarded August 7, 1913, and were under three separate heads:

THE ELECTROLIER *used on Sherman Way, with street signs when on corner of two roadways.*

First, the furnishing of the bare electroliers erected on cement bases.

Second, the installation of conduits, wiring, building pole line, furnishing time switches, lamps, 16-inch Alba globes for upright lights, 12-inch Alba globes for pendant lights, and everything necessary to put the system in complete operating order.

Third, maintenance of electroliers on a flat rate per month, which included furnishing electrical energy, painting posts once a year, renewing all broken globes and lamps, cleaning globes and posts once a month, and maintaining system on the following schedule: Three-light posts to burn from dusk to 1 a. m.; five-light posts, the upright to burn all night and the four pendants from dusk to 1:00 o'clock a. m.; all to burn every night in the year.

The contract under head one was awarded to the Llewellyn Iron Works of Los Angeles for the sum of $13,100; under head two, to the Newbery-Bendheim Company of Los Angeles for the sum of $21,188; and under head three to the Southern California Edison Company at the rate of $2.75 per month for the three-light posts and $4 per month for five-light posts.

At the same time the district took over 78 five-light posts and 39 three-light posts which had been installed by the Suburban Homes Company in Van Nuys, Owensmouth and on North Sherman Way at a cost of $14,157.40, and which were included in the maintenance contract with the Southern California Edison Company. The electroliers for this contract and for additional street lighting in the townsites of Van Nuys and Owensmouth were furnished by the Llewellyn Iron Works. The Pacific Underground Construction Company of Los Angeles installed the conduits and wiring.

On September 29, 1913, contracts were awarded under similar terms with the same three companies for two additional five-light posts and four three-light posts, which were found necessary to complete the boulevard lighting. The cost of installation was distributed as follows: Llewellyn Iron Works, $285; Newbery-Bendheim Company, $320.

In the fall of 1913, a further sum of $24,000 was levied to put the electroliers along South Sherman Way, leading from Van Nuys to the State Highway, and along the State Highway to connect with the west end of the system already installed. The total distance covered by this additional lighting is 11 miles, and the work is now under way. When finished, a continuous 25-mile circuit of paved and lighted highway will be provided.

Contracts for this work, which provide for 188 three-light poles, were awarded October 20, 1913. The Llewellyn Iron Works secured the electroliers and bases for $8,765, and B. F. Kierulff, Jr., & Co. the installation for $11,134.

When all the system now under contract is completed, the Van Nuys Lighting District will have in use 484 three-light posts and 129 five-light posts, which will have cost for installation $69,649.40, with an average cost for each post of $114.

The yearly maintenance cost will be $22,164.

In addition, there are 24 five-light posts in each of the townsites of Van Nuys and Owensmouth, which were installed and are being maintained by the townsite companies, and also several private three-light posts along the boulevard.

With these, the grand total of electroliers in use in the district will be 664. The total distance of highways and streets covered will be 33 miles.

The assessed valuation of the Van Nuys Lighting District for 1913 was $5,869,915, which showed an increase over the preceding year of more than $700,000, mostly due to building improvements. So this enterprising Southern California community believes that highway lighting pays. Further extensions are being considered for the near fnture, which will include 100 additional electroliers.

SHERMAN WAY *by night in the village of Van Nuys, Cal., four electroliers at each street intersection.*

SUBURBAN STREET LIGHTING

LIGHTING OF NORTH SHORE BOULEVARD, LYNN TO SWAMPSCOTT, MASS.

By G. N. Chamberlin, Engineer Arc Light Department, General Electric Co., Schenectady, N. Y.

This second article, for which we are indebted to the General Electric Review, describes the installation of ornamental luminous arc lamps on a highly improved shore drive in the metropolitan park system of Boston and its suburbs, and compares it with its predecessor, a system of gasoline lamps. Comparison with the installation described in the preceding article will also be of interest.

THE employment of the ornamental luminous arc for the lighting of principal business thoroughfares has been met with such favor that, as a natural consequence, its use is now being rapidly extended to the lesser populated areas. The suitable illumination of public highways has not as a rule been given the careful consideration that it deserves. When such large sums are spent in the building and up-keep of parkways, boulevards and shore drives, it is thoroly in keeping that the lighting units should be of the same high order of excellence.

The following example will clearly illustrate the immense improvement in lighting which can be secured along such highways.

At the expiration of the contract for boulevard lighting, the engineers of the Massachusetts Metropolitan Park Commission, being familiar with the excellent illumination obtained from the luminous arc, approached the Lynn Gas and Electric Company relative to the illumination of that section of the North Shore boulevard from the Bath House, Lynn, to Monument Square, Swampscott, a distance along the ocean front of about two miles. A thoro consideration of the subject resulted in a contract which provided for the installation and maintenance of forty lamps by the Lynn Gas and Electric Company.

The lighting system previously employed consisted of gasoline mantle lamps, two on a pole. The poles were about 12 feet high and the lamps were equipped with large clear globes arranged in the usual manner. The mantles were rated at 32 cp. each, but, under service conditions, some were found to run as low as 15 cp., and a number of tests showed an average of about 25 cp. per mantle. Each lamp contained a small reservoir which held only enough gasoline for one night's burning. The method used in filling these reservoirs is shown in Fig. 1.

The light given by these lamps was, however, thoroly inadequate for either the automobilist or pedestrian. Photometric tests made in the center-line of the street with a Sharp-Miller photometer gave an average of 0.03 foot-candles opposite the lamp and an intensity halfway between the lamps far below the reading limits of the instrument.

The new lamps, which were turned on for the first time Christmas night, 1913, are of the ornamental luminous arc type, operating on a 4.0-ampere rectifier circuit and consuming about 300 watts each. The arc is placed 18 feet from the ground, and the lamps are spaced from 200 to 300 feet apart on the shore side of the boulevard. A light-diffusing globe is used which distributes a well-diffused and

NEW LUMINOUS ARC LAMP *of artistic design, harmonizing with the beautiful boulevard.*

pleasing white light. Fig. 2 shows a complete unit installed. These tall, slender poles with a single globe at the top are in no way conspicuous, but, when attention is directed to them, they are found to be artistic in design, harmonizing perfectly with the beautiful stretch of boulevard maintained by the Commonwealth of Massachusetts.

The work on this installation was started December 3 and completed December 23, underground construction being used. Fig. 3 shows a section of the Shore Drive with the luminous units installed, and the old lighting units will also be seen, not having been removed at the time the photograph was taken.

Fig. 4 is a night view of the roadway and promenade. Photometric tests, made under similar conditions to those with the old gasoline lamps previously mentioned, show for the luminous arcs 0.37 foot-candles in the center of the road opposite the lamps and 0.008 foot-candles halfway between the lamps. This is about twelve times the illumination secured from the gasoline mantle lamps, and it is rather interesting to note that this increased illumination is being furnished at less cost than that of the previous gasoline installation. Altho the roadway presents a dark, poor reflecting surface, the single units are of sufficient intensity to make use of the now generally understood silhouette principle of lighting.

The promenade is of granolithic construction having a better reflecting surface, and shows figures in excellent relief.

A very pleasing sight, since the installation of these arc units, is the white crests of the breakers along the beach. The intrinsic brilliancy of the light source is also noticeably low and does not interfere with the ocean view from the residences on the opposite side of the Shore Drive.

DAY AND NIGHT VIEWS *of the boulevard are shown by the two photographs on this page. The location and handsome and harmonious appearance of the new lamps and posts show best in the day view, and the amount of light and its diffusion are demonstrated by the night view.*

From the results now being obtained, it would seem certain that the ornamental luminous arc lamp can be used as economically and efficiently for this class of work as for the illumination of the more densely populated areas.

REINFORCED CONCRETE TRESTLE

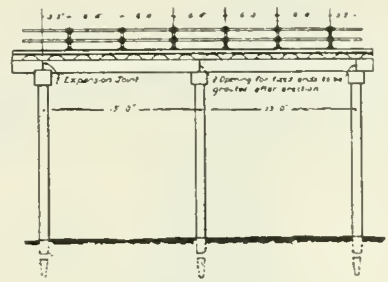
IN CALIFORNIA HIGHWAY

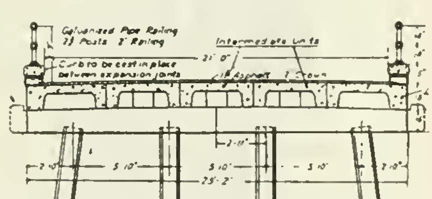
The floods in the Sacramento Valley have long been known as exceptionally violent. The State Highway Department had the experience of the Southern Pacific Railroad in this particular case and seems to have provided ample waterway for the floods passing thru the railroad trestles, with something to spare for a maximum greater than any yet experienced, a contingency which recent experience elsewhere indicates as possible, if not probable.

THE Sacramento River in the vicinity of Sacramento, Cal., is subject to frequent overflows, which are occasionally heavy enough to produce very serious results. Sacramento itself is located on the east side of the river in Sacramento County.

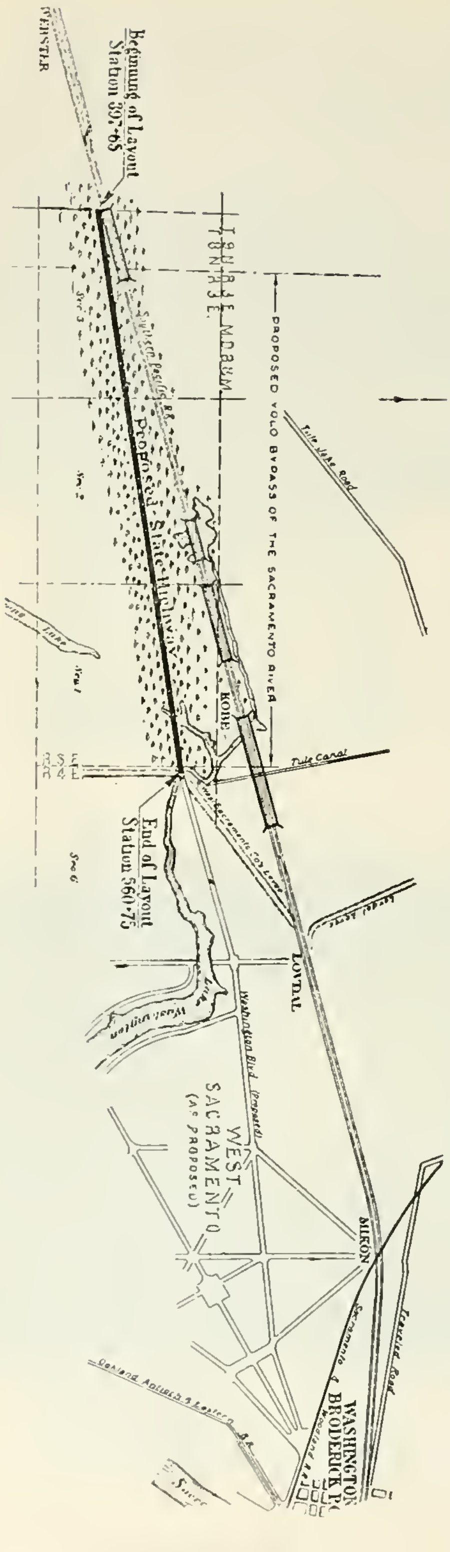
When the State Highway Commission planned for the improvement of the highway into Sacramento from the west, passing thro the proposed plat of West Sacramento, in Yolo County, on the west side of the river, it was considered necessary to elevate about three miles of it above the ground across what is called the Yolo by-pass, an overflow channel for the high water in the river.

It will be seen from the plan of the highway that the Southern Pacific Railroad, on the north and upper side of the line of the highway, has several long trestles in its roadbed across this same Yolo by-pass, which together have a length of more than one and one-half miles, and that the levees and the railroad grade force all the water in the by-pass to go thru these railroad trestles before they reach the highway. Nevertheless, it was considered best to leave the entire three miles of the roadway open for the passage of the water, and it is, therefore, carried on trestles with bents 19 feet apart. The clearance between the ground surface and the bottom of the girders carrying the roadway is not less than 15 feet, and in a few places is as much as 28 feet.





ELEVATION OF CONCRETE TRESTLE *in Yolo County, California, highway, above. Section showing concrete pile bents and cross-section of floor system, below.*



PLAN OF STATE HIGHWAY TRESTLE *across Yolo By-pass, just west of Sacramento, Cal. Note Southern Pacific Railroad grade on north or upper side and length of trestles thru it; levee around West Sacramento; and continuation of highway on fill at the west end. A half mile of temporary trestle at the west end gives an opportunity of testing the sufficiency of the openings before filling with earth or replacing with a continuation of the concrete trestle.*

The concrete trestle is 13,851 feet long, starting from the West Sacramento levee at its east end, and a temporary timber trestle extends 2,318 feet farther west, apparently with the intention of filling in this section later with earth or other material.

Four concrete piles are to be driven for each bent, two vertical and two other piles on a batter of 1 in 8, as shown in the sectional drawing. The piles are made of 1:2:4 concrete, 14 inches square at top, with 7/8-inch round rods in the four corners, wound with No. 6 black wire wound spirally with pitch varying from 1 inch at top to 5 inches for all but the upper 2 feet length. The lower 5 feet of each pile is tapered to 6 inches square at the bottom and the corners are chamfered for 25 feet down from the top.

The piles are driven with a 3,000-pound steam hammer by the *Engineering News* formula, and are estimated to average about 32 feet long in place.

The piles are allowed to harden for at least 30 days before driving. Concrete caps are cast in place on top of the piles, being of form and dimensions shown on the drawings, viz: 23 feet long, 2 feet wide, 16 inches deep at ends and 18 inches deep at center. Special forms of caps are provided at expansion joints and lamp-post locations.

The concrete floor units are inverted trough sections as shown in the drawings, the forms of the three intermediate units being slightly different from the two outer units, which carry the wheel guard and railing. The slabs of the floor units are 18 feet 10½ inches long, the outer units 4 feet 10 inches wide and the intermediate units 4 feet 6 inches wide, thickness 6 inches. The long sides of the channels are 10 inches thick at the bottom and 11 inches at the top, and 12 inches deep, making the total depth of the floor members 18 inches. The ends or short sides of the channels are 8 to 12 inches thick at bottom and 3 inches thick at top. These floor units are cast in the yard and hardened at least 30 days before placing.

The floor units are tied together by bolts and dowels, with special connections at expansion joints, there being a ½-inch expansion joint at every third bent.

The caps and floor units are fully reinforced with ½-inch and ¾-inch rods, stirrups, ties and spacers.

On the outer edges of the outer floor units the wheel guards or curbs are cast in place, doweled into the floor unit, and carrying the pipe rail fastened also by dowels. The curb is 15 inches high and about 12 inches thick, and is relieved by arch-like openings, each 2 feet 2 inches span by 8-inch rise with 12-inch bearing between.

When the concrete floor system is completely set and dry its surface is coated with an asphaltic paint binder applied with broom to give a thin, uniform, black, glossy film, hardening in two hours. On this film, as soon as hardened, an asphaltic wearing surface is laid which averages 1½ inches thick after compression. This wearing surface is made of 7½ to 10 per cent. bitumen, 8 to 17 per cent. stone dust and the remainder broken stone or gravel and sand held by a 200-mesh sieve and passing a No. 2 sieve, in specified proportions of various sizes.

The grade of the trestle is level from end to end. The extra 2-inch depth of the caps of the pile bents at the center of the roadway is all thrown into the top, so that there is almost a 2-inch crown to the roadway in its 21 feet of width, enough to drain the roadway, the water running out thru the openings in the wheel guard or curb above described.

REVISION OF WATER RATES IN BLOOMINGTON, ILL.

The income of the water works of Bloomington, Ill., in 1913, was $50,316.03, and the operating expense of the water and light department (street lighting only) was about $26,000.

The city has 5,000 water meters in use.

The State Utilities Commission has ordered every city having municipally owned water and light departments to place these plants on strict business basis, collecting from water rents, revenue sufficient to meet operating and maintenance costs and in addition balance that will pay interest on the money invested and create a sinking fund for the ultimate rehabilitation of the plant.

The City Council is considering the revision of water rates in accordance with these instructions and Superintendent Noble reports in regard thereto as follows:

"I know of but few things that would give me more pleasure than to comply with the text of this resolution, but in order to do so it will require the expenditure of $6,000 on the part of the Council to equip the water and light department with the proper meters and instruments for ascertaining these costs. Instruments needed are: A 20-inch water meter, cost $1,000; four recording watt meters, cost $400; two recording steam flow meters, cost $500; one hot water meter, $700; one track scale for weighing coal, $1,500; expense of installation, $1,000; expense of bookkeeper and accountant, $900."

Mr. Noble recommended that this expense be undertaken if possible.

RATE MAKING FOR PUBLIC UTILITIES

By Prof. W. G. Raymond, University of Iowa, Iowa City, Iowa.

At a municipal conference held at the University of Iowa, Professor Raymond, who is in charge of the Department of Civil Engineering, presented the following clear discussion of the principles underlying the process of establishing rates for service rendered by public utility plants under both private and municipal ownership.

I PROPOSE to discuss this subject with you rather than to undertake to tell you just how rates should be fixed. I am not sure that I know how they should be fixed. I am sure that I am not an expert accountant and hence my methods of dealing with the subject may not pass the accountant's tests. I shall try to present what seem to me to be certain fundamental principles that should guide in rate making and shall ask you to criticize and make counter-suggestions as they may occur to you.

In the time at hand it will be impossible to go into detailed argument concerning certain methods of computing depreciation, handling appreciation, etc., but I hope that the general principles enunciated will serve as a basis for your further consideration of details after you have gone to your homes. If then you should have questions to ask, I shall be glad to have you ask them by correspondence and I shall be only too glad to give you such knowledge as I have and refer you to others who have more than I have when I can not answer the questions you ask.

We shall begin by considering a municipally owned plant and shall try to discover what the rates should cover. Let us suppose that the plant cost $100,000, is new, and will last 20 years before it must be renewed. This last consideration is not so simple as it sounds. Parts of the plant will be worn out and renewed in a year, parts will last 5 years, while other parts may last 30 years or even 100 years; the plant must be kept up in working condition all the time, and must be extended with the growth of the community or its business; and all these things are included in the simple statement that the life of the plant is to be 20 years.

The cost of the plant will be raised by borrowing money obtained by the sale of bonds, we will say at par, drawing 5 per cent. interest. The rate may be high, but it is not material to the present discussion.

Now what must the plant earn? Certainly it must earn the 5 per cent. interest on the bonds. Certainly it must earn its proper operating cost, labor, supplies, and all repairs that are not renewals, and including everything in the way of supervision, corporation counsel's time, treasurer's time, and all general items of this sort which are not usually considered, but should be. Concerning these two items of interest and operating expense, there will be little dispute except possibly as to what is to be included in the second.

Now the plant begins to operate, some rates have been fixed, and let us suppose they are meter rates—not automatic meter rates collected in advance, but meter rates that are collected after the water or gas or electric power has been used. Immediately expenses will begin before rates are collected and it is found that working capital is necessary. We may get this by drawing on the treasurer if there is any fund available, or we may borrow it. No matter how we get it, we shall have to pay interest on it, directly or indirectly. Therefore, I think we should include interest on a sum that we will call working capital. This amount we will not now discuss.

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THE INVESTMENT *must receive its compensation and must be repaid by the time the plant has worn out.*

The plant must be made good when it is worn out, and, if we say its average life is 20 years, we should lay aside each year at least such a sum as that which, placed at compound interest, will aggregate $100,000 at the end of 20 years. This we may call a sinking fund, or depreciation fund, or what not. Its purpose is to renew the plant at the end of its life. We don't always think of it in just this way. We think of it as a sinking fund for the retirement of the bonds. But if we retire the bonds in 20 years and the plant is then worn out we must borrow another $100,000 to build a new plant. Such a thing cannot occur. We must renew parts of the plant from time to time, so that at the end of the 20 years we shall have a plant as good as new. The $100,000 should never be paid. That is invested capital. Future generations should expect to pay interest on the same capital, provided that the plant it represents is kept up to 100 per cent. and serves them as it serves us. It may be necessary to put in extensions to the plant, and, if so, the necessary money may be taken from the sinking fund, which will necessitate borrowing later for replacements, or it may be borrowed as needed. If borrowed, it will be additional capital invested in the plant and capital interest must be paid on it. If sinking fund money on hand and not needed for renewals at a given time is put into extensions, it should be considered not to be new capital invested in the plant, but should be considered as keeping the original capital intact. An equivalent amount will eventually become new capital when it is borrowed to replace part of the original plant.

THE ITEMS *which must be covered by the rates for service are recognized and set forth.*

For the present let it suffice to say that the public must expect to pay in rates:

1. Interest on capital, invested and working.
2. Cost of operation, including repairs.
3. Some sort of renewal fund.

Interest on a given capital can be computed with accuracy. Cost of operation, if carefully kept, with repairs properly separated from renewals, may be accurately known, but the actual depreciation at any time and the theoretically correct renewal fund may not be determined with accuracy. Certain assumptions and theories must be developed to determine what these are as near as may be.

Generally speaking, the laws of Iowa do not require the maintenance of a sinking fund for the retirement of bonds. The laws prescribe the term of the bonds, but they may be paid by refunding so long as the legal debt limit is not exceeded. I am disposed to suggest that this debt limit should be quite large if it is to include money borrowed for publict utilities that yield a direct return, such as water works, gas plants, electric light and power plants, street railroads, etc.

Many smaller communities are building new works and must fix rates in the beginning without knowing how many customers are to be served or what the expense of operation is to be. An estimate must be made, and rates fixed subject to adjustment after a little experience has shown what the expenses are to be and what sale there is to be for the output of the plant.

Any public service plant owned by a municipality except, possibly, street railway plants, rarely so owned in this country, gives a service to the public for which the whole taxable public should pay. A lighting plant lights the streets and a water works system furnishes water for fires, for street cleaning, sewer flushing and other public uses. It seems to be proper that all property served or to be served by water mains or gas mains which have been laid, or electric light wires which have been strung and street lights operated, should pay a portion of the return that must be collected to cover the three items of interest, cost of operation and depreciation. The part that such properties should pay should be levied as a separate item in the tax, collected by the tax collector or treasurer and placed to the credit of the public service plant for which the tax is levied. Again all citizens who make use of the streets and the government and are subject to taxation should pay a part of the rates, in addition to that paid by the property actually or potentially served by the utilities lines. Thus there are three parts into which the income should be divided for collection.

THE SOURCES *of income of a municipal plant are insisted upon, as many municipally operated plants do not avail themselves of all these sources.*

1. A portion levied on every taxpayer for the general service to all citizens.

2. A second portion levied on all property enjoying potential or actual service because of the existence of the service lines in its vicinity.

3. A third portion paid by the users for the actual service rendered to them exclusively.

A municipally owned plant should pay the three items of interest, operating expenses and depreciation from the start, and since the number of customers and the quantity of output sold in the earlier years of the plant will be relatively small, it is suggested that in the beginning a relatively larger portion must be borne by the community as a whole for actual public use and potential private service than will be proper in later years, when a much larger output may be sold to individuals and the common tax reduced.

The following is suggested as one way to apportion the amounts to be paid by the public at large and the individual users: Measure the output at the plant, meter all individual connections, including public buildings, and estimate the quantity used for public purposes on streets and at fires. The difference between the total output and the measured and estimated use is the loss or leakage. This may be divided between the users as a whole and the community as a whole in proportion to the measured and estimated quantities used. Augment the total private use and the total public use by the portions of the leakage or loss thus assigned to each and divide the sum of the three items, interest, cost of operation and depreciation, between the two augmented totals as indicated in what follows.

The sum of the three items, interest, cost of operation and depreciation, divided by the entire output, will give the average cost per unit of output.

THE SHARES *to be paid by the public at large, by property benefited, and by consumers, are not always as equitably divided as is here proposed.*

A more or less arbitrary portion of the whole expense may be levied against real property served or to be served by the plant. What remains should be divided between the public at large and individual consumers in proportion to the total quantity of output used. So much as is to be paid by consumers for use should be arranged with a sliding scale, to be determined for different utilities in different ways, so that the larger users shall pay the lower rate, since the cost of service to a single user is not in proportion to quantity of output used, but is less per unit as the number of units is greater.

In the case of water works plants in small or moderately large cities the portion to be paid by the general public for fire protection is larger than would be obtained by considering only the amount of water used. Water mains must be much larger than would be required for ordinary business and domestic consumption in order to furnish large quantities of water in short periods for fires. Moreover, for the same reason, when the water is supplied by pumps the pumps must be of greater capacity than necessary to furnish the domestic and business supply. These differences may well be estimated and the interest and depreciation of the portion that may be necessary for fire protection only should be included in the general levy on all taxable property, only the balance of these items being used in the sum to be divided as before described. This concludes the statement of general principles underlying proper rate making for publicly owned utilities.

Now, let us suppose that the municipality prefers not to engage in the business itself, but wishes to hire some person or corporation to do its business for it. Should there be any difference in the allowed rates? I think there should to this extent: That the individual or corporation must be paid a wage for doing the business. This wage may, and ordinarily will, take the form of a larger return on the capital invested than mere savings bank interest and should be such as to be fairly called interest and profit on the invested capital.

It would be well to make the articles of employment, called the franchise, such as to reduce the risk to the individual or corporation to a minimum, and it might even be agreed that in return for good service with a plant reasonably well designed, constructed, and operated, to the satisfaction of the municipality's engineering officer, the company should be guaranteed against loss from the start by rates leved much the same as for a municipally owned plant. Such a guarantee would lessen the risk and reduce the interest rate on the companys' securities, and, hence, the total rate that the public should pay. And it might be further agreed that when the company should be on a paying basis, it should receive a higher wage in proportion as it increases efficiency and reduces the cost of service.

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IF THE CITY CONTRACTS *with a private company for the desired service, the rates must allow for the payment for the business ability and time required to carry on the business.*

And this indicates the theory I hold in common with some others, namely, that a public service corporation is a public agent, supplying money, constructing works and operating them for hire; that it should be paid for the use of its money at a reasonable interest rate; that it should be paid its operating expense; that it should be repaid the sum that may be reasonably invested in its plant by the time the plant is worn out or obsolete, and must be replaced, or what is the same thing in effect, but not necessarily in amount, the cost over repairs of keeping the plant at 100 per cent. value, and it should be paid a wage or profit for the service rendered.

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THE ALLOWANCE FOR DEPRECIATION *is the bugbear, estimates only being possible, with insufficient data upon which to base them.*

The only item in all this that is really difficult to determine is the item of replacement, or, as it is generally called, depreciation. There are many ideas as to how this item should be treated. It has been suggested in an earlier part of this paper that the sum to be laid aside annually for depreciation or renewals is that sum which, placed at compound interest, would produce the cost of the plant at the end of its life, but this may be questioned even in the case of a municipally owned plant, and is certainly not the proper sum in the case of a privately owned plant. Because renewals of parts of the plant will be required in a few years and will continue at intervals during the entire life of the plant, some items being renewed several times during the lives of other items, it is not feasible to place the depreciation allowance at interest, unless, possibly, the lives of each class of items, short lived and long lived items, have been considered separately and depreciation allowances fixed accordingly. In the case of a privately owned company it is not proper to require the company to place the depreciation allowances at interest in order to realize the full investment by the time the plant has been entirely replaced. Rather should the whole sum be returned to the investor by that time. We should then regard the depreciation allowance in the rates as a return of capital and should so arrange it that it will be less at first and more at the last, since the renewals are likely to be greater as the plant grows older. But it is also desirable for rate making that the total allowance for interest and renewals shall be practically uniform from year to year. The committee appointed by the American Society of Civil Engineers to report on methods and principles to be used in the valuation of public utilities has devised a way of meeting these requirements, which is as follows:

PRACTICALLY *depreciation is not equivalent to sinking fund in amount or method of estimating or computing interest, tho the final result should be the same.*

The different classes of items are considered separately and for each class that sum is found which, placed at compound interest, will produce the cost of the items at the ends of their lives. Summed for the several classes, this is the first year's depreciation allowance. To this is added interest on the whole investment for the total allowance on account of interest and depreciation. The depreciation allowance being considered as a return of capital, it is subtracted from the total investment, the plant representing which is presumably worth that much less because of the assumed depreciation. Interest is computed on the first depreciation allowance and added to that allowance for the second year's depreciation allowance, and interest is computed on the original investment depreciated by the first year's depreciation allowance for the second year's interest allowance. The sum of these two items is then the whole payment in rates for interest and depreciation for the second year. The method is continued from year to year.

REPLACING *worn-out parts from the depreciation fund should keep the plant always up to* 100 *per cent. efficiency, thus preserving the original investment exactly as it was when built new, whether as a whole or in parts.*

The total depreciation payments made during the life of the plant will equal the whole original investment, and the subtractions from capital will reduce the original capital to nothing at the end of the life of the property. If the plant has been maintained at 100 per cent. efficiency or value, it now represents just the capital originally put into it, and the payments from the public should go on as before. If it were possible to conceive of such a thing as the gradual and finally complete destruction of the plant by reason of its use and the failure of the company to reinvest in it the sums allowed for depreciation, and this result should obtain at the estimated end of the life of the property, there would be no further service, and no further payments due. The company would have received interest on all the capital actually invested in the plant at all times up to the end of its life, cost of operation and profit or wage for its service; and would have received back also the capital it had originally invested. It would thus stand even, having received interest on its capital while in use and pay for the service given. Of course, no such thing could happen because if the plant were allowed to run down the service could not be maintained and would cease to be efficient long before the end of the life of the plant. The property must be considered to be a permanently continuing enterprise.

If the same rate of interest is used for capital and depreciation the annual payments will be equal.

THE OPERATOR *of the public service industry, if under private ownership, is entitled to ample payment for his services, and, as in all other business enterprises, he is entitled to a reasonable profit. He is not permitted to take advantage of the monopoly granted him to charge excessive rates for the service, and his profit must therefore be limited.*

If the interest allowed on capital differs from that allowed in computing depreciation the payments will not be quite uniform and if the interest on capital is the greater, the totals will be somewhat greater at the first than at the last. This is undesirable, but can not be avoided under the plan which allows profit in the shape of large interest on invested capital. I suggest that interest be the same on capital and depreciation allowances and that profit or wage be computed on cost of operation.

The business man in any private commercial enterprise expects to earn interest on his invested capital, wages for his time and energy in directing the business, and a profit as well. It may be said that he should expect to earn only interest and wage and this may be true, but scarcely anyone will deny that the wage should be commensurate with the risk and magnitude of the enterprise. No one would expect a Marshall Field managing a business of millions of dollars yearly to be satisfied with the same wage that would satisfy John Smith, who conducts a suburban corner grocery doing an annual business running not far into the thousands of dollars. And no man or group of men can be expected to undertake public business, unless a wage is permitted that is commensurate with the risk and the magnitude of the undertaking. Of course, the capital invested will largely measure the magnitude of the undertaking, and yet this is not always so. A bank with a comparatively small capital may do a very large business and consequently earn a very large dividend on its capital, tho not earning an exorbitant percentage of profit on the business done. Just so, by fortunate location and wise planning, one public enterprise may do a large business on a relatively small capital when compared with another less favorably located or less wisely constructed. Hence it seems to me that if possible the profit or wage allowed the corporation should be allowed as a percentage of the cost of operation, it being understood that there will be supervision to the extent of preventing undue padding of this cost, and an agreement whereby the profit or wage may be larger as the cost per unit is smaller.

METERS AND RATES IN THE LOUISVILLE WATER WORKS

The Louisville Water Works management has a way of lowering water rates by increasing the discount for prompt payment, which now makes the difference so great that prompt payment is almost a universal rule. In 1912 the discount was 25 per cent, but in 1913 it was increased to 33 1-3 per cent.

The gross amount of bills shows the increase in business of the water works, being 8.2 per cent in 1913 over 1912, but the increase in discount reduced the actual receipts for water by $24,711.21, or 3.7 per cent.

The total number of services in active use in the city was 35,610, of which 4,312 are metered. These are all of the larger consumers, meters being applied under present rules when the bills paid amount to $36.50 a year or more. More than one-fourth the metered consumption runs thru 35 6-inch meters, and nearly two-thirds of it is thru 539 meters of 2 to 6-inch size; so that the average consumer does not have a metered supply. At present 42.2 per cent. of the supply is metered and pays 46.7 per cent. of the revenue, while 57.8 per cent. is not metered and pays 53.3 per cent of the revenue. The latest report of Chief Engineer Theodore A. Leisen recommends the lowering of the minimum bill for which meters would be installed to $29.20 a year and a daily allowance for that rate of 533 gallons. This would largely increase the number of consumers who would pay only for the water they used. Under present rules, the ⅝-inch meters, smallest size in use, which were in use thruout the year, averaged 632 gallons a day.

CHICAGO BUILDS MOTOR CARS

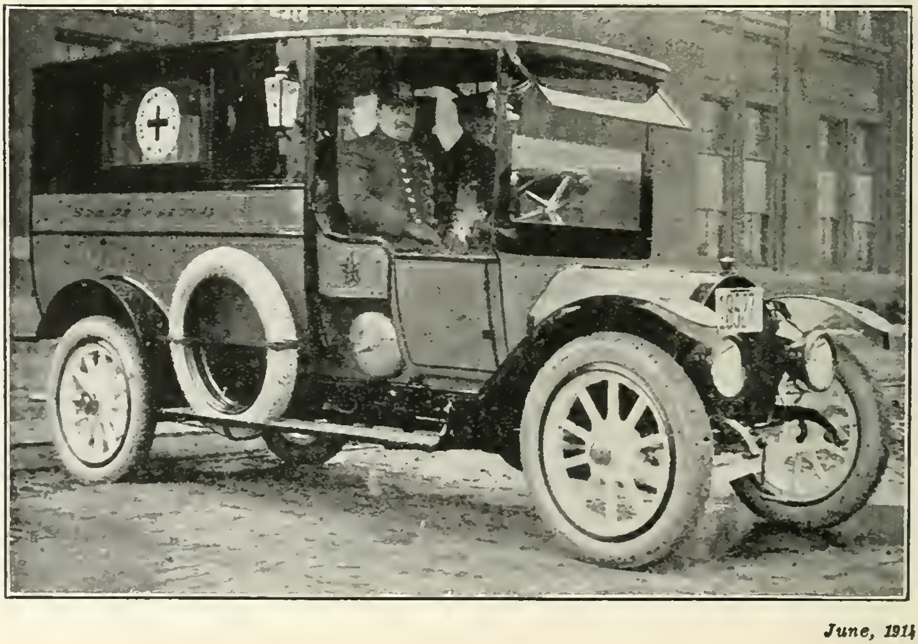
By Warfield Webb, Chicago, Ill.

This is a report of an experiment which the City of Chicago is making in assembling motor cars in its own shop and it has the enthusiasm of novelty. A couple of years' experience will demonstrate its advisability and show whether the first estimates of saving in cost of machines have been overdrawn.

A NOVELTY is the building of some newer types of automobiles for the police department of Chicago in the city's own plant. The first of these is one of a number of police ambulances, embodying a number of pleasing features, that was constructed at the city's shops, under the direction of C. J. Brethauer, in charge of this department. Before the end of the present year there will be nine of these cars built at this shop, and there will be at least a saving of one-half to the city. This is the first instance where a city has manufactured its automobile ambulances in its own plant and by city-paid men.

The new cars are known as the light-weight type, and are capable of attaining a speed of from fifty to sixty miles per hour. The cars are fitted with 60-horse-power, 4-cylinder engines, and each car weighs about 3,300 pounds. The bodies are of deep blue, with white wheels and 5-inch pneumatic tires. They are extra long and carry a complete ambulance outfit. The inside of the cars is white enamel, and embodies the very latest ideas in this character of municipal adjunct.

All the parts of the car are standardized and interchangeable, and in the event that a car should meet with an accident, the damaged parts can be duplicated at a very small cost. The construction of the cars is under the juris-

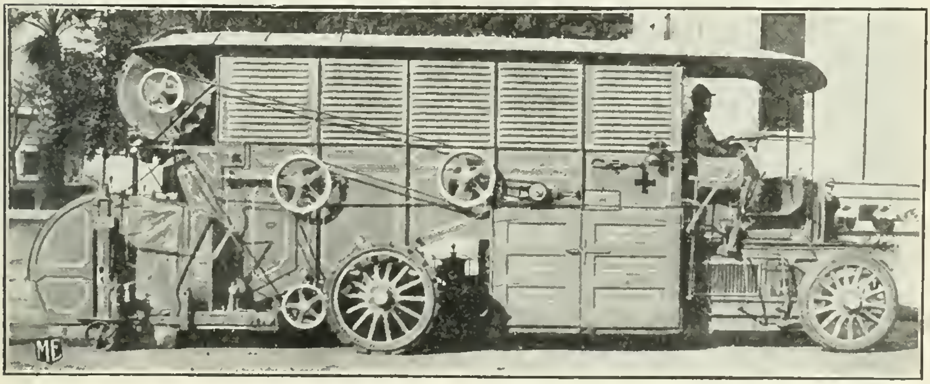


diction of the Second Deputy Superintendent of Police.

In addition to the motor ambulances there have also been added to the police department, and portions of these have been assembled at the above plant, clever motorcycles, equipped with pulmotors, and able to carry a physician in a contrivance that is a part of the cycle, where a hurry-up call for the above device is demanded. In cases of asphyxiation or drowning only a minimum amount of time will be consumed in reaching the sufferer. There are eleven of these attached to police stations that have been fitted up as emergency hospitals. The speed of these cycles can be as high as sixty miles an hour.

Automobile dog catching wagons are likewise manufactured here, and these have proven to be effective methods of ridding the city of rabid dogs and others that are found without license. These are only a few of the several styles of motor cars and other vehicles that are turned out in this department. The saving in cost in all cases is large enough to make possible a material saving in operating costs, and also permits a larger number of cars to be placed in commission.

MOTOR DRIVEN STREET SWEEPER IN OAKLAND, CAL.



GERMAN MOTOR TRUCKS AND TRAILERS

The train of wagons hauled by a motor truck has been an impossibility except on the hardest and most nearly level roads, because the tractive force available thru the friction of the motor wheels on the road surface has not been sufficient to handle more than one, or perhaps two, trailers. This German solution of the problem utilizes electricity generated on the motor truck and transmitted to motors on each trailer truck, thus making each nearly independent as to motive power, tho controlled as to speed and direction by the driver of the motor truck.

THE accompanying photograph and drawing show one of the modern automobile road trains developed at Berlin-Steglitz as designed and constructed by the W. A. Th. Mueller Strassenzug-Gesellschaft.

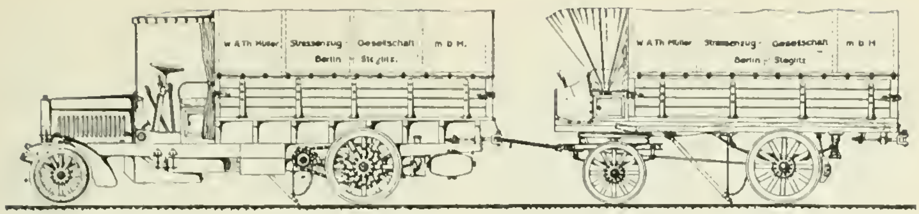
The service by automobile road trains may be compared with that of small or electric railroads, with the advantage of not being limited to one road, so that a service of automobile trains can be made profitable even in districts with very small traffic; so much the more, as the number of cars in a train can be adapted to the requirements down to a single engine-truck with one trail car.

In Germany the automobile road trains thus afford a means of conveyance which forms the missing link between the large service of railways and the individual service by wagon and automobile. Wherever there exists today the desire for an electric or small railroad line, and where the construction of the same is impossible on account of insufficient returns, automobile road trains will fill the gap.

It was hoped to be able to haul loaded trailer cars in the same manner as on railroads and thus convey large loads. Soon, however, it was found that this was only possible up to a certain extent and on level, well-constructed roads. Even the traction engines with four driving wheels were not able to produce the necessary tractive force with absolute certainty if they were not very heavy machines.

These attempts, however, were not without certain results. They have shown that the traction principle can be employed when the tractor itself carries as large a load as possible and the number of trail cars is reduced down to one. On this principle the German engineers constructed their automobile road trains for small loads. The tractor carries, as a rule, a load of from 4,000 to 5,000 kg. (8,800 to 11,000 pounds), and the trail car a load of 2,000 to 5,000 kg. (4,400 to 11,000 pounds). Notwithstanding, the load on the driving axle of the tractor does not exceed the maximum weight of 6,000 kg. (13,200 pounds). In special cases, where roads and bridges allow of greater loads, the capacity of the vehicles is raised to 6,000 kg. (13,200 pounds) each, so that a total of 12,000 kg. (26,400 pounds) can be conveyed. The design of these road trains embodies all the latest improvements in automobile engineering. A new type of trains has been developed at Steglitz for loads up to 50,000 kg. (110,000 pounds).

After the failure of the traction engine principle the automobile road train for greater loads remained for a long time an unsolved problem. The elementary reasons for the failure were found by a comparison of the iron rail with the surface of a highway. The resistance of vehicles against propulsion on a road is from three to ten times as great as on rails and the friction of the driving wheels at the point of contact with the road for de-



Benzole engine· 31/50 h. p. (also for heavy benzene) *Working load hauled: 13000—20000 lbs (6000—10000 kg) Maximum load on axles: 13000 lbs (6000 kg)* *Speed: 10 miles p. h. (daily capacity in 10 hrs. abt. 80 miles)*

GERMAN AUTOMOBILE *road train for small loads. Gasoline motor car and single trailer without motor, carrying together* 13,000 *to* 20,000 *pounds of load.*

veloping their tractive force, particularly on hard pavements and in wet weather, may be smaller. The consequence is that only by positively driving several wheels can success be attained, i. e., it is necessary to apply a driving power not only to the wheels of the tractor but also to those of the trail cars.

The difficulties became apparent by tests and trial runs which had been continuously made for several years. In these experiments it was attempted to obtain the direct drive of the trail cars by a jointed driving shaft running thru the entire train. This developed in the coupled wheels forces quite uncontrollable. The wheels of the trail cars coupled to the driving mechanism developed propelling forces and no braking effects, whereas a perfect control and regulation of the propelling forces of all the wheels from the driver's cab and an absolutely reliable working of the whole mechanism is essential. The propelling forces of the wheels must not have any detrimental influence on the steering gear of the train. In order to reduce the wear on the roads to a minimum the single vehicles of the road train must not exceed a given weight and the load must therefore be distributed upon a large number of cars. A train of great capacity must consist of many vehicles, and these must be steered in such a manner that one positively follows the other, however long the train may be. As each single vehicle successively advances automatically into the position of the preceding car, the driver can avoid obstructions and prevent collisions with other vehicles, regardless of the length of the train. It is claimed that all these problems have been solved in a scientifically correct and at the same time technically reliable and practical manner by the German automobile road trains for heavy loads illustrated. Such a train has six motor trail cars, each of 5,000 kg. (11,000 lb.) capacity. The engine power suffices to haul ten such motor trail cars, making a total load of 50,000 kg. (110,000 lbs.).

The only solution for this problem thus far developed is the electric transmission of power between the engine and the driving wheels. The energy developed by the engine is, therefore, transformed into electric energy and supplied in this form to electric motors.

As a source of power, combustion engines with gasoline or oil fuel are employed, as these motors combine great power with small weight and allow of carrying a sufficient quantity of fuel to last for a whole day's run of 60 to 90 miles. In special cases, where these points are of less importance, steam engines for oil, wood or coke are employed.

In the Mueller automobile road train the first vehicle, noticeable by its peculiar shape, is the one which contains the necessary engines for supplying the power. It is, therefore, aptly termed the "engine-car," or "tractor." At each end a combustion motor is arranged with the necessary cooling arrangements and all other accessories and between these two engines stands the driver's cab, in which all levers for operating and steering the whole train are placed.

Each of the combustion engiues is directly coupled with a dynamo, so that there are thus two separate independent generating aggregates, which may be employed together or separately, according to the amount of power required, the length of the train and the condition of the roads. The regulating devices for the dynamos allow of varying their working pressure from nil to the maximum in a very gradual manner. The current thus generated is supplied by means of a cable, which can, of course, be disconnected between two vehicles, along the whole length of the train to the electric motors at the driving wheels.

The engine-car and the motor trail cars are constructed in such manner that they can be run in either direction. For reversing the direction of travel they therefore do not require to be turned around. For this reason the driver's cab on the tractor is double-sided, and there are two independent steering gears, one for each axle. The driver is, therefore, in a position to steer either the front axle only, according to the direction of travel, or both axles. Between the several vehicles there are provided the cable junction and mechanical coupling contrivances for holding the train together. These must serve at the same time for operating the positive steering of the motor trail cars in the direction determined by the driver for the travel of the engine-car.

These couplings have been designed in a very ingenious manner for the necessary steering effect, and also to allow the whole train to travel backwards, by simply detaching, reversing and rehanging the chains. The engine-car may be arranged at any part of the train, in front, at the rear or in the middle, so that the shifting of the train can be carrled out as on railroads.

It should be mentioned that the entire steering of the whole train is carried out by the driver on the engine-car and no further help is, therefore, required on the train. For starting the train the driver need only start one of the engine aggregates. The second aggregate can be started or cranked up at any time during the travel with the aid of the first aggregate. A main switch serves for setting the electric connections to "forward," "stop," "brake" and "backward." This switch can, however, only be operated when the dynamos are free of tension, and the switching is thus carried out only when the wires and cables carry no current, so that the contact surfaces cannot be burned.

The starting and the varying of the speed is obtained solely by excitlng the dynamos, i. e., by operating the shunt regulator of the dynamo, in which there are currents of comparatively low tension only, thereby obtaining unsurpassable

MOTOR TRUCK *in front, with two gasoline engincs generating electricity. Trailer chassis behind, each with an electric motor supplied from generators on the truck and steered by the operator of the truck.*

reality and safety of regulation. The starting is thereby effected as quietly and steadily as when the steam valve is gradually opened on a locomotive. In a similar manner the electric brakes of the train are put into operation, and act under perfect control of the driver uniformly on all wheels.

In addition to the electric brake each vehicle is provided with a hand brake, which acts on all four wheels. Trains intended for use in mountainous districts are furthermore fitted with a second continuous brake, which may be operated either electrically or pneumatically. A complete train includes amongst the other contrivances a flexible conducting cable for facilitating the shifting of single vehicles. By means of this "shifting cable" the motor trail cars can be supplied with current and be brought from distances up to 3,000 m. (10,000 feet), or be sent that distance, respectively, without the engine car having to be moved from the spot.

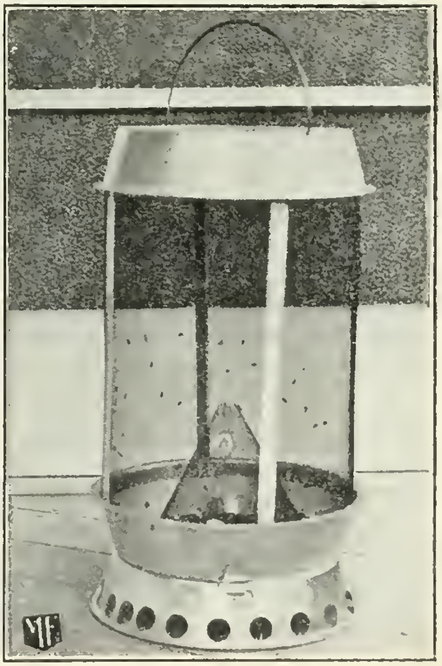
Not in all cases do the trains require all wheels to be driven, as some cars can be included in the train which contain no electric motors and driving gears. It is advisable to make up a train in such manner that more than half the number of axles are driven, as on the number of driven axles depends the reliability of the operation of the train.

Experiments have shown that field roads can be traversed without difficulty, the speed alone being slower. The train can also travel on sandy soil, meadows and prairies. Even if one or another of the wheels should furrow and sink into the soil, the train will not be stopped, as the other axles continue their propelling effect and will draw these wheels out onto solid soil. As long as the soil is capable of bearing the load, the applicability of the road trains is practically unlimited. The wheels have broad steel tires without any projections which might damage the road, and even have a smooth, leveling effect. Therefore the road cannot be destroyed.

MUNICIPAL FLY CATCHER

The City of Redlands employs a man whose sole duty it is to look after our municipal fly traps which are placed on the sidewalks in the down-town section by our merchants. This man baits and empties the traps daily.

These traps are made on the multiple cone plan and in different sizes, although the character of the type is uniform. From September 1st to September 24th, or the first three weeks after these were all in place, this official, A. E. Chapman, caught fifty gallons of flies in the traps, which he estimates to be equal to 3,750,000 flies. The local papers state that these traps have kept the business houses almost entirely free from flies. Each day the traps on the streets are baited with material which will attract the flies, first being emptied of those which had been collected during the previous day. The flies thus collected are burned.



Control of Check Valves

ON EMERGENCY FIRE SYSTEMS CONNECTED WITH REGULAR WATER SUPPLY PIPES

By J. Walter Ackerman, Superintendent of Water Works, Auburn, N. Y.

Some years ago the city of Auburn had a serious epidemic, the source of which was traced to polluted water used in the special fire-protection systems of certain factories, which were connected with the regular water supply pipes. The check valves on these lines leaked and the polluted water got into the city water supply, causing the epidemic. This paper before the American Water Works Association describes the methods of testing the tightness of these check valves which are now in use.

IN the year 1908 the Water Department of the City of Auburn, N. Y., caused an examination to be made of the check valves of the mill and factory connections in the City of Auburn. And, as these check valves were of the type that are bought on a competitive basis, and simply represented a design made looking towards an economy of material and labor, the results of this examination can be easily imagined.

It was found in many cases that even the locations of the valves were unknown to the factory, and some had been buried in the ground for a period of twenty years, without ever having been examined. The final result of this inspection was that each and every mill or factory using city water for fire protection, and having a polluted auxiliary supply, was required to install double check valves of a special design, and to be placed in a brick or concrete vault, accessible at all times to inspection and test.

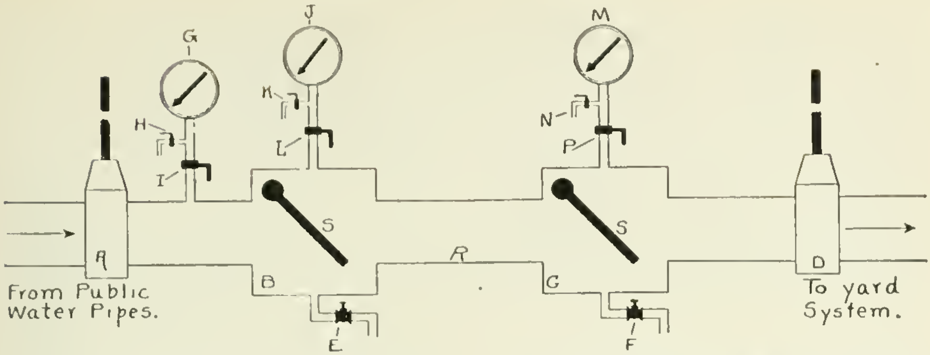
The specifications under which the check valves were made require that the seat ring, disc holding ring and screws, and, in fact, all moving parts, and the hinge pin and bushings of same be of bronze, the disc to be faced with medium hard rubber and liberal clearance to be made all around the clapper, the pin, the arm, etc. These specifications were largely determined by the inspection department of the Associated Factory Mutual Fire Insurance Companies of Boston, and they also had to meet with the approval of the Water Department of the City of Auburn.

The regulations are that they shall be tested once every six months by the Water Department, and taken apart once each year and examined for defects or obstructions, and during this latter inspection a representative from the Associated Factory Mutual Fire Insurance Company is present to observe the condition of the valve and assist at the test.

It is specified by the Water Department that the inspection and test shall be at the expense of the factory or mill where the tests are made.

Figure 1 shows a diagrammatic representation of an installation made in the City of Auburn. The stop gate valves *A* and *D* are so placed in line as to absolutely shut off the water from the check valves. On the entering side, between the first valve *A* and the check valve, is a tap with cock and air vent, on which is placed the pressure gage *G*. Likewise, two other taps on the two check valves are made with the same type of connection. Tapped into the bottom of each of the check valves is a ¾-inch connection, controlled by cocks *E* and *F*.

The actual test is made as follows: Closing gate *A*, either the cock *E* or the air cock *H* is opened. The pressure at *G* only should fall if the check valve *B* is tight and the gate *A* is tight. It sometimes happens that the opening of the air



TYPICAL ARRANGEMENT *of check valves to prevent water from factory fire system leaking into the city water supply system with which it is connected.*

cock *H* releases the pressure so slowly that the back pressure on check valve *B* will not seat the clapper *S* in valve *B*, and the gages both *G* and *J* will fall: while if the ¾-inch cock *E* is opened the valve *B* will close tight. This simply gives the degree of sensitiveness of the check valve, and indicates its condition; for if the air cock does not show it absolutely tight, the drip *E* may. This generally shows that the rubber facing on the clapper is either coated with slime or, some small indentions occurring, allows the water to pass thru this valve. The conditions of tests are slightly different, depending upon whether a mill has one connection or two. If it has two connections there is always present the city pressure from the other connection coming back to the two valves; whereas, if there is only one connection, there is only the static head, or else the fire pumps in the mill are way. If the flow from *E* or *H* is continu- started, and pressure is created in that ous, it is an indication that there is a leak either thru both check valves or thru the stop gate *A*. If the pressure with *E* and *H* open drops on *G* only, and not on *J* and *M*, it is the gate *A* leaking; but, to make absolutely sure, allow all the gages to assume the normal pressure, and then suddenly release *F*. If gages *J* and *G* drop, and M does not, and flow continues, then it is an indication that the leak is thru *A*, and not thru *B* and *G*.

After the condition of gate *A* and check valve *B* have been thoroly determined by the above method, then the opening of air cock *K* or drip *F* will disclose whether there is a leak on check valve *G*. And, as before noted, if it shows a leak with *K* open, and tight with *F* open, it simply does not seat properly under a low differential pressure. And this is important, because the valve is called upon to act when the fire pump raises the pressure above that of the water in the city mains. And there always will be a time when the pressure on each side is just equalized, and then the pressure on the mill side will begin to build up above that of the city side. And while the test may show from both the drips a tight condition, it will not show a tight condition when only the air cocks are used slowly, allowing the difference in pressure to be gradual.

In order that a number of trials may be made on check valve *B*, pressure should be taken from some source and introduced between the two valves. It is preferable in this case to take the pressure from the main on the mill side between check valve and the mill or factory and allow it to come in thru either the drip pipe *F* or some other place, in order to balance the pressure on each side of check valve *G*. Then this by-pass connection would furnish water for unlimited trials on check valve *B*, independent of check valve *G*, for any water which leaks thru *B* would be replaced by the by-pass connection, which, if it was not there, would soon be exhausted if check valve *G* was tight.

The actual value of the test is obtained after it is completed and the examination made of the interior to show actual conditions, such as tuberculations on the iron body, the smoothness of seat ring, the condition of the rubber facing on clapper, and the manner of the closing of the valve. And, while the test is only to show working conditions, the examination shows the way the valves are living up to the requirements imposed upon them.

The rules in our department which control the installation of check valves and kindred appurtenances are as follows:

No water pipes in any building or premises supplied with water by the city shall be allowed to receive a supply of water from any other source except in case of pipes used exclusively for fire protection that conform to the requirements given below.

No connection of the city mains shall be allowed with pipes having another source of water used for miscellaneous purposes except to a tank open to the air, nor shall such pipes have any physical connection with the pipes used for fire protection.

Between the pipes used exclusively for fire protection and the city mains there shall be two check valves placed between two positive valves and located in an accessible brick or concrete pit, with such valves, gages and connections as may be prescribed by the water board for each installation and for the purpose of testing. The check valve shall be of a type approved by the water board. The check valves shall be kept in working order by the consumer and shall be at all times subject to inspection and test by the superintendent of water works, the cost of such test being borne by the consumer. The pure water pipes that have direct connection with the city supply, before the same have passed through the aforesaid double check valves, shall be painted blue; the pipes used exclusively for fire protection shall be painted red, and the pipes carrying the impure water and used for miscellaneous mill purposes, but not for drinking, shall be paiuted yellow. These different systems of pipes shall not have any physical connection with each other in the mill or factory.

There shall be placed on the discharge main of the fire pump a check valve and positive gate. The latter shall be kept closed and sealed by the superintendent of water works, and opened only in case of fire or for the purpose of occasionally testing the fire system, but notice of such occasional test shall be given to the superintendent of water works, and, during the test, the positive gate between the fire system and the city main shall be kept closed. During the weekly trials of the pump prescribed by the fire underwriters the water shall be discharged either thru the relief valves of the pump or thru hose connections from the pump.

CONCRETE ROADS IN ILLINOIS

The Illinois State Highway Commission completed last fall and now has in service two concrete roads running out of Edwardsville, which are 16 feet wide, the bids being nearly the same as for a 9-foot concrete road with macadam shoulders. The Troy road is 6,300 feet long, 11,200 square yards of concrete, and has expansion joints 40 feet apart, protected with steel plates. During construction the fresh concrete was shaded by an awning about two feet above it and as soon as it had hardened sufficiently earth was thrown on it, and kept wet for several days. The proportions of concrete were 1 Universal portland .cement, 2 sand, 3½ crushed limestone.

The Old Fairgrounds road is 3,900 feet long and 18 feet wide, 7,800 square yards of concrete, and has a grade of 8 per cent. in one place. The foundation being of stiff clay, curbs were put along the edges of the brick surface on the hill to prevent washing of the shoulders.

Illinois State Highway Department specifications were used. Dunlap-Dippold Company and Geo. R. Hyten, both of Edwardsville, were the contractors on the respective roads.

WATER WORKS OF BRIDGETON, N. J.

This clear and concise account of the new water supply system of Bridgeton, N. J., is taken from the report of Henry Ryon, designing engineer and superintendent, and will be of interest to many operators of small plants who have similar problems to solve.

THE city of Bridgeton, N. J., began the agitation for water works as early as 1872, when its population was not much more than 5,000, and succeeded in building a plant in 1877 with a supply from East Lake, pump of 1,500,000 gallons capacity, distributing and storage reservoirs. The distributing reservoir was replaced in 1898 by a steel tank in the same location, 100 feet in diameter and 45 feet deep, and this tank was coated inside and out in 1908 with reinforced concrete at a cost of $20,000. It has an available capacity of 2,000,000 gallons and forms a part of the new system which has just been constructed.

East Lake was supplanted as the regular supply in 1887 by a 30 by 30-foot well, and used thereafter as a supplementary supply in dry weather. Galleries supplemented the well, but the supply could not be increased to correspond with the demand and in 1910 Clyde Potts was employed to find a new supply and the new plant was constructed from his designs.

This new supply is taken from the west branch of the Cohansey river, which has a watershed of 46.9 square miles, with four large mill ponds to aid in conserving the supply. Its minimum dry-weather flow is 23,000,000 gallons a day. It has no villages on the area and a small number of farm houses.

The intake, at the upper end of Tumbling Dam pond, is in a neat buff brick house with heavy concrete base, is 6 feet wide by 3 feet high and has three movable screens, one of ½-inch by 2-inch iron bars across the above opening, and behind it a ¾-inch mesh brass screen and a ⅜-inch mesh brass screen, all of which can be raised separately for cleaning. A wooden shut-off gate is provided.

A 30-inch vitrified pipe conduit carries the water under the lake and thru the bank west of the raceway, 14 feet deep in places, some 8,500 feet, to the coagulation basin of the filter plant. It can carry 4,200,000 gallons in 24 hours, with gates wide open, and the difference in level of 4 feet between the two ends. An emergency intake is provided on the raceway below the dam which has also a blow-off gate for draining the pipe.

The accompanying larger drawing shows the lay-out of the pumping station and filter plant and the course of the water thru it can be followed readily. It enters the bottom of an inlet well about 4 feet square at the southwest corner of the basin, rises in this chamber and passes thru a 30-inch balanced float valve into the basin proper. This float valve automatically cuts off the inflow when the water in the basin reaches the level for which the valve is set. An overflow weir in the north side of the inlet chamber at the level of the water at the intake house provides for any surge due to the sudden closing of the valve, and prevents damage being done to the vitrified tile conduit due to water hammer. A 12-inch blow-off gate is provided for drawing off the upper portion of the water in the basin. The lower 4 feet is, however, too low to drain by gravity, and a pipe from the bottom of the basin is connected to the sludge well in the main building, from which the water may be pumped by a 6-inch centrifugal pump operated by a 10-horse-power steam engine.

The soda and alum used in treating the

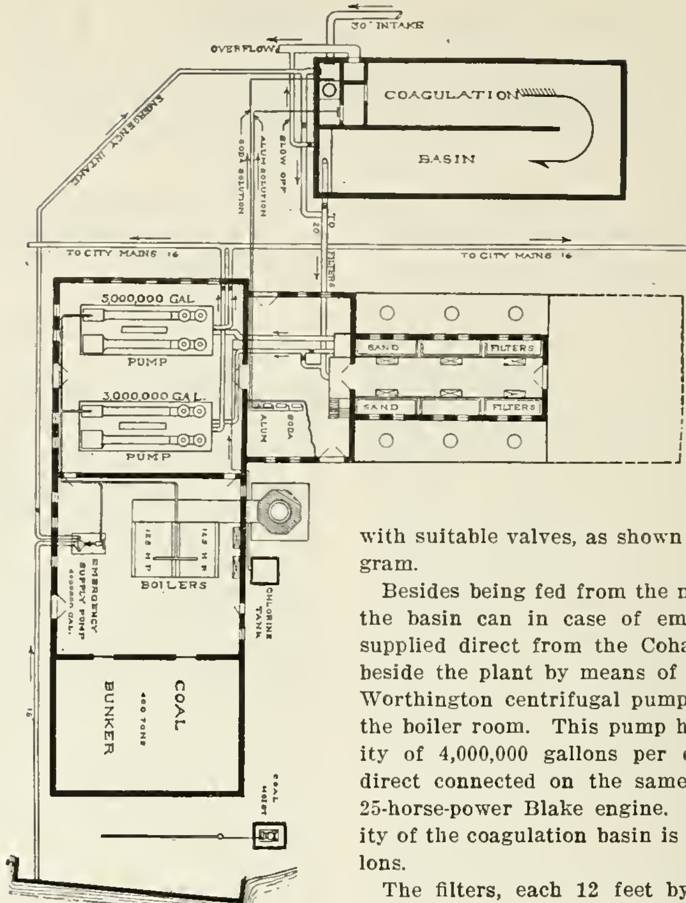


FIGURE 1 *gives the plan of the pumping station, coagulation basin and filters, showing all the connections described in the article and the course of the water thru the plant.*

water are applied in the order named at the entrance of the coagulation basin on opposite sides of the balanced valve. When operating at normal capacity the water requires a little over one hour to pass thru the coagulation basin, moving north on the west side of the middle baffle and south on the east side to the concrete collecting trough, from which a 20-inch pipe carries the water to the sand filters. To provide means of operating the plant while the basin is being cleaned, a by-pass has been built across the end of the basin with suitable valves, as shown on the diagram.

Besides being fed from the main intake the basin can in case of emergency be supplied direct from the Cohansey river beside the plant by means of the 12-inch Worthington centrifugal pump located in the boiler room. This pump has a capacity of 4,000,000 gallons per day and is direct connected on the same base to a 25-horse-power Blake engine. The capacity of the coagulation basin is 150,000 gallons.

The filters, each 12 feet by 14 feet 6 inches, are arranged in two rows of three each on opposite sides of the operating floor and pipe gallery. The 20-inch inlet pipe from the coagulation basin runs the full length of the filter house and is connected to each of the filters by an 8-inch pipe. The water passes thru these pipes into the filters and down thru the 30 inches of sand (effective size 0.4 mm.) and 18 inches of gravel. It is collected at the bottom of each filter by 616 brass strainers, shown in Fig. 2. These strainers are tapped into 2-inch iron pipes, which lead to the manifold in the center of the filter and from which the water passes to a rate-control of the Venturi meter type, and drops into the clear water basin beneath. The rate-controls consist of balanced valves operated by diaphrams moved by the difference in pressure at the throat and full section of the Venturi meter. They prevent the filters from being operated at a higher rate than that for which they are set.

Mercury column gages are provided on each operating table for showing the head on the filters. When the filters are clean, the loss of head thru them is about 2 feet and the rate-controls automatically close sufficiently to prevent the water from passing thru at too high a rate to give satisfactory results; but as the sediment gradually clogs the surface of the sand, the loss of head increases and the controls open wider, offering less resistance to the flow. After being in operation for from eight to twelve hours, depending on the condition of the raw water, the beds become so clogged as to need cleaning, in order to deliver the required amount of water. This condition is indicated by the mercury gages.

The cleaning is accomplished by means of blowing air and running water thru the beds from the bottom. The wash water is taken from the city mains by a 6-inch pipe which connects to the manifold of each filter, the water entering the sand bed from the brass strainer in the opposite direction from that in which the filtered water leaves. The air is supplied at about 5 pounds pressure by a No. 3 Root blower direct connected to a 25-horse-power Troy engine, and is conducted to the filters thru a 4-inch pipe and distributed over the bottom of the filter by a small perforated brass piping, as shown in Fig. 3.

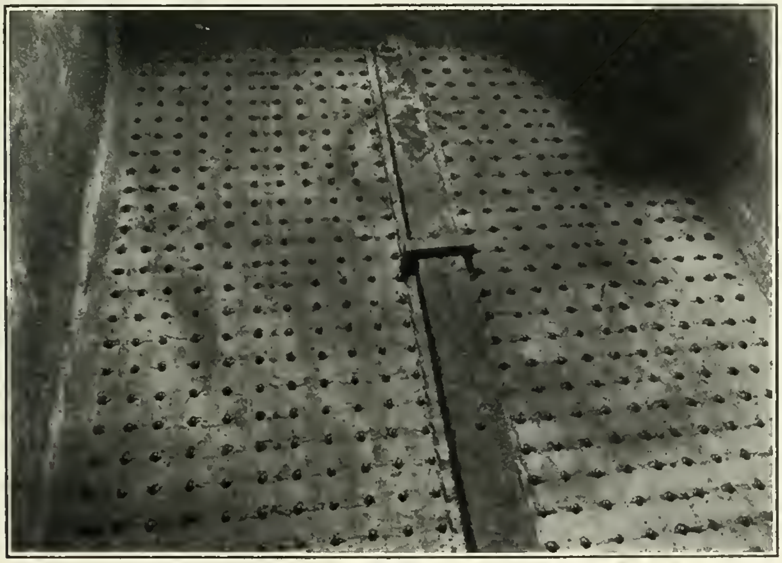
The air and water break up the crust formed on the filter and the water carries off the dirt from the top of the filters thru a 10-inch waste pipe. When the filters are started after washing, the first filtered water is wasted to the river by opening a valve connected to the same pipe which carries the waste wash water from the top of the filters. The amount of water used for washing is about 1½ per cent. of the total amount filtered.

All valves, except the rewash valve, on pipes connected to the filters are operated hydraulically by turning levers on th operating table. An indicator shows the condition of each valve.

A sampling faucet is also provided on each table for taking samples from the filters separately. The water is drawn to these faucets by a partial vacuum produced by an aspirator. Each filter has a capacity of 500,000 gallons per day.

The clear water basin is of concrete 72

FIGURE 2 *shows the brass strainers on the bottom of the filter, which drain thru two-inch pipes to the manifold running down the center.*



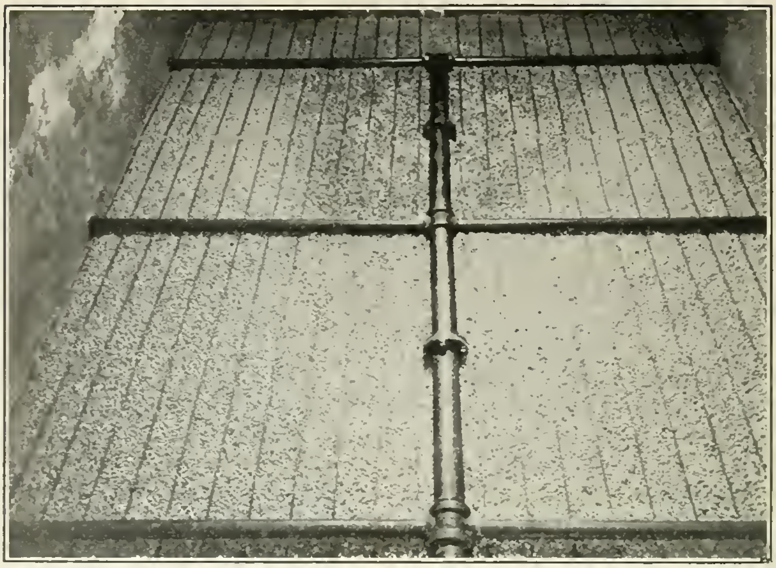


FIGURE 3 *shows the coarse gravel laid on the bottom of the filter and the small, perforated brass pipes thru which air is forced to aid in the process of washing the filter sand.*

feet long, 42 feet wide and 11 feet deep, and is located directly beneath the filters, extending underground 28 feet beyond the end of the filter house. Its available capacity is 200,000 gallons. The suctions of the pumps draw from the south end of this basin.

Alum is used as coagulant in treating the water. The usual dose of alum required is about 0.6 of one grain per gallon, the quantity being varied slightly with the condition of the raw water. Since the water has an alkalinity of from 6 to 8, it is necessary to apply soda ash or lime a large part of the time. The latter seems to give better results.

The chemical solutions are mixed in concrete tanks on the upper story of the building. These tanks are in duplicate. Each of the two alum tanks has a capacity of 3,500 gallons and each of the two soda tanks a capacity of 1,950 gallons. The tanks are fitted with hot and cold water and perforated brass air pipes are provided on the bottoms of each tank for agitating the solutions. From the mixing tanks the solutions flow to the porcelain lined orifice tanks in the laboratory. The level in these orifice tanks is kept constant by float valves, and the outlets, brass needle valves, are adjusted to feed accurately the amount of chemical necessary.

To supplement the filtration process and effect a saving in the amount of alum required, arrangements have been made to apply chlorine to the filtered water whenever it is deemed necessary. The "chloride of lime" solution used for this purpose is mixed in a 6 by 6-foot square concrete tank having a capacity of 1,000 gallons. This tank is located outside of the building in order to prevent the fumes of chlorine from coming in contact with the machinery. One-inch lead pipes lead from this tank to the suctions of each of the two pumps. The partial vacuum produced in the suctions draws the solution into the water as it comes from the clear water basin and the passage thru the pumps thoroly mixes the chlorine solution into the water. Brass needle valves are used to regulate the quantity applied and a water gage on the wall of the pump room shows the level of the water in the solution tank.

The application of chlorine is only necessary when the quality of the raw water is below normal. The dose usually required is about 0.2 of a part of "available chlorine" per million.

To provide for the intelligent operation of the filters, a small laboratory has been installed in the station. Here the quality of the water supplied to the city is carefully watched. Tests for B. coli and bacteriological counts on agar at 37½ degrees C. are made daily on both raw and filtered water. Complete analyses are made at frequent intervals. Daily determinations are also made of the alkalinity of the raw and filtered water to determine the amount of soda or lime necessary for the neutralization of the alum. The turbidity is so slight even after heavy rains that it in no way affects the amount of coagulant required.

As stated above, the soda solution is applied as the water enters the coagulation basin, and the alum a little farther along, after the soda has become mixed with the water by passing several baffles. The alum when it comes in contact with the soda and the calcium and magnesium salts naturally present in the water forms aluminum hydroxide, a sticky gelatinous substance, insoluble in water. A portion of this hydroxide settles to the bottom of the coagulation basin, carrying with it some of the particles of dirt and bacteria in the raw water, but part is carried over to the filters and caught on the top of the sand beds, forming a coat over the surface of the sand thru which the water must pass. This jelly-like covering catches and holds the suspended matter in the water, including the bacteria. When this coat becomes too thick to pass the water at the required rate, the bed is washed and a new coat started. No alum reaches the city mains, as enough soda or lime is always applied to change the alum to aluminum hydroxide, which cannot pass the filters. The calcium and magnesium salts in the water change part of the alum to hydroxide, but the quantity of these salts is so small in the raw water that it is necessary to supplement them with soda ash or lime. The raw water is tested daily to determine the exact amount of soda ash or lime necessary, and as a check the filtered water is also tested daily for traces of alum (lacmoid indicator).

The quantity of chlorine applied is almost infinitesimal, so small that there is no test delicate enough to test it. Prof. Hewlett on the witness stand in a Jersey City case testified that a man would

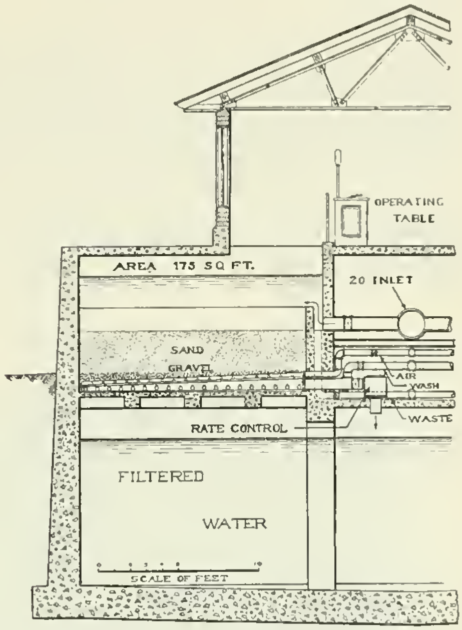


FIGURE 4 *is a cross-section of the filter plant, showing the operating table, above, a cross-section of a filter and of the pipe gallery, below, and the filtered water storage, at the bottom.*

have to drink 2,620,700 gallons to get as much chlorine as is given for an average dose when used as a medicine, when twice as much chloride of lime was used (10 pounds per 1,000,000 gallons) as is used in this plant.

During the first month of operation of the new plant, August 8 to 31, 1913, bacteria to the number of 45 to 180 per cubic centimeter were found in the raw water and 0 to 8 in tap water. Bacillus coli was found in raw water always in 1 centimeter tests and frequently in even 0.1 centimeter. In filtered water it was found five times in the filtered water and once in 10 cubic centimeters of tap water. Chloride of lime in proportion of 0.3 parts of available chlorine per million gallons was applied to the filtered water.

The fourth figure shows a cross section of half of the filter house. The fifth shows the outside of the pumping and filter plant.

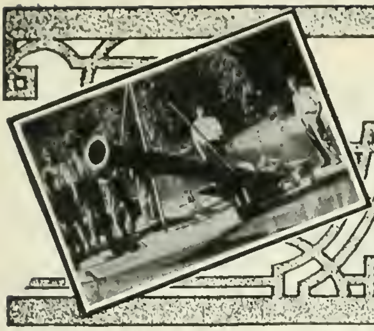
A 5,000,000-gallon Snow pump from the old plant is retained in service, and a new Platt Iron Works pump of 3,000,000 gallons capacity has been installed. Two 125-horse-power water-tube boilers supply steam at 125 pounds pressure.

The water is pumped to the distribution system thru a 16-inch cast iron main running thru the center of the city to the concrete coated reservoir above described, and a new 14-inch main, installed to reinforce the supply to the north end of the city.

The population of Bridgeton is now 14,209. Consumption of water varies from 1,200,000 to 2,200,000 and averages 1,600,000 gallons a day. There are 32.1 miles of distribution mains and 2,978 taps.

Timothy Woodruff was superintendent of the original plant from the beginning in 1877 to January 1, 1913, when he was succeeded by Henry Ryon, who designed the new plant while assistant to Mr. Potts, and to whom we are indebted for information and illustrations.

FIGURE 5 *is an exterior view of the buildings of the plant, looking at the corner of the pump room; boiler house and coal storage to the right; filter room to the rear on the left.*



EDITORIAL

A COMPREHENSIVE SEWERAGE PLAN.

One of the most valuable contributions of the most efficient city administration Cincinnati has ever had is the "Report of a Plan of Sewerage," which has just been issued in a book of 730 pages on India paper so that it is a light and convenient book for reading and reference.

The ordinance providing for the preparation of the plan was comprehensive enough to warrant a thoro study of all branches of the subject and the money necessary was appropriated, nearly $150,000, and the result is the report, the letter of transmission of which by Victor T. Price, director of public service, to Henry T. Hunt, mayor, was one of the latest communications of that administration. The report itself is by H. S. Morse, the engineer in charge, and Harrison P. Eddy, consulting engineer, and is made to H. M. Waite, chief engineer of the department of public works, the responsible head of the technical bureau of the department, and it has a number of detailed reports of special investigations by assistant engineers in charge of them, all of which are correlated and coordinated so as to make a complete whole.

This is not the place for a review of the report, but simply for a word of commendation of a great work well done.

A history of the existing sewerage systems, a full underground survey of the city, a topographic survey of the city and its surroundings in full detail, with maps which will be published shortly, general plans for relief sewers for districts which have outgrown present facilities, plans for intercepting sewers and creek improvements, a thoro study of sewage disposal as it may be applied to the local conditions, a detailed description of the organization and statements of cost, each is developed as tho it was the main object of the work.

The various reports contain also the studies made by others which can be used in the work, such as rainfall and run-off statistics, sanitary surveys of various areas tributary, studies of trade wastes, etc., thus bringing into one view all the matters pertinent to the study in hand.

Of the $6,000,000 or so considered necessary to construct the works that are most immediately necessary, some $3,000,000 has been provided by the city council and some of the work is now in progress.

THE BUSINESS OUTLOOK.

Almost all practical business men who discuss the present apparent stagnation in business really attribute it, not to apprehension of "something going to happen," but rather to conservatism. The desire seems to be to do the business which is at hand and not to expend effort in developing new business, in exploiting new opportunities.

Doubtless much of this is due to unfortunate experiences in exploitations in the past, the ideals having been so much greater than the realities that success was impossible on the scale of development attempted tho it might have been successful on the scale which would be adopted when conservatism is the fashion.

Is not this conservatism really a good thing? Is not the difficulty really imaginary? If we will cut our suits according to the cloth we have will we not in the long run make a better showing than many have been able to make in times of over-production and over-stimulation of business?

The chances for new developments are steadily diminishing in number and our improvements must come in intensive cultivation of the opportunities we have rather than in discounting the future on our ideas of what it may bring forth. That is to say, judicious advertising of the good things we have will be more successful than loud exploitation of things which we hope we may have if our imaginations have not run away with us.

In other words, business is suffering from a state of mind rather than any actual danger.

PROGRESS IN WATER PURIFICATION.

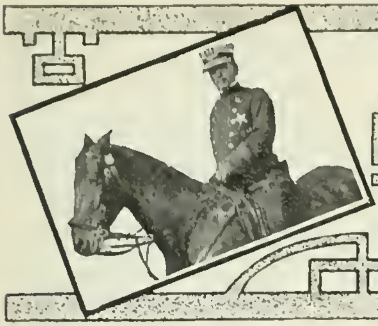
The number of papers and discussions of the subject of water purification which are appearing, some of which are abstracted in this number of Municipal Engineering, indicates an activity which should result in much benefit to public water supplies. Doubtless much of this activity is due to the introduction into general use in water supplies of the hypochlorite process of sterilization, which is so new in this application as to require considerable experimentation and argument to convince the advocates of the older methods of treatment.

The enthusiasts on the new processes are disposed to go too far and to claim that they can make acceptable drinking water out of any source of supply, tho they will admit that filtration is necessary and that lapses in the accuracy with which the processes are applied will produce dangerous conditions for greater or less lengths of time.

On the other hand, there is a prejudice in the minds of many against a chemical treatment of any kind, which it is difficult to eradicate without evidence from longer experience than is as yet available. Many engineers have joined the procession, however, and chemical methods are popular.

New methods are developed almost yearly and practice varies according to the opportunities of engineers to know the new things and their willingness to accept the experience or the conclusions of others. As a consequence there is more or less fashion in processes and, indeed, in principles of purification of water.

In the face of so many new things it is well to remember that not all of them are as yet fully tested and proved efficient. And it is well to remember that a water supply which is protected from pollution, so that the chances of infection reduced to a minimum, is much more certain to result in a completely sterilized effluent from the purification plant at all times, than one which is known to be seriously polluted at its source and which must depend upon the human fallibility of the operators and the machinery and the judgments exercised in putting this bad water thru its purifying process.



QUESTION DEPARTMENT

Makers of Small Garbage and Refuse Destructors

I have to destroy all the wastes of food, garbage, etc., relating to a hospital. I think it well to have a garbage incineration plant. About 200 persons are supposed to occupy the hospital. If possible, refer me to somebody who will furnish me the specifications and details of that plant. Do you think the garbage incineration plant is the best I can do?
B., ———, Que.

The following firms build such small plants as would be suitable for the conditions stated: Morse-Boulger Company, 39 Cortlandt street, New York; City Wastes Disposal Company, 156 Fifth avenue, New York; William F. Morse, 90 West street, New York; Atkinson-Morse Destructor Company, 628, 30 Church street, New York. Builders of larger plants are The Destructor Company, New York; P. Wylie, Vancouver, B. C.; J. B. Harris, Stahlmann Building, Nashville, Tenn.

Makers of Asphalt Paving Tools and Supplies

We would like to know the names of dealers in asphalt paving equipment and supplies.

What we are interested in is the purchase of asphalt tools, such as rakes, tampers, heating pins and all such classes of equipment.
L., Salt Lake City, Utah.

The principal makers of street asphalt tools are the Barber Asphalt Paving Co., Iroquois Works, 178 Walden Ave., Buffalo, N. Y., and Warren Brothers Company, 59 Temple Place, Boston, Mass. Heating and mixing machinery for asphalt paving materials, portable and stationary, is made by Hetherington and Berner, Indianapolis, Ind., East Iron and Machine Co., Lima, O., The F. D. Cummer and Son Co., Cleveland, O. Heating tank wagons are made by E. D. Etnyre & Co., Oregon, Ill., dryers and heaters for rock and sand by American Process Co., 68 William street, New York; power tampers by Lourie Mfg. Co., Springfield, O., rollers by Erie Machine Shops, Erie, Pa., Kelly-Springfield Road Roller Co., Springfield, O., Buffalo Steam Roller Co., Buffalo, N. Y., Ohio Tractor Mfg. Co., Marion, O., Austin-Western Road Machinery Co., Chicago, Ill., Acme Road Machinery Co., Frankfort, N. Y., as well as the makers of street asphalt tools mentioned above.

Makers of Concrete Molds and Block Machines

Will you please put me in correspondence with some reliable firm that makes molds for porch post columns and block machinery.
F., Middleport, O.

The Besser Manufacturing Company, Alpena, Mich.; U. S. Standard Manufacturing Company, Ashland, Ohio; Sterling Machinery Company, La Crosse, Wis.; C. D. West, Kendallville, Ind.; Zagelmeyer Cast Stone Block Machinery Company, Bay City, Mich.; Simpson Cement Mold Company. Columbus, Ohio; Geo. W. Edgecombe, Benton Harbor, Mich., are prominent makers of the machinery and molds desired.

Success of Garbage Incinerators

Could you cite me to any data of value in regard to the operation and success of garbage incinerators?
City Manager, ———, Ariz.

Morse's book on "The Collection and Disposal of Municipal Waste" ($5) gives a full history of the successes and failures in garbage and refuse disposal. Venable's "Garbage Crematories in America" ($2) gives a full list of American patents and styles of furnaces. Parsons" "Muncipal Disposal of Refuse" ($2) is mainly devoted to the methods and results of the New York City system. Most of the successful plants of recent years and some not so successful have been described in more or less detail in MUNICIPAL ENGINEERING, the latest articles being "Garbage Disposal at Erie, Pa., in vol. xlvi, p. 481; "Garbage Reduction by the Hirsh Process," p. 390; "Garbage Disposal for Small City," p. 237, giving a list of the more important articles in earlier numbers.

Voids in Crushed Stone

Can you refer me to any articles or books which treat upon the voids in various sizes of crushed stone? I have been making some experiments which do not seem to bear out the tables given in Taylor & Thompson's "Plain and Reinforced Concrete."

W., ———, Iowa.

Any assistance our readers can give will be appreciated by our correspondent. Articles on filtration, more particularly of sewage, reports of experiments on sewage and water filtration, such as those of Columbus, Ohio, articles on specifications for macadam and asphalt macadam pavements, such as the one by Mr. Blanchard, abstracted elsewhere in this number, may be of interest, as well as those on concrete, such as given in Sabin's "Cement and Concrete," Blanchard's "Highway Engineering" and in proceedings of the American Concrete Institute.

Books on Architectural Drawing, Designing and Specifications

Will you please tell me where I can get a book or books on architectural draughting, designing and specifications.

D., Norfolk, Va.

The catalog of architectural, scientific, industrial and technical books issued by the William T. Comstock Company, 23 Warren street, New York City, contains long lists of books on the subjects named, each with a brief description of the contents, from which selection can be made. A copy of the catalog can be obtained on application to the Comstock Company.

Municipal Improvements Without Bond Issues

Are there any cities in the United States that have carried through their city improvements without the issuance of bonds, and, if there are such cities, by what means the necessary money has been raised?

So far as I know, the small town of Aledo, Ill., is the only municipality in the United States that can boast of this record.

K. M., New York City.

If the issuance of municipal bonds for paying for street, sewer, sidewalk and other municipal improvements is intended to be covered, scarcely any cities in Indiana have issued bonds of the city for such purposes. In most cases bonds have been issued, called "Barrett Law Bonds," from the name of the author of the original law, for which the city assumes no liability, but they are liens directly upon the property upon which the assessments for the improvements were made and run for ten years, one-tenth being due each year.

Omitting indebtedness for buildings, city hall, police and fire departments, parks and schools, the following cities are reported in Table 30 of the "Financial Statistics of Cities for 1911," as having no indebtedness for sewer, streets, bridges and the like improvements: Washington, D. C.; Indianapolis, Ind. ($95,000 bridge bonds); Des Moines, Iowa; Evansville, Ind.; Fort Wayne, Ind.; Berkeley, Cal.; Davenport, Iowa; Tampa, Fla.; Augusta, Ga.; Dubuque, Iowa; Springfield, Mo.; Quincy, Ill.; Austin, Tex.; Council Bluffs, Iowa.

The Indiana and Iowa cities take care of these improvements as above stated by special assessment bonds of short term and not city obligations.

Who Produces Novaculite?

We would like to have the address of companies or firms producing crushed stone for macadam known as "Novaculite."

About ten years ago a mile of road in this city was improved by applying novaculite, which, I believe, was secured from producers who had a quarry in Southern Illinois not far from Chester.

D. D., ———, Ill.

Can our readers supply the desired information? Quarries of novaculite exist near Cairo, Ill., in Missouri and Arkansas and a stone of similar nature is found near Lafayette, Ind. Some years ago it was reported that the only firm handling novaculite commercially was the Novaculite Paving Company, Equitable Building, St. Louis, Mo., but there may be others now.

Ordinances Abating Nuisances

Will you please send forms of ordinances for removing nuisances from private property and assessing cost to owner?

F., Lincoln, Neb.

Ordinances governing signs and billboards are given in MUNICIPAL ENGINEERING, vol. xlii, p. 249. Provisions of ordinances regulating weed cutting and refuse removal are outlined in vol. xliii, p. 254, and a little more fully in vol. xliv, p. 425.

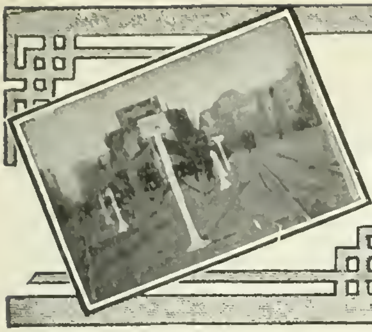
Form of Water Meter Record

Will you kindly refer us to some firm that makes up different styles of meter reading books? We wish to keep a good record of our water meter readings and wish to have an up to date system of bookkeeping.

J. C. G., ———, S. D.

A form of office record of meter readings is given in MUNICIPAL ENGINEERING, vol. xlii, p. 251, with some suggestions of improvements that could be made in it. In vol. xliv, p. 233, is a full description of what a meter reading book should be and instructions for making one are given. On p. 522 of the same volume is a form of meter record for an electric current which could easily be modified for a water meter record.

The Buffalo Meter Company, Buffalo, N. Y., prints a form of water meter record.



WORKERS IN THE FIELD

A Word For the Much Abused Septic Tank

The Editor of MUNICIPAL ENGINEERING:

Sir—In considering the efficiency or otherwise of the septic tank, it too frequently happens that municipal authorities and others are influenced by the opinions of those whose experience has been limited to experimental tanks in which, for various reasons, no attention has been paid to well established principles.

It is unfortunately true, also, that absurd claims have been made as to the possibilities of the septic tank, some having gone so far as to state seriously that tanks of their design will produce a perfectly pure effluent without subsequent treatment, and when later it is found that these promises are not fulfilled, it is the septic tank that is discredited, and not its designer.

The septic process is divided into two stages—the anerobic or putrefaction stage, which takes place in the septic tank, and the aerobic or nitrifying stage, which takes place when the effluent from the septic tank is exposed to air and light. When an effluent is to be discharged into a relatively large body of running water, it is often quite permissible to rely on the septic tank alone for a sufficient degree of purification, but when, as often happens, it is to be discharged into a ditch or small stream, liable to run dry during the hot summer months, it is necessary to subject the tank effluent to some form of subsequent treatment, either in contact beds, filters or otherwise. The character and extent of this subsequent treatment will, of course, be governed by local conditions in each case.

The reasons for the failure of so many so-called septic tanks are numerous. In some, possibly to economize on the cost of construction, the rest period has been reduced to 6, 8 or 10 hours, instead of adhering to a 16 or 24-hour basis. This prevents the development of septic action, because, before it is established, the tank fills up with solids and smells badly; hence the necessity for frequent cleaning and the existence of bad odors, which are entirely unnecessary.

These short-period tanks are mere catch basins or cesspools, in which only the heavier solids are retained, and it follows that the relatively rapid flow of sewage thru them carries away the anaerobic menstruum which is relied on for complete liquefaction; this, too, is often emphasized by defective inlet and outlet arrangements.

Instead of extending the inlet and outlet openings across the entire width of the tank, at mid-depth, they are frequently constructed with one or two pipe openings; these naturally create currents thru the tank and result in dead corners where the sewage lies stagnant. This stagnation, aside from having a detrimental effect on the micro-organisms that are being developed, wastes space that in a properly designed septic tank is effectively utilized.

In some cases the outlet consists of a weir overflow, using a baffle wall extending from above the surface down to within a foot or two of the bottom to keep back the scum. The flow of sewage is thus directed downward and the solids at the bottom are disturbed to such an extent that as the putrefactive or liquefying process goes on, the flocculent matter, or partially dissolved solids, are swept out of the tank and make trouble, for all of which the septic tank is blamed. Such an arrangement of the outlet would be bad enough if the tank were otherwise correctly proportioned, but is disastrous with a tank whose rest-period is too short anyway.

In conclusion, it is not too much to say that no septic tank which is properly designed with due regard to the character and volume of the sewage to be treated, and in which the fundamental principles of the septic process are correctly applied, will fail to operate successfully and do all that can be reasonably claimed for it, and, further, that such an installation is not only the most economical in first cost and operating expense, but the most efficient method of sewage disposal that is known today.

H. D. WYLLIE, Sanitary Engineer,
Chicago, Ill.

Sewer Under Railroad Track

In the construction of a sewer under the four Grand Trunk railroad tracks at Richfield road and Avon street, in Flint, Mich., the railroad engineer permitted the contractor, Albert H. Prange, to use vitrified clay segment blocks instead of 27-in. cast iron pipe. This made it possible to lay the sewer in tunnel, 6 inches of concrete being laid around the sewer, the same as was required by the specifications for the cast iron pipe construction. R. W. Stoddard, the engineer for the contractor, reports the length of the tunnel 64 feet, width 5 feet and height 6 feet. A shaft 5 feet square was sunk in the center of the four tracks and the tunnel was worked both ways from it. As soon as the end of the sewer was reached the blocks were laid, no time being lost in enlarging to admit long pipes or large diameters, and no derricks or rollers being necessary or space to pour lead joints.

The tunneling required 180 hours of workmen's time, laying the blocks 20 hours, placing concrete 20 hours, backfill 40 hours.

Removal of Snow From Street Railway Tracks

Some extracts from a paper by Martin Schreiber, maintenance of way engineer of the Public Service Railway Company, operating between Jersey City and Camden, N. J., in some 140 municipalities, read at the recent snow-removal conference in Philadelphia, show the advantages of thoro preliminary organization in getting to work and the necessity of planning as nearly as may be the order of abandonment of lines when the storm is too severe for the organization to cope with.

No special supervisory organization is required in handling snow, only the regular force of employes is enlarged. Early in the fall the various departmental heads and their assistants, including the superintendents of transportation, maintenance of way, distribution and equipment meet and lay out a co-ordinate plan of action. The transportation department, thru the division superintendents and supervisors at the various car houses, assigns certain crews to operate the snow fighting apparatus, such as plows, sweepers and levelers. The names of the crews, with their addresses, are posted in each car house in advance, so that they may be called on at a moment's notice.

Likewise, the equipment department, thru the division master mechanics and car house foremen, selects the proper mechanical men to accompany the snow-fighting equipment and others to look after repairs continuously thru the period of the snow storm.

The maintenance of way department, thru the division roadmasters and section foremen, also records the addresses of a large number of emergency men and teams, who may be quickly assembled at anticipated locations.

At the preliminary meeting of the heads of departments the various locations are decided on where snow must first be cleared away, such as intersections, curves and crosswalks, so that the track foremen may begin operation at the most important places, and follow up at other locations in a consecutive order.

The distribution department also keeps in close touch with all the plans so that they may decide in advance how to increase the power on particular lines by switching in and out feeders, in order to take care of the heavy drain on the distribution system that is caused by the operation of the plows and sweepers. Besides, they arrange to have extra emergency crews at certain locations to take care of line breaks.

Along with the definite organization scheme, the snow equipment is carefully inspected and all necessary repairs are made to the snow plows, sweepers and levelers during the summer, so that the entire apparatus is in first-class condition.

The equipment consists of 76 snow sweepers, 21 shear plows, 2 rotary plows and 7 work cars equipped with levelers. A careful inspection is made of the railway strip to make sure that no paving stones, crossing planks or other obstructions exist which would interfere with the operation of the plows and sweepers. Sewer manholes and dumps are selected which will be the most economical and satisfactory to the city, and means of access to these places by the trucks are also planned.

All of the plows and sweepers which have been assigned to particular trackage are actually operated on these lines on trial trips, and all troubles which are possible to eliminate are promptly remedied.

As soon as a storm sets in, all of the departments marshal their crews and extra men at the various yards and car houses in each division. Ordinarily one trackman inspects ten miles of track. During a storm at least six men are kept busy, cleaning switches and special work on a section of this length. The crews for the plows and sweepers are kept on waiting orders at full pay, so that no time will be lost in getting into action. As soon as the snow reaches about 2 inches the sweepers are brought out and operated continuously during the entire storm. Telephone communications are established and the transportation department assigns a man to keep hourly records of the location of the regular operation on the 111 lines of the system.

Snow collected on the sides of the tracks thru the operation of plows and sweepers over the roadway is forced away from the tracks (if the storm continues) by means of levelers attached to the sides of the sweepers and plows, or special work cars. Depending on the severity of the storm, two or more track laborers are assigned to each plow or sweeper for the purpose of digging out snow and ice with hand shovels wherever drifts are encountered. The rotary plows are reserved for handling the extra heavy drifts, which occur more frequently in outlying districts or on suburban lines.

When the snow begins to collect faster than it can be handled with the snow removing apparatus, the outlying lines are abandoned first and the apparatus is concentrated on the city service. During the last storms the company had a number of cars which were snowed in for 24 hours. This was caused by broken down telegraph and telephone lines crossing lighting and trolley circuits, introducing a great source of danger, so that the power had to be shut off. With the power off, the snow was quickly packed around the cars and they could not be moved until actually dug out by hand labor.

As soon as the storm is over, or, in fact, as soon as the snow is piled in any quantities along the side of the tracks, the work of removing it is started. The largest part is hauled away by teams and dumped into sewers, rivers or meadows; in one city a great quantity was dumped into a canal. Considerable progress has been made in hauling away snow in some cities by avoiding conflicting organizations working on the same street at the same time. Definite schedules are mapped out so that the railway company removed all the snow on certain highways between building lines, and the city all the snow on other streets. Some municipalities remove all the snow themselves and the railway company is billed for their portion of the cost on streets where tracks are constructed. One of the customs of the company is to follow up the men on snow removal with special provision cars, so that the men are supplied with hot coffee and sandwiches, all of which has been greatly appreciated by the employes.

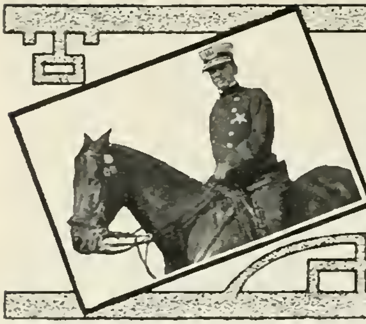
It is doubtful, under present conditions, if it is practical for the railway company to make many more improvements for cleaning track and roadway of snow. Of course, there is always room for improvements by strict planning, inspection and supervision of the work. One of the most unfortunate conditions surrounding the handling of snow by the railway company or municipality is the fact that the apparatus is idle such a large portion of its existence. The possibility of the mechanical equipment being out of commission so long a time will always be the cause of strong argument against the development of any special machine for melting or removing snow.

It appears that about the only way to efficiently remove snow is thru further co-operation of the railway company and municipality—for example, stations and dumps could be established and the railway company contract with the municipality for hauling all the garbage and refuse. So, in the winter, in case it was required to haul snow, all the equipment for garbage, including the stations and dumps, could be pressed into service for disposal of the snow, without any extra investment expense.

Another plan would be to design streets and roadways with special gutters equipped with flushing apparatus, which could be used for cleaning and draining streets as well as getting rid of the snow.

Automatic Street Lighting in Leeds

Leeds, England, has been experimenting with automatic lamp-lighting installations, and they have proved so successful that it is proposed to have the City Council apply to the Local Government Board for sanction to borrow $112,000 to equip the 17,000 gas lamps which help light the city. Two systems have been considered and preference has been given to the adjustable clock over the wave-pressure system. It is estimated that 77 men at 28s. 6d. ($6.93) per week can be dispensed with, which means an annual saving of about $28,000. It has been shown that failures in lights by the clock system are only 23 in 10,000, and these can be adjusted by inspection. It is claimed that by the automatic system there is an enormous saving in mantles, and the authorities of Newcastle are reported to estimate that by this system there is an all-around saving of nearly 20 per cent.



LEGAL DECISIONS

Decisions of the Higher Courts of Interest to Municipalities

Inequality in Sidewalk—In a city requiring property owners to provide a sidewalk in front of their premises at their sole expense, a difference in level ranging from 2 to 2½ inches, but which, by the accumulation of dirt on the lower sidewalk, had been reduced to an average of 1½ inches, and where the higher sidewalk did not end abruptly, but began 1½ inches from the dividing line, and sloped at an angle of 45 degrees toward the lower sidewalk, was not such an inequality as to make the city guilty of negligence, and liable to one injured by stumbling over it in daylight. The duty of municipal corporations is to see that their sidewalks are in reasonably safe condition for persons exercising ordinary care and prudence. Goodwyn v. City of Shreveport (La.), 64 S. R., 762.

Damages for Removal of Shade Trees—A municipality may remove shade trees from a street without being liable to abutting owners for resulting damages if their removal was reasonably necessary to improve the highway, but is liable therefor if their removal was unnecessary and arbitrary. Town of Durant (Miss.) v. Castleberry et ux., 64 S. R., 657.

Towns Cannot Issue Bonds for Improvements Already Paid for by Taxation.—St. 1907, c. 476, providing that the town of Lincoln may issue bonds for the extension of its waterworks did not authorize the town to issue bonds to reimburse it for extensions already paid for by taxation, so as to keep the waterworks' finances separate; the town being a single municipal entity, of which one department could not become the debtor. Chapin v. Town of Lincoln, Mass. 104, N. E. R. 745.

Damages for Nuisance and Damage from Overflow Occasioned by Storm Sewer.—Where the sewerage system of a city drained into a natural water course, and covered the land of a lower riparian owner with foul and offensive deposits, the city was liable in damages for a nuisance, notwithstanding the acts of third parties in filling in the channel of the stream below, which also contributed to the result. Where a city by its sewerage system intercepted water which would naturally have drained below plaintiff's land and discharged it into the stream above such land, it was liable for damages caused by an overflow on such land, tho the natural channel was sufficient to accommodate all such drainage and was rendered insufficient by lower riparian owners filling in their land below. Judd v. City of New Britain (Conn.), 90 Atl. R., 35.

Sewage Disposal Company Liable for Nuisance from Defective Operation.—The fact that a sewage disposal company is chartered by the state to perform a public service, and that its duties are exercised under the direction of the State Board of Health, and that its plant was constructed under plans approved by the State Drainage Commission, would not relieve it from criminal responsibility for maintaining a nuisance by the faulty construction or operation of its plant. In a prosecution for maintaining a sewage disposal plant so as to constitute a nuisance, evidence of the cost of the plant and that it was not profitable was not relevant. In a prosecution for maintaining a nuisance, caused by the negligent construction and operation of defendant's sewage disposal plant, evidence that sewage could be treated near dwellings without offense was admissible to show that the noxious odors from defendant's plant could be eliminated by proper construction and operation. State v. Collingswood Sewerage Co. (N. J.), 89 Atl. R., 525.

When Water Company Is Liable for Fire Damage Loss from Defective Hydrants.—Where a water company has contracted with a city to furnish a sufficient water supply for the protection of the inhabitants against fire, the company is liable in damages to a property owner for fire loss resulting from its failure or refusal to perform such contract; but a citizen's right is measured by the duties imposed on the water company by the contract itself, and no recovery can be had, unless it appears that the water company's failure to comply with some provision of the contract was the proximate cause of the loss.

A franchise authorized defendant private water company to furnish water to the city and its inhabitants provided that defendant should "furnish and set" 100 fire hydrants of modern pattern and good efficiency, that the hydrants should be rented by the city for five years; the city agreeing to use them carefully, and pay for any injury that might happen to them by any officer or servant of the city or member of its fire department. The contract further provided that the hydrants should be used only to extinguish fires and flush gutters and sewers, that the chief of the fire department should have control of them, should cause them to be inspected, and if, on inspection, any were found out of working order, defendant should be notified in writing, and was required to put such hydrants in effective working order with reasonable dispatch. *Held*, that the word "furnish" as applied to the duty to provide hydrants meant "provide at its own expense," and did not require the company, at its peril, to keep the hydrants constantly in working condition so as to render it liable to a citizen for a fire loss due to a hydrant being out of repair, without any notice having been given defendant thereof. Tobin v. Frankfort Water Co. (Ky.), 164 S. W. R., 956.

Damages for Grading Street.—A purchaser of property purchases with the implied consent that the street must be made reasonably safe and convenient for travel, and cannot complain that it is lowered or filled to make it safe for travel, so long as the city has established a grade so as to inform him of the extent to which it would be lowered or raised. In reducing inequalities in streets by changing the grade, more latitude should be allowed to large cities than to the smaller cities or country towns; paving being a necessity in the larger cities. Gray et al. v. Salt Lake City (Utah), 138 Pac., 1177.

Free Water for Street Sprinkling.—Where a city employs a street railway company to sprinkle its streets, it may delegate to such company its right, under a contract with a water company, to take water from hydrants for use in sprinkling streets where the contract with the water company contains no restriction, even by implication, as to the method of putting the water on the streets. City of New Castle Water Co. v. Mahoning & S. Ry. & Light Co. (Pa.), 89 Atl. R., 811.

City Not Liable for Damage from Broken Water Main.—A city is not an insurer of its water system, but is required only to use reasonable care in establishing and maintaining it, and hence was not liable for the flooding of a cellar through the bursting of a water pipe, in the absence of any negligence in its construction or operation, or in the repair thereof after notice of the break, or actual notice by like prior occurrences that the pipe was defectively constructed or maintained. Simon v. City of New York (N. Y.3, 143 N. Y. Supp., 1097.

Franchise for Trolley Line

Waterford, Pa., has granted the Erie Southern Railway Company the right to construct a trolley line thru the boro. This is an interurban line running south from Erie, Pa., which is at work securing franchises and rights of way and making surveys for construction as soon as the way is clear therefor.

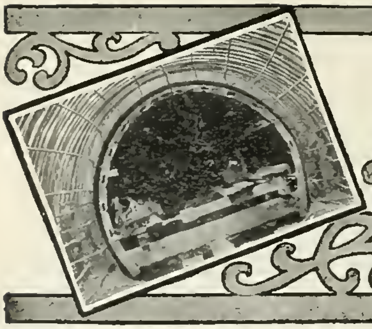
Concrete Reservoir at Latrobe, Pa.

The Latrobe Water Company has recently completed a new filtration plant near Kingston station, Pa., having a sedimentation basin 120 by 120 by 10 feet and a coagulating basin 120 by 85 by 14 feet, with walls and floors of reinforced concrete. Crushed Ligonier stone, Ligonier stone dust instead of sand, and Universal portland cement were used in proportions to make the densest concrete possible. When the forms were removed the inside surfaces were washed and plastered with a mixture of cement and stone dust. As an additional precaution the bottom of the reservoir has a layer of 4-ply paper and asphaltum. The result is satisfactory as to water-tightness.

The site being 250 feet above the railroad track, an inclined tramway was built up the hill from the railroad siding. Stone cars were unloaded by gravity into the Koppel tramway cars, which were hauled up the incline by a hoisting engine at the top of the hill. From this point the cars were run partly by gravity and partly by a mule team to the location of the concrete mixing plant, which was changed as required. This arrangement reduced the stone-handling gang to three men and the team, one to load cars below, one to run the hoisting engine and one to unload at the top.

Grade Crossings in Iowa

The State Highway Commission of Iowa is receiving the co-operation of the railroads in relieving the dangers of grade crossings, and plans are being made for eliminating the most dangerous, Page County being the first on attacked. No new grade crossings of railroads are permitted, and a recent problem in Woodward of the crossing of an interurban and the Milwaukee road was settled by dividing the expense of an overhead crossing by the interurban between the two roads.



SANITATION

Sewage Purification for Akron, O.

The City of Akron, Ohio, discharges its sewage into the Cuyahoga River, which later flows thru Cleveland into Lake Erie. On account of complaint concerning the deleterious effect of the sewage on the river, the city instituted a series of tests to determine the best method of treating the sewage of the city to produce a satisfactory effluent.

A testing station was erected on the recommendation of E. G. Bradbury, the engineer engaged to report upon the most practical and economical method of solving the sewage disposal problem, and Harry B. Hommon was put in charge of the experiments, with sufficient force of assistants. Grit chambers, Imhoff, Dortmund and septic tanks, sprinkling filters and contact filters were all provided and operated singly and in appropriate combinations.

Special observations and tests were made of the trade wastes from the rubber, salt, rubber reclaiming and paper manufacturing plants discharging into the sewers or directly into the river, and in general it was decided that there was little or no deleterious effect upon the river and no probability of interference of such wastes with any process of sewage purification tested.

The results of the tests have been printed in detail in a report by Mr. Hommon and the final conclusions as to the best method of treatment are stated as follows:

These tests have clearly shown that the sewage of the city of Akron can be successfully purified at a plant which would comprise:

1. A small grit chamber for the removal of sand.

2. Imhoff tanks of a capacity equivalent to a period of flow of about 2.5 hours, and sludge beds corresponding to an average net accumulation of about 1.4 tons of dry solids per million gallons. (Drying period—July 1st to November 1st.)

3. Sprinkling filters operated at the rate of 2,000,000 gallons per acre in 24 hours, and small settling basins of about 2 hours' flow, with ample means for the withdrawal of sludge.

4. Adequate means for the disposal of an accumulation in the settling basins of about 0.5 tons of dry solid matter per million gallons.

The evidence is conclusive that such a plant would purify the sewage of Akron in a most thoro manner, and under continued proper operation and efficient supervision would prevent all visible contamination of the Cuyahoga River below the outlet of the Akron sewers.

Separate and Combined Sewers in Their Relation to the Disposal of Sewers.

By John H. Gregory, Consulting Engineer, New York City.

In his paper before the American Society of Municipal Improvements of which this is an abstract, Mr. Gregory, wha is a member of the firm of Hering and Gregory, has clearly stated the principles upon which the design of sewers and disposal of sewage should be based, and it is an authoritative chapter upon this subject.

In the construction of a new sewerage system, or of new sewers, one of the problems which first arises is the question shall the sewers be built on the combined system, or partly on both. Two factors of the greatest importance are the questions of cost and of sewage disposal.

As a general proposition, where both sewage and storm water are to be removed it is probably safe to say that the cost of building a combined system is less than that of constructing a separate system, in which the sewage flows in one set, called sanitary sewers, and the storm water in another set, called storm water drains. This is especially true where the territory is more or less closely built up and the streets are paved. But in territory, not closely built up nor likely to be in the near future, and where the storm water is easily diverted into natural water courses, the separate system will in general cost less, for the sanitary sewers may be built first, the storm water drains being deferred, or only such drains built as are immediately required.

¶ COMBINED SEWERS *are advisable in many instances with the advantages here set forth.*

The character of the topography should not be overlooked. With steep grades and relatively high velocities in the sewers it might prove more advisable, on account of the relatively small additional cost, to build combined rather than separate sewers. In narrow streets and in congested districts combined sewers have one advantage by reducing the subsurface obstructions. With the separate system two pipes are required, and sometimes three, when a sanitary sewer is laid on each side of a storm water drain, built so close to the surface of the street as to prevent the carrying of house connections over it.

With the combined system, but one house connection is needed, whereas with the separate system, especially in closely built up districts with paved yards and areas, two are required, one for the removal of the sewage and the other of storm water from roofs, paved areas, etc. The practice of discharging storm water across the sidewalks to the gutters is not one to be recommended. The storm water is, however, sometimes removed by pipes laid just below the surface of the sidewalk and discharging at the gutter. Such pipes frequently give trouble, and often would not be low enough to drain paved areas adjacent to or in the rear of buildings.

Combined sewers are generally laid on flatter grades than separate sewers and may increase the area which can be served without pumping. They may even eliminate pumping entirely. It sometimes happens that combined sewers can be advantageously adopted for a part of the system and separate sewers for the remainder. The writer has in mind one of the large cities in the east where no pumping is required and in which three-quarters of the city is sewered on the separate system and one-quarter on the combined system because it was too low to be sewered on the separate system without pumping.

Higher velocities are required in combined sewers in order to prevent the deposition of grit. When deposits occur in combined sewers organic matter is likely to be held back and settle out or become stranded and may cause the sewage to be ponded and become stale, or possibly septic, a condition to be avoided, independent of whether the sewage is to be treated or not.

¶ THE QUESTION OF SEWAGE DISPOSAL *is of great importance where economy is essential.*

So far the subject has been considered without reference to the question of sewage disposal, one of the most important factors. If the sewage is to be discharged into a body of water without treatment, combined sewers would frequently offer the simplest and cheapest solution of the problem. If, however, the sewage is to be treated, separate sewers have certain advantages. It will be assumed here that the sewage must receive some treatment and that ample opportunity is afforded for the discharge of storm water without carrying any great distance.

Sewage treatment works cost money. It is therefore desirable to keep them as small as possible. Rarely, if ever, would all of the storm water have to be treated; hence the question of treating other than the first wash of the streets, in addition to the sewage, will not be considered.

With a separate system the volume to be handled at the treatment works is made up of house sewage, ground-water leakage and trade wastes. The flow may be increased in times of storm by taking in the first wash of the streets from the storm water drains should it be found necessary or desirable to treat the first wash.

With a combined system, under dry weather conditions, the volume to be handled ordinarily is also made up of house sewage, ground-water leakage and trade wastes. In times of storm, however, the flow in the combined sewers is increased by the storm water from the streets, which changes the character of the liquid flowing. The first wash from the streets is often exceedingly foul and may give a stronger sewage. As more storm water enters the organic content of the liquid is decreased, resulting in a weak or dilute sewage.

If only the dry weather flow is to be intercepted, then the volume to be handled at the treatment works would, in general, be substantially the same from the combined system as from the separate system. With the separate system no raw sewage escapes to the streams, while with the combined system a mixture of sewage and storm water must reach the streams.

It probably often would be the case, that as far as the temporary reduction of dissolved oxygen in the stream is concerned no harm would be done, but floating particles of paper and fecal matter are offensive to the sight. If the stream is sluggish it may easily be that the continued overflow of sewage into it, from time to time, with the accumulation of sludge deposits on the bottom, would lead to offensive conditions.

While considering the question of the overflow of raw sewage from combined sewers the point of view of the public should not be overlooked. They know that the sewage must be treated and their natural inference is that all of the sewage will be treated. But if the sewers are built on the combined system and the public sees raw sewage, even if dilute, discharged into the streams from time to time will they be satisfied? And will the state authorities be satisfied?

¶ INTERCEPTION OF EARLY STORM WATER *essential to satisfy observers who see sewage overflowing with storm water into stream.*

In order to reduce the number of times during the year that raw sewage would overflow, it might be planned to intercept some storm water as well as the dry weather flow. This would increase the size of the sewage treatment works, and their cost.

If it is found desirable or necessary to intercept and treat the first wash from the streets, the separate system is more advantageous than the combined system, as by its adoption no overflow of raw sewage to the streams will take place. The storm water drains receive only storm water and the first wash from the streets can be intercepted in the storm water drains and discharged either into the sanitary sewers, or into the intercepting sewer leading to the treatment works. As the flow in the storm water drains increases, the surplus water overflows to the streams but carries no sewage with it.

¶ SEPARATE SYSTEM MORE FLEXIBLE *in disposing of trade wastes, many of which are rather inoffensive.*

The separate system, under certain conditions, offers greater flexibility in the disposal of trade wastes than does the combined system, unless the first wash of the streets is to be intercepted and treated. Some trade wastes are offensive and if discharged into the sewers in such a condition must be treated. Some are inoffensive and can be discharged directly into the streams without causing any nuisance or trouble.

With the separate system the offensive trade wastes can be discharged into the sanitary sewers and the inoffensive wastes into the storm water drains. The offensive trade wastes only would then be carried to the treatment works. With the combined system all of the trade wastes, the inoffensive as well as the offensive ones, would have to be intercepted and carried to the treatment works, with the result that the treatment works would have to be somewhat larger in size, and hence would cost more.

With a community which is largely residential in character the volume of trade wastes would affect but very little the total sewage flow. With a manufacturing community, however, the trade waste might amount to quite a large percentage of the total flow and in extreme cases might equal in volume the house sewage. Under such conditions it is evident that, if any considerable percentage of the trade wastes is inoffensive, separate sewers would be of decided advantage as they would permit of the inoffensive wastes being discharged direct into the storm water drains.

With a combined system automatic regulators are generally used on the connections between the combined sewers and the intercepting sewer to limit the amount of flow from the combined sewers to the intercepting sewer. With a separate system automatic regulators are not required unless the first wash from the streets is intercepted in the storm water drains. Automatic devices in sewers, as a general proposition, no matter how well designed, are to be avoided wherever possible.

The presence of grit at a sewage disposal works is generally more or less of an annoyance, especially when the sewage has to be pumped and passed thru settling tanks. With combined sewers, receiving as they do storm water from the streets, a considerable amount of grit must be expected to reach the disposal works, not only during wet weather but during dry weather also. With separate sewers the amount of grit received at the disposal works is relatively small unless the first wash from the streets is intercepted in the storm water drains and carried to the disposal works.

It has been suggested that a considerable amount of grit could be prevented from reaching the disposal works from combined sewers by inserting a catch basin or sand catcher on each connection between the combined sewers and the intercepting sewer. It is probably true that such would be the case but it is a question whether this would be a good method of removing grit. In the first place these sand catchers would sooner or later fill up and unless cleaned at proper intervals would fail to serve the purpose for which they were built. Again, it is very probable that more or less organic matter would be deposited in them, especially when only the dry weather flow, consisting as it would mainly of sewage, was passing thru them.

The inserting of sand catchers between storm water drains and an intercepting sewer would seem to be a more practicable proposition. They would still have to be cleaned to make them effective.

¶ SAND-CATCHERS *in sewers before sewage enters intercepter are often best way to keep grit out of system.*

It is a question if the simplest way of handling the grit is not to admit it into the intercepting sewer from the combined sewers or storm water drains, without attempting to intercept any portion of it, and then to transport it with a good velocity in the intercepting sewer direct to the sewage disposal works. In any event enough grit is sure to reach the sewage disposal works to require its removal before the sewage is pumped or passed thru settling tanks, and the removal of grit at one point instead of at numerous points has many advantages.

With sewage from a combined system the volume of sludge accumulating in settling tanks is greater than with sewage from the separate system. It may even be nearly twice as much, as has been found to be the case by comparison of the quantities of digested sludge removed from different Imhoff tanks, some of which have been connected with combined systems and others with separate systems. The greater volume of sludge from the combined system may mean that less organic matter has reached the streams than would have been the case if the sewers had been built on the separate system. If, however, the first wash from the storm water drains of a separate system is intercepted and carried to the treatment works then the volume of sludge should be approximately the same as if the sewage came from a combined system.

¶ WHEN SEWAGE MUST BE PUMPED *economy requires that the least possible amount of storm water be pumped, tho the lift would probably be less in combined system.*

In many instances pumping is required in order to pass sewage thru a treatment works. It may even be that the sewage would be delivered at an elevation below that of the stream into which the effluent was to be discharged.

With a combined system the total height to which the sewage would have to be pumped would probably be somewhat less than with a separate system, but the difference would not be great. Some saving in fuel might therefore result from the adoption of the combined system, but the same operating force would be required in either case. So long as pumping is required the actual saving in cost due to pumping the sewage against a less head, due to the adoption of the combined system, would be slight compared with the total cost of pumping, including fixed charges.

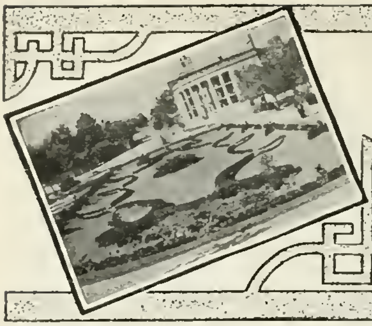
In conclusion no hard or fast rules can be given for the adoption of either the combined or the separate system. Each has certain advantages. These, as well as local conditions and cost of construction and operation, must be taken into account. Other things being equal, especially as more attention is being given to the question of sewage disposal, the separate system seems to offer greater advantages. With either system, however, to secure satisfactory results too much stress cannot be laid on the necessity of not only proper design, but satisfactory maintenance and operation.

New York Opposition to Passaic Valley Sewerage Plans

The clerk of the New York Supreme Court has demanded of the City of New York the advance payment of $18,175 for printing and court fees before it can appear to argue the suit against the Passaic Valley Sewerage Commission's plans for a trunk sewer emptying into New York harbor. There will be additional expenses carrying the amount to $26,000, and it is possible the new administration will not continue the fight.

Concrete Road Construction About Detroit, Mich.

The Wayne County road commissioners at Detroit, Mich., have made plans and specifications and are letting contracts for more concrete roads. The seven-mile road will be completed from Mack to Woodward. The old macadam on Grand River road will be replaced by concrete. Dix road will be concreted to the new bascule bridge over the River Rouge. Eureka road will be concreted for 6½ miles, completing it from Romulus to Wyandotte. West road will be concreted for 5 miles. Part of Belleville road, from Michigan avenue to Belleville, will be constructed. All roads but the Eureka road will be 24 feet wide, with 15 feet width of concrete. A few smaller jobs will be done as opportunity offers.



CIVIC BEAUTY

A Practical Civic Organization

The Commerce Club of St. Joseph, Mo., seems to be the first commercial organization to make the civic work of the city the duty of one of its main departments.

Municipal investigation has been done mostly by Bureaus of Municipal Research, such as are found in New York, Philadelphia, Chicago, Dayton, Milwaukee, Westchester County, Toronto, etc. These are backed by private subscriptions, but have no active membership, and in a great degree they lack that which is most essential, i. e., the co-operation and backing of a large club of well-organized citizens. Again, they have often failed financially after a few years, because they had no continuous sustaining body to aid them.

Civic work from a more strictly social viewpoint has usually been handled by charity organizations and societies. While these societies are often strongly organized in smaller cities, their organization from a business and "achieving results" standpoint is not comparable with organized commercial clubs.

The work of the Civic Division of the Commerce Club is a combination of the Bureau of Municipal Research and social agencies. It aims to aid in carrying out the entire community needs of the city and make the city an ideal one from a municipal and civic standpoint. At the same time it helps the city in carrying out its functions with the same economy, forethought and intelligence as shown in our private business.

An industrial commissioner, a traffic commissioner and a civic commissioner working together with ideals and a program will accomplish great things for St. Joseph.

One of its first efforts was a "clean-up week" set for May 11 to 17. A little circular announces the campaign over the signature of W. K. James, the vice president in charge of the civic division of the club, and in a proclamation by Mayor Elliott Marshall suggesting the things to be done and giving the co-operation of city officials and employes.

A full program of work is also given, which covers front and back yard cleaning, tree, hedge, shrub and vine planting, fences, walks, painting, whitewashing, gutters, sodding, screening and covering manure and garbage, filling holes and turning down vessels which might catch rain water, to prevent the growth of mosquitoes, screening doors and windows, providing and applying disinfectants, flyproofing and disinfecting outhouses and vaults, reporting bad conditions, offering vacant lots for flower or vegetable garden purposes, etc.

This is but the first step taken under the direct supervision of D. O. Decker, the civic commissioner of the club, and others will be announced in the monthly numbers of *The Optimist*, the new publication of the club.

Birmingham the Beautiful

Some sections of Birmingham, Ala., are so well designed and so well improved that no more beautiful streets, lawns and views can be found anywhere. The city has a very large area, nearly 43 square miles, in proportion to its population, about 160,000, and there are many open spaces, some of which are naturally very beautiful and require only a little care to keep them continually in good condition.

The executive department has assumed the promotion of a "city beautiful" movement which has for its object the enlisting of all the citizens in the work of bringing all of the city areas up to the high standard of the handsomest sections. This will be possible with their co-operation in all areas but those covered by the great slag piles of the furnaces, the railroad yards scattered about the city and the like.

But the large corporations have been interested in the movement, have promised their co-operation, and have made contributions to the expenses of the campaign. Steel works and railroads are showing already the results of this co-operation, available spaces being decorated with flowers and grass in increasing amounts, so that in two or three years a very great improvement in these large areas is foreshadowed.

Neighborhoods are encouraged to form city beautiful societies to organize the work in districts and the kinds of detailed work possible to individuals and groups are set out in a booklet giving the outline of the form of such organizations.

A circular makes additional suggestions as to hedges, objectionable and desirable trees, vacant lot cultivation, shrub and rose planting, methods of preventing damage by cattle, horses and chickens, use of the boy scout organization and the benefits of club co-operation by the employment of a worker to do work on streets common to the neighborhood or the purchase of such apparatus as lawn rollers, too expensive for one and useful to many.

The circular offers the services of the city as an employment bureau for men to do the work for those able to pay for it: to haul tree trimmings; to impound animals; to arrest and fine drivers allowing horses to bite trees, and the like; and offers street sweepings free for use as fertilizer. Fire department houses are made distributing points for plants, shrubs, etc., those having them to give away taking them there for distribution to those not able to pay for them. The city office serves as a clearing house for assigning vacant lots offered by their owners to children and others desiring them for cultivation.

A list of annual vines, flowers for various purposes, foliage plants, early and late, which is well classified for the different uses for which they may be desired, is given in the circular.

Another circular gives lists of prizes offered by the Birmingham Horticultural Society, amounting to $225, divided into several groups: e. g., greatest improvement in home grounds, school grounds, church grounds, sidewalk parking strips, rear yards, best porch box on dwelling porch, window box in business building; best appearing vegetable garden on home grounds. But one of the eleven prizes is in cash, the rest being appropriate shrubs, flowers, trees, fruit trees, plants, seeds, bulbs, fertilizer, tree surgery work or spraying, lawn mower, and porch box. The street railway companies have also offered prizes in three contests, amounting to nearly $500 in value, for work along their lines.

The city commissioners specially request every one to plant Enonymus Japonica along the street between the curb and the sidewalk, which remains green thruout the year. The city also offers a reward of $25 for the arrest and conviction of anyone mutilating or removing without permission any of the plants, shrubs or trees on public or private property.

The city commissioners are A. O. Lane, James Weatherly and George B. Ward. The city beautiful work is particularly in the charge of Mayor Ward.

The Postoffice Department, by special arrangement, delivered the printed matter to every inhabited house in the city addressed "To the Yard Beautiful from the City Beautiful," with one cent postage prepaid in cash under the permit system.

Why Not Collect the Tickets?

The city of Copenhagen is reported to have installed automatic machines at trolley stations in which passengers can deposit their used railway tickets with a coin valued at a half cent and get a numbered ticket in a monthly drawing of a municipal lottery, in which the prizes are goods of local manufacture. It is said to have operated to reduce the litter from the used tickets dropped in the street.

Park Extension in Waukegan, Ill.

Lake Front Park, in Waukegan, Ill., is being extended east of the city water works plant along the lake shore, the city having begun the surfacing and grading of the area by city teams. Cinders from the pumping plant have been spread to equalize the area and will be followed by a coating of black soil and grass planting. This park extension is made possible by the gradual drifting of sand into the harbor, forming a body of land more than a block long and wide.

Large Philadelphia Park Contract

The great improvements planned for the southern part of Philadelphia include the grading and improvement of League Island Park, work on which has been in progress for eleven years, and no part is yet available for use. Director Cooke has just awarded to Senator Edwin H. Vare, the lowest bidder, the contract for completing the improvement at $523,000. With the completion of Southern Boulevard this year and the letting of the first contracts for grade separations in South Philadelphia, long steps will be taken in the progress of that section of the city.

WATER

Conservation of Purity of Croton Water Supply

The present source of water supply for the City of New York, which will long be one of the sources from which it will draw, is the Croton River, the waters of which are stored in several reservoirs of various sizes, large and small. Its quality and the methods used to conserve it were described in a paper by George W. Fuller before the New York Section of the American Water Works Association, and Dr. Frank E. Hale, in discussiou of the same, and these discussions are here abstracted as applicable to many other surface waters stored in reservoirs or lakes.

The Croton water on average is of fair quality. The turbidity is usually moderate, averaging from 3 to 5 in the city; at times of heavy rains in the watershed, particularly when the level of the reservoirs is low, the turbidity may reach as high as 100.

The color is frequently high, running from 10 to 65 on the platinum scale. The watershed contains much swampy land, and the color is of vegetable origin. Odor is perceptible, and is sometimes very marked. Microscopic growths give the water a distinct taste, sometimes very disagreeable. Bacteria are moderate in number, particularly in the city, after the water is treated with hypochlorite of lime. The 1912 records show a range of bacteria at 37 degrees C. of from 5 to 1,200 per cubic centimeter. B. coli, in 1912, are found in 1 cc in 20 per cent. of the tests.

The average alkalinity is 32.

The pollution of the water is of various kinds.

1. The watershed is inhabited by about 25,000 people, whose sewage eventually reaches the reservoirs. Some part of these are provided with sewerage systems; a very small part of the population is provided with sewage disposal works.

To protect the water supply as far as is practicable, the city maintains four hypochlorite application plants in the watershed, located at Mount Kisco, Brewster, Lake Gleneida and Katonah Brook. In addition, all the water passing through the new Croton aqueduct is treated with hypochlorite at Dunwoodie in South Yonkers.

The city also maintains a force of 89 men, whose duty it is to patrol the entire watershed systematically, report on and see to the abatement of all nuisances or sources of infection they may discover, and operate the treatment plants. Of the above force, 28 men are regularly detailed and 61 are used for this service as occasion demands.

2. Microscopic vegetable growths discoloring the water and giving it a disagreeable taste and odor result from the swampy lands forming part of the reservoir system.

To reduce these as far as possible, copper sulphate is applied by the reservoir forces.

3. The watershed contains some 13 miles of railroad track within 300 feet of the flow line, and 18 railroad bridges aggregating 1,700 feet in length. The sewage from the passenger trains enters the reservoirs practically raw, and may often contain pathogenic bacteria. So far, it has not been practicable to enforce proper sanitary control over the wastes from these railroad trains.

The difficulties of asserting authority aud abating nuisances are considerable under existing laws, and make watershed protection harder than it should be.

4. Highway bridges, 19 in number, aggregating 4,200 feet in length, discharge their wash into the reservoirs.

5. Wash from roads and run-off from farm lands, and the existence of some 24 miles of swampy land, cause at times a heavy turbidity, and at times a marked color, bad odor and taste.

Typhoid fever has been moderate in New York, particularly of late years. The table gives death rates for New York City and other large American cities for the last thirty years.

The possible danger to the health of the community from infection from the polluted drinking water cannot be evaluated into definite figures. Typhoid statistics

TABLE 9

Annual typhoid fever death rates for various American cities. In deaths per 100,000 population

YEAR	CHICAGO	MILWAUKEE	DETROIT	CLEVELAND	BUFFALO	TORONTO	BOSTON	NEW YORK	MANHATTAN AND THE BRONX	PHILADELPHIA	BALTIMORE	WASHINGTON	CINCINNATI	PITTSBURGH	SAN FRANCISCO	ST. LOUIS	NEW ORLEANS
1880	34	37	......	44	......	44	42	25	......	58	59	54	70	135	34	40	24
1881	105	47	......	99	67	66	56	38	......	74	58	86	71	151	37	53	30
1882	82	32	......	68	69	71	57	32	......	73	47	66	55	158	61	45	33
1883	62	25	......	65	34	81	52	32	......	64	35	62	51	107	64	41	23
1884	56	31	......	60	42	63	56	29	......	71	42	76	56	70	58	42	25
1885	75	28	......	34	23	59	40	27	......	64	42	65	42	76	44	31	17
1886	69	30	39	56	28	46	34	26	......	64	39	71	54	68	19	30	13
1887	50	31	65	52	34	61	41	26	......	63	41	78	142	128	23	28	15
1888	47	42	46	47	29	52	40	23	......	77	42	87	70	87	33	31	19
1889	48	28	31	74	30	46	43	24	......	71	47	94	49	95	55	33	17
1890	92	41	19	69	40	93	35	22	......	64	59	112	69	132	44	31	21
1891	174	33	34	50	51	100	34	23	......	64	35	82	62	101	42	29	24
1892	124	30	94	59	34	47	29	22	......	40	44	89	40	100	32	93	20
1893	54	35	42	52	37	45	31	21	......	41	49	86	44	111	32	44	15
1894	38	25	28	29	59	26	29	17	......	33	47	91	55	56	37	34	29
1895	38	26	24	35	26	27	33	17	......	40	36	86	39	78	34	21	44
1896	53	18	23	43	20	27	31	16	......	34	38	58	52	62	26	20	33
1897	29	12	15	23	20	18	33	16	......	33	37	48	32	64	19	23	52
1898	41	17	22	34	27	16	34	21	......	52	36	71	33	73	41	17	66
1899	27	17	13	32	24	20	30	16	......	75	29	73	37	111	22	23	55
1900	20	17	27	54	26	20	26	21	......	35	35	78	39	144	13	29	40
1901	29	22	21	36	27	17	25	20	......	34	27	60	55	125	22	34	48
1902	45	15	24	33	33	13	24	21	......	44	42	78	62	134	27	37	45
1903	32	17	20	114	35	16	20	17	......	69	36	48	42	134	......	47	39
1904	20	14	20	48	23	23	23	17	......	53	37	47	79	142	27	36	36
1905	17	23	21	15	23	16	20	16	......	48	36	48	40	99	24	20	32
1906	19	31	24	20	23	26	20	15	......	72	35	50	70	130	......	17	30
1907	18	26	35	19	28	22	10	17	......	59	41	35	45	125	......	15	55
1908	16	17	22	13	20	20	25	12	11	35	33	37	18	45	......	14	33
1909	13	23	23	13	23	23	14	12	12	21	25	33	13	23	......	16	29
1910	14	45	20	19	20	41	12	12	11	17	42	23	6	28	......	13	32
1911	11	19	17	15	25	20	9	11	10	14	27	21	11	26	......	11	31
1912	8	25	18	6	11	12	8	10	7	13	24	22	7	13	14	14	14

New York includes Borough of Manhattan only through 1898—since 1898 Greater New York.

are a general indication of the average sanitary quality. A high typhoid death rate shows generally a dangerous water; a low rate, such as ours in New York, shows a water of safe average quality. It does not, however, show that the water may not, at some future time, become grossly polluted by bacteria-causing diseases such as typhoid or other intestinal diseases, in the watershed, and such infection may be transmitted to the city.

For some years the water reaching the city has been treated with hypochlorite, and the grosser sources of pollution in the watershed are individually treated. But, while such treatment we know to be fully effectual and reliable when treating a filtered water or a clear water of small organic content, it is only a rough palliation for waters such as the Croton.

Dr. Frank E. Hale states that the question of filtration has come up and been turned down. Filtration probably will come when the people demand it.

In lieu of filtration, we might run rapidly over the various means which are taken to protect the Croton supply. In the first place, there is continual inspection by the Sanitary Division, under Messrs. Coffin and Culyer. There are regular trips over the various watersheds, streams, reservoirs, etc., to observe physical signs of pollution, and these are abated.

Every case of typhoid fever on the watershed is recorded and carefully looked after. Disinfectants are furnished aud, if necessary, the cases are removed to the hospitals. All trains in passing over the watershed have their toilets locked in transit. Bridges over the reservoirs and streams are swept daily to remove the horse droppings, etc.

At several points on the watershed the sewage is treated, and besides, at several small places, chlorination is used. There is a disposal plant at Brewsters, with subsoil irrigation. At Mount Kisco there is an entire sewage disposal plant, comprised of a septic tank, contact beds, sedimentation and filtration beds, followed by chlorination, and the raw sewage goes thru the plant and comes out as clear as crystal and at times safe to drink.

In the Laboratory Division samples are taken weekly from the various sources of supply and analyzed, and also daily from the supply as it leaves Croton Lake, as it arrives at the city at 135th street, and further down in the city, at City Hall. Between Croton Lake and the city, at Dunwoodie, the whole Croton supply is continuously chlorinated.

¶ TASTE AND ODOR *coming from microscopic organisms is a serious trouble in Croton water which is minimized by proper management of drawing water and treating reservoir.*

Probably the greatest trouble we have with the Croton water is the taste and odor coming from microscopic organisms. We try to avoid this by drawing the water at a depth wherever possible and by treatment locally with copper sulphate. The speaker might say that the reservoirs are so deep that amounts are figured on the top 10 feet only in treating the water. We have also tried the last couple of years to improve the supply by drawing from Croton Lake at depths, in 1912 about 50 feet below the surface, and during the last year about 75 feet below the surface.

During 1912 the thermocline of which Mr. Fuller spoke was some 15 to 20 feet below the surface. During last summer there were two thermoclines, one about 20 to 25 feet and the second at 90 feet. Below 90 feet the water has been completely stagnant, but above 90 feet the draft at a depth has kept the water iu circulation.

Here are a few figures to show what the effect of drawing at a depth has upon the supply: In 1911 the temperature during the months of July, August and September at 135th street, that is, of the water as it reached the city, was 72 degrees; in 1912 it was 67 degrees; and in 1913, 65 degrees. The improvement during these three months was 7 per cent. At times the water was at least 10 degrees cooler than iu previous years.

The number of microscopic organisms in the water at 135th street in 1911 was 2,836; in 1912, 1,072, and in 1913, 677; in other words, less than 25 per cent of what it was two years previously. That this is due to drawing the water from the bottom is shown from the figures taken at Croton Lake. The surface of Croton Lake in 1913 had 1,405 organisms, against the 677 in the water at 135th street. The samples taken in the screen chamber of the gate house where the water is just starting for the city contained 635, as compared with 677 organisms at 135th street, showing that this benefit did come from drawing the water at a depth.

¶ CHLORINE TREATMENT *of Croton water removes practically all intestinal germs with ease.*

The treatment of the supply with chlorine at Dunwoodie seems to have been quite effective during the last year. As the water left the gate house at Croton Lake there was an average of 7 per cent. in 0.1 cc., 23 per cent in 1 cc. and 59 per cent. in 10 cc. tests for B. coli. When it reached the city it contained 0 per cent. in .1 cc.; 3 per cent. in 1 cc.; aud 23 per cent. in 10 cc. Comparing the tests by multiplying the 0.1 cc. tests by 100, the 1 cc. tests by 10, and adding to the 10 cc. tests, there was 95 per cent. removal of B. coli. In the same way during 1912 there was 90 per cent. removal of B. coli. This reduction was probably caused chiefly by the chlorine treatment.

George A. Johnson, in deploring the abandonment of the project for filtration of the Croton water, made the following statements regarding the limitations of the hypochlorite process:

In making a complete analysis of the practicability of this process, it is necessary to recognize the fact that it is not possible by the use of this germicide to overcome certain disadvantages, such as the following, which do not appear in connectiou with certain styles of water treatment:

1. Inability to remove or destroy all of the spore-forming barteria not considered to be pathogenic to man, at least, not those common to water.
2. Inability to remove bacteria which are embedded in particles of suspended matter.
3. Inability to remove turbidity.
4. Inability to remove appreciable amounts of color or dissolved vegetable stain.
5. Inability appreciably to remove organic matter.
6. Inability to remove swamp tastes or odors.
7. Inability to remove creosote tastes or odors coming from the cleaning of stills used in the destructive distillation of wood.
8. Inability to soften water; as a matter of fact, the addition of hypochlorite of lime usually results in a slight increase in the hardness of the water, altho this is not ordinarily measurable, notwithstanding the fact that the commercial product usually contains a little free quicklime, which reduces slightly the carbonic acid in the water.

9. Difficulties encountered in applying this process, except with the greatest care, to waters which contain substantial quantities of reducing agents or compounds capable of oxidation, such as nitrites and unoxidized iron.

The foregoing statements set forth the advantages and shortcomings of this process which, like other things that are new, is likely to be, and in some cases is, considered a cure-all for all water ills, no doubt with disappointing results in some cases.

The application of hypochlorite to water, while comparatively simple, should always be carried out with much care and fidelity by a competent analyst; otherwise, if the dose is not adjusted so as to meet satisfactorily all local conditions, there is liable to be alternately an underdose of the chemical insufficient to sterilize, or an overdose which will result in objectionable tastes and odors readily noticeable to the consumers, and due to the bleach itself.

The use of hypochlorites cannot be considered in the light of a substitute for filtration. Where waters are uniformly satisfactory in appearance, but open to suspicion as regards their content in bacteria, the use of the hypochlorite process alone in many cases may prove sufficient. ical appearance and are also polluted and Where waters are unsatisfactory in physrequire filtration, the combined use of filters and the hypochlorite process is called for. As an adjunct to filtration processes it has a distinct field of applicability, as hereinbefore stated, for at a moderate cost it is feasible to obtain a water which is practically above suspicion; and, furthermore, there is brought about a substantial economy in the first cost of the filtration plant. This is made possible by the use of higher rates of filtration than are ordinarily used, and the required filter area may therefore be reduced. It also effects a substantial economy in the cost of operation.

Reservoirs and Their Relation to Epidemics

Altho much of the recent paper by Professor W. P. Mason before the Franklin Institute is occupied very largely in stating the advantages of reservoir storage, it also contains some warnings of the care which must be taken of water in storage to secure the best results. The part of the paper on the necessity of preventing pollution of reservoirs by typhoid bacilli and other dangerous bacteria is abstracted in the following:

Stagnation has its disadvantages, of course. Increase in color naturally follows if water be permitted to remain long in contact with a muddy bottom loaded with soluble extractive matters. Not only is damage to the water's physical appearance a result of such contact, but the material passing into solution is likely to furnish abundant food for those minute forms of life which carry objectionable tastes and smells to many public waters.

The condition of "standing water" of being overstocked with vegetable growths is practically the only one toward which objection can point when considering the pros and cons of reservoir storage.

¶ VEGETABLE GROWTHS IN RESERVOIRS *give much trouble from taste and odor when they decay.*

The word "vegetable" is here to be taken in its broad sense, as it should include not only those growths which would be recognized by the public at large, but also those of the minute world as well, which latter constitute one branch of that lake life known as "plankton."

As an instance of excessive overgrowth, a small lake could be named, which is so loaded with dense vegetation that decay gets ahead of new growth, and the use of its water is productive of temporary diarrhoea. It is a stained water, but its color is not to be considered as a measure of its objectionable qualities for table use, as many water of much darker tint are of excellent quality for such purpose. Color and fitness for drinking bear no relation to each other.

It is true that colorless waters are now demanded by the people and "meadow teas" are growing in disfavor, but that change in public opinion is of recent date and is not based upon established hygienic grounds.

The deepening in color of the lower layers of a water stored upon an unclean bottom; the encouragement of growths of small organisms producing taste and smell by reason of an accumulation of extracted food suitable for their development; and a deficiency in dissolved oxygen in the bottom levels, constitute the sum of objections that can be raised to the impounding of water, and they are much more than balanced by the advantages that accrue from such storage.

The pollution from shore drainage that reaches a reservoir water is likely to be naturally much smaller in quantity than that received by a flowing stream; nevertheless, very serious pollution may occur in a concentrated form, even when the efforts of the caretaker are the most earnest. Thus, the writer has seen numerous loads of stable manure spread upon the very steep banks of a small cup-shaped distributing reservoir. The intention in this case was good, and much pride was taken in the fine lawns of the water works park, but a better choice of fertilizer could have been made for such a location.

¶ THE WATER SHED *of a public water supply reservoir should be policed carefully and sources of dangerous pollution removed.*

It is entirely possible to protect a reservoir, and, to a great degree, the watershed also, if careful policing of the district be established. Country towns situated upon the banks of streams tributary to the reservoir are the sources of greatest danger, and an earnest effort should be made to remove all privies, manure heaps, farm yards, refuse dumps and other sources of pollution from drainage into the stream or any of its feeders. This is sometimes difficult to accomplish completely, but a high degree of thoroness can be attained by suitable and tactful management.

Board of health rules are expected to cover care of public water sheds, but rules and laws will not enforce themselves, and the city official is commonly at a distance and more interested in the distribution system than in that of collection. The most simple arrangement would seem to be to appoint a local physician in each town or village upon the watershed as the sanitary inspector for that particular district, and to give him authority to employ an intelligent laborer as a sub-inspector, to do the necessary work under his directions.

The writer has found this arrangement both efficient and cheap. In one noteworthy instance, besides caring for the sources of pollution noted above, the sub-inspector's duty included the daily patrol of a mile of railroad track which ran along the border of the reservoir. This question of possible danger from railroad pollution has but recently been recognized. Altho it is always well worthy of consideration, there is no question but that it greatly varies in importance with change in topography, soil or season. Rocky, steep slopes are easily washed by the rain, and frozen embankments naturally fall into the same classification, while flat roadbeds and sandy soils offer better chances for polluting material to be disposed of by natural methods.

Whatever the character of the roadbed, it should be the sub-inspector's care to remove all night-soil dropped from passing trains, and he should exercise greater vigilance in winter than during summer.

The physician-inspector would be in a position to know of cases of disease, such as typhoid, in his district, and, being so informed, could take proper precaution against contamination of the public water, which act on his part would be of vastly more practical value than a location of the trouble by some sanitary commission after an epidemic was well under way.

¶ THE INSPECTOR *of the water shed should be a physician who could find the cases of dangerous intestinal diseases and care for them promptly and effectively.*

The greatest responsibility borne by the inspector, however, would be during periods when gangs of laborers were employed at construction work within the limits of the watershed. Should the workmen be many, and the time of their remaining be two weeks or more, nothing short of incineration of all camp waste and night-soil should be demanded, and the utmost care should be taken that sanitary instructions were carried out to the letter. A Woodruff pit, which can be constructed in a few hours, would be suitable for a temporary camp; while, if something more permanent were demanded, a well-constructed incinerating furnace should be built.

Dr. A. C. Houston, of the London Metropolitan Water Board, has undertaken some very extended researches upon the question of water purification as a result of storage. He found that in stored Thames water the death of typhoid bacteria took place rapidly, altho the rate varied with the temperature of the water. In cold water they lived longer than in warm, and 50 degrees F. seemed to be a critical point, above which their mortality rate was much increased.

In his seventh research report Houston states that typhoid bacilli lived in stored raw Thames water for the following lengths of time:

At start, 103,328 in each case.

Number of Typhoid Bacteria Remaining.

Temp., deg. F.	32	41	50	64
1 week	47,766	14,894	69	39
2 weeks	980	26	14	3
3 weeks	65	6	3	..
4 weeks	34	3	..	..
5 weeks	3	..	..	..

He concludes: "It is difficult to escape the belief that 30 days' storage of river water is tantamount to sterilization, so far as the microbes associated with water-borne epidemic disease are concerned."

Altho Dr. Houston is doubtless sound in his judgment that a great measure of safety will result from four weeks' reservoir storage of a polluted water, yet we must be assured that the period of storage is real and not simply apparent; or, in other words, we must know that all of the water really does remain in the reservoir for the specified length of time before it is used for public consumption.

If the lake be long, narrow and deep, and all of its water be obliged to traverse its entire length before being taken for supply, then the conditions would appear ideal for purification of the inflowing water before the outlet was reached, and yet even under these excellent conditions it is possible to have introduced unexpected and upsetting factors, as is instanced by the history of the typhoid epidemic at Auburn, N. Y.

¶ LONG - DISTANCE TRANSMISSION *of typhoid fever infection in one water supply is demonstrated and explained.*

Lake Owosso is one of the so-called "finger lakes" of Western New York. Its length is about 10 miles, breadth 1 mile, watershed 190 square miles, depth about 175 feet. A small stream enters its head, and Auburn, a city of some 30,000 inhabitants, has an intake located at the north end, or foot, of the lake and 40 feet below the surface. The temperature of the water at that point in May, 1913, I found to be 42 degrees F.

The peculiar feature of the case which has special interest here is the possibility of polluting material of a fecal character being transported from a village near the head of the lake down the inlet stream and then northward for the entire 10 miles of the lake's length to the Auburn intake, situated near the lake outlet.

We have all faithfully held to the dictum that "sedimentation and time" are the great purifying agencies upon which to rely for the natural improvement of a once polluted water, and it takes a good deal of evidence to persuade us that sewage of a small village could make the trip down such a lake in a length of time and in such a manner as to dangerously affect the water at the lower end. Experimental data, however, have been secured showing that such a result can actually take place. Investigation showed the following facts: The village sewage was, of course, small in volume, but during the winter months it was deposited at several points upon the banks of the inlet stream, and there it collected in a more or less frozen condition until the occurrence of the spring thaw, at which time there was opportunity for much accumulated fecal matter to be washed into the lake in a state of suspension. There was also a chance of its being actually ferried upon cakes of ice, for the reason that certain privies were located upon bridges and fecal matter was dropped upon the very center of the ice-covered stream.

As stated, the shape of the lake is long and narrow and its axis lies north and south. It must be further noted that the prevailing wind is from the south, with a tendency to blow the surface water directly toward the city intake at the north end.

¶ RELATIVE VELOCITIES *of surface and sub-surface currents in the lake were carefully determined.*

By means of triangulation and the use of floats constructed so as to be moved by water currents existing at the different depths of 5 to 20 feet, it was ascertained that the upper strata of water moved southward with the wind, as would have been expected. The rate of this movement being ascertained, it was found that with relatively light winds the movement of the water down to a depth of 5 feet amounted to about 3 per cent. of the wind movement, while at lower depths this water movement diminished to as low as 0.75 of 1 per cent. of the wind movement. Thus, to quote from the figures of Mr. Ackerman, who made these tests, with a wind movement of 6 miles per hour the percentage which the water movement was of the wind movement was as follows: At 5 feet depth, 3.2 per cent.; at 10 feet, 1.74 per cent.; at 15 feet, 0.87 per cent.; at 20 feet, 0.75 per cent.

With a higher wind velocity the water also traveled with a greater velocity, but its movement was then not so large a percentage of the wind movement. Thus with a wind blowing 17 miles an hour the water movement at a depth of 5 feet amounted to but 1.25 per cent. of that of the wind. From these data it was easy to calculate that pollution entering the head of the lake could make the trip to the foot of the lake in three days or less.

Knowing, as we do, from Dr. Houston's experiments, that cold water below 50 degrees F. will favor the longevity of the typhoid fever bacillus, it is easy to see how entirely possible it would be for living germs to reach the intake in dangerous condition.

There is no question but that this particular case, showing, as it does, the dangers that may arise from such winter accumulation, and showing further the possibility, under favorable conditions, of the transportation of such material over considerable distances in a lake, will cause many of us to materially amend our notions about the dependence to be placed upon lake and reservoir storage as a measure of protection against the evils following water pollution. We should not trust to simple storage without a thoro knowledge of just how it is being accomplished. The writer has in mind an instance of a large lake, some five miles in length, which has a stream entering within one mile of a city intake, and, because of the entering water having a low specific gravity, there is a possibility of it flowing over the surface of the lake toward the intake whenever the wind is in the right direction. The great length of that lake is, under the circumstances, of small value for purification purposes.

All of this certainly goes to show that we should be cautious about banking too strongly upon the efficiency of reservoir purification under all circumstances, and it demonstrates the necessity of our being well acquainted with the conditions surrounding each individual case before venturing an opinion on the matter.

It should be noted here that, in judging of the bacterial efficiency of lake or reservoir storage, the interpretation of the results of an examination may be obscured by an increase in the total count of bacteria reported due to the disturbing influence of the spring or autumn "turnover."

In conclusion, permit a word to be added concerning the value of storage as a protection against spreading disease thru the use of an "emergency" water supply. The underwriters very properly insist upon a sufficient fire service, which shall be available in the event of a temporary breakdown of the regular distribution system. It too often happens that upon such occasions a very inferior water is supplied by the "emergency intake," and as a result of its use there follows an outbreak of typhoid fever. Commonly, some old intake is allowed to remain in place for "emergency service," when pollution of the former supply has so grown in intensity as to force the authorities to seek a new source for public water.

Further fouling of this old supply goes on progressively as population increases, until after some years the water becomes practically dilute sewage. Suddenly some accident to the regular water system induces the authorities to open the old gates, and the result may be imagined.

Such has been the history of typhoid epidemics in a number of cities.

Storage for a sufficient length of time, supplemented, if necessary, by an appropriate dose of bleaching powder, will render even a poor water acceptable for emergency uses, and the reservoir capacity for such storage need not be large.

Municipal Water Supply for San Francisco

The Board of Supervisors of San Francisco has authorized test wells in certain districts not now supplied or poorly supplied with water, and will put in pumping plants if water is found to serve until the Hetch Hetchy system is completed.

The Spring Valley Company will extend pipe lines and furnish water to the extent of its capacity until the transfer is made, but cannot supply the demands in all the new districts.

American Motor Apparatus Used by Vancouver Fire Department

The report of the chief of the Vancouver, B. C., fire department shows that its equipment consists of eighteen pieces of automobile apparatus—two ladder trucks, eight hose wagons, one combination hose and chemical wagon, five chemical engines, one chief's car, and one assistant chief's car; one self-propelled steam fire engine, fourteen horse-drawn apparatus—four steam engines, two ladder trucks, five hose wagons, one combination hose and chemical wagon, and two chemical engines; and thirty-one horses.

Owing to the city's recent rapid growth, it has been enabled in purchasing to secure apparatus of the latest improved makes, and in consequence has an excellent equipment for a city of its size and population. The first automobile apparatus was purchased in 1908, and since that time whenever old apparatus was replaced or the demands of the city required increased equipment, this class of apparatus has been added. All automobile fire apparatus is of American manufacture.

Financing Amsterdam, Holland

It will require about $15,650,000 to operate the City of Amsterdam, Holland, for 1914, an increase of nearly $800,000 over 1913. As the city owns its gas, water, electric light and power, street railway and telephone systems, many of the docks and a large amount of ground in the business portion of the city, leased for building purposes, more than half this sum is raised from the proceeds of their operation, nearly two-fifths being from ground rents, and over one-fifth from the municipal public service plants. Taxes supply about one-third of the necessary funds.

ROADS AND PAVEMENTS

Progress of the Asphalt Industry

The annual reports of the General Asphalt Company to its stockholders are good indexes of the progress made in the asphalt industry, for that company practically controls three of the most prominent and valuable sources of asphalt, and has recently made some development of asphalt oils derived from wells in the same regions as the Trinidad and Bermudez asphalt lakes.

The business of the company is reported to have shown a heavily increased demand for asphalt and asphalt products during the first eight or nine months of the year, for road and street construction purposes, but the last months in the year showed a marked falling off, due to the difficulty in marketing their securities experienced by contractors as well as municipalities. The improvement in the market for such securities this spring promises good business for the year 1914.

The tariff of $3 a ton on refined asphalt and $1.50 a barrel on crude was removed by the tariff act of 1913, which will somewhat reduce prices for Trinidad and Bermudez asphalts hereafter.

The entire tonnage of asphalt sold and consumed by the company in 1913, reduced to a basis of crude asphalt and including Trinidad and Bermudez asphaltic products of all kinds, Trinidad liquid asphalt and its products, amounted to 312,222 tons, an increase of 7 per cent. over the preceding year and of 66 per cent. over 1909.

The use of asphalt for road work has increased very rapidly in recent years. In 1913 33,020 tons of Bermudez road asphalt were sold for such purposes, enough for 4,308,000 square yards of road surface, or 490 miles of roadway 15 feet wide. This is an increase of nearly 1,800 tons over 1913 and from only 1,500 tons sold in 1909.

Trinidad liquid asphalt has been on the market three years, and 3,601,322 gallons were sold last year, a little more than one-third the total amount sold.

Only 19,457 tons of gilsonite were shipped out over the company's railway to the district in Utah in which it is found, a falling off of some 40 per cent. from the shipments in 1912.

The Barber Asphalt Paving Company is the construction arm of the organization, and it seems to have been the policy in recent years to use the working capital of the parent company in the handling of asphalt more largely than in building pavements. As a consequence, the yardage of sheet asphalt constructed by the company in 1913 was 947,469 square yards, less than half the work done in 1911. The pavements built with other materials by the company in 1913 covered 533,032 square yards, only 55 per cent. of the work done in 1911. These figures do not include 586,413 square yards of pavement laid for private parties and repairs for which payment was received.

The company sold $1,471,247 worth of asphalt for other purposes than paving in 1913, a slight increase over the preceding year and nearly 50 per cent increase over 1909.

The length of the period for which pavements are guaranteed has been greatly reduced during recent years. Of the 1,480,501 square yards of pavement of all kinds constructed in 1913, 51.6 per cent. were without guarantee. Since 1905 the percentage of pavements laid without guarantee has increased from 6.4 to 51.6 per cent. The average length of guarantees on pavements laid has reduced in the same time from 7.2 years for those laid in 1905 to 2.45 years for those laid in 1913. There has been a consistent reduction in this figure each year except 1908, when there was an apparent increase of 0.2 year over the 5.0-year average of 1907. Nearly all the pavements guaranteed in 1913 were for the five-year period, 725,229 square yards, there being only 674 yards guaranteed for one year and 398 for three years. The yardage of pavements guaranteed is more than 200,000 less than the yardage of sheet asphalt pavements constructed, so that the omission of guarantees takes place with respect to sheet asphalt as well as

ONE OF THE OIL WELLS *of the General Asphalt Company on the Island of Trinidad, from the product of which Trinidad liquid asphalt is derived.*

with respect to other and newer forms of asphaltic pavements and roadways.

Of the guarantees expiring in 1913 on 3,124,773 square yards of pavement, over half, or 1,644,324 square yards, were for ten years, 764,764 for five years, 363,557 for fifteen years, and 206,982 for two years and the others in smaller amounts for one, three, seven, eight and nine years. The average length of the expiring guarantees on these pavements was 8.54 years.

The yardage of pavements still under guarantee has been reduced to 11,868,364, from nearly double that figure in 1907. Over half of this is for five years or less, and only 217,986 square yards for over ten years. There remain less than 150,000 square yards in all which are under fifteen-year guarantee, and but little over 5,000,000 yards under ten-year guarantee.

The most interesting part of the report is that covering operations for obtaining petroleum in Trinidad and Venezuela. The wells have been very difficult to complete on account of the large quantity of oil, the enormous gas pressure and the great thickness of the series of formations in which the oil is found. Notwithstanding these difficulties and consequent delay in finishing wells, the burning of the best well and a small outbreak of yellow fever which stopped all operations until it was stamped out, the crude oil produced in the year was 362,684 barrels, as compared with 247,208 barrels in 1912. Since operations were resumed in February the yield has averaged 1,000 barrels a day.

These oil wells are located in several groups near the famous Trinidad asphalt lake and are connected by pipe lines with the shipping stations to which the oil is in part pumped and in part runs by gravity.

In Venezuela nearly all the wells are in or on the borders of the Bermudez asphalt lake. The oil here found is very heavy, too heavy to pump, but it is under very heavy gas pressure, which causes it to flow out of the few wells which have been drilled. The heaviness of the oil and the enormous gas pressure make these wells hard to drill and to control. One well produces 1,000 barrels a day and another 600, tho neither of them has yet passed thru the whole of the series of oil-bearing formations.

The Yellow Pine Ring Rule

At a meeting of the Yellow Pine Manufacturers' Association in Chicago on May 5 the committee on grades made a favorable report on a proposed change in, or addition to, the grading rules relating to pine timbers, and the meeting accepted the committee's report. That action, however, did not constitute an adoption of the proposed change, but will serve to bring it before a future meeting of the association, which will have authority to adopt, modify, or reject.

The ring rule is not a new thing as applied to pine timbers. Its principle is well understood. It is based on the number of rings of yearly growth per inch on a line measured from the tree's heart to the bark. The recent purchase by the Panama Canal Commission of six million feet of southern yellow pine on an inspection based largely on the number of rings to the inch has brought the matter to the front at this time. There are four leading southern yellow pines, commonly called long leaf, short leaf, loblolly and Cuban. The first of these is usually of slow growth, with narrow rings. It is known commercially as hard or Georgia pine, and possesses great strength when the timber is of slow growth. The other three pines usually grow more rapidly, with wider rings; but any of the pines may grow slowly or rapidly, depending upon whether conditions are favorable or unfavorable.

The proposed ring rule does not favor or disparage any particular species of southern yellow pine, but is concerned only with the width of the growth rings. This is on the assumption that timbers with rings of the same kind are of the same strength, without regard to exact species. In connection with the number of rings to the inch, their character is likewise considered, with regard to the proportion of the ring composed of dense summer wood and of lighter spring wood.

The proposed rule has been favored because of its simplicity, and especially because it would remove a fruitful source of disputes and misunderstandings concerning the exact species of yellow pine. Anybody can count rings and measure with a rule, but it is not always an easy matter to determine the precise species of pine from which a timber was cut.

The Forest Products Laboratory at Madison, Wis., paved the way for the adoption of such a rule by making numerous tests of pine beams to ascertain their strength in relation to the width of the rings and the comparative quantities of spring wood and summer wood. The tendency of the tests all pointed one way, and showed that, so far as the southern yellow pines are concerned, strength is not a matter of species but of structure, and that two trees with similar rings do not differ much in strength, tho one may be long leaf and the other loblolly.

On a ring rule system of grading, timbers would be classed as "dense wood" and "not dense wood." A somewhat explicit definition of what dense wood is would necessarily form an important paragraph in the grading rules. The definition which the committee had before it at the meeting on May 5 was as follows:

Dense wood shows on cross section an average of not less than eight growth rings per inch, measured over the third, fourth and fifth inches, on a radial line from pith to circumference, containing in the greater number of rings one-quarter or more of summerwood; or it may have an average of six or seven rings as above, provided that, in the greater number of rings, one-third or more of the ring is summerwood; or wider ring material if in the greater number of rings, one-half or more of the ring is summerwood as above; and the ring must show a sharp contrast in color between springwood and summerwood.—*The Hardwood Record.*

Sprinkling Street Car Tracks in Clinton, Iowa

A little over a year ago the Clinton, Iowa, Street Railway Company received a new franchise to operate in Clinton for the next 25 years. A clause in their franchise provides that they shall operate a sprinkler car. The city had no money to use for the purpose of purchasing this car, so, in order that the citizens

CAR FOR SPRINKLING *the streets of Clinton, Iowa, purchased by popular subscription and operated by Street Railway Company under its franchise.*

might have this service, the Commercial Club raised by popular subscription along the lines of the street railway company an amount sufficient to purchase a sprinkler car, $3,500. The car cost complete on track ready for service $3,744.81. The capacity of this car is 3,000 gallons. It is equipped with four sprinkler heads and two flusher heads. It requires two men to operate the car.

The accompanying photograph shows the car ready for operation.

Modern Bituminous Surfaces and Bituminous Pavements

By Arthur H. Blanchard, M. Can. Soc. C. E., Professor of Highway Engineering in Columbia University, New York City, before the Canadian Good Roads Congress, May 20, 1914.

The various methods of using bituminous materials will be explained by the following definitions:

Bituminous surfaces are those consisting of superficial coats of bituminous materials with or without the addition of stone or slag chips, gravel, sand or materials of a similar character.

Bituminous macadam pavements are those consisting of broken stone and bitutails of the original construction. It has been found that a road with a thoroly rolled and well-puddled broken stone wearing surface composed of road metal from 1 inch to 2½ inches in longest dimensions may be easily cleaned and the minous materials incorporated together by penetration methods.

Bituminous gravel pavements are those consisting of gravel and bituminous materials incorporated together by penetration methods.

Bituminous concrete pavements are those having a wearing surface composed of stone, gravel, sand, etc., or combinations thereof, and bituminous materials incorporated together by mixing methods.

Bituminous Surfaces.—In the case of broken stone and gravel roads, the most efficient method of procedure is to thoroly clean the surface by sweeping with hand brooms or horse sweepers and hand brooms, the final sweeping being done with bass or other fine fiber brooms. The bituminous material, which is generally heated, is applied to the surface in amounts varying from one-quarter to one-half gallon per square yard, with the aid of pouring cans, hose attached to tanks, hand-drawn gravity distributers, horse-drawn or motor-truck gravity or pressure distributers. Some kind of mineral coating is generally applied to cover the bituminous material. The degree of cleanliness of the surface obtained by sweeping will depend to a large extent upon the de-essential adhesion of the bituminous surface readily secured. This method is characteristic of the modern practice of many of the foremost English and French engineers.

Considerable development has taken place in the use of different kinds of bituminous materials. Tars, both of the water gas and coal gas types, continue to be used to a large extent. There has been noted a growing objection to the use of certain asphaltic oils which require from two to three weeks to "set up" to such an extent that tracking will not occur.

Bituminous Macadam and Bituminous Gravel Pavements.—Bituminous macadam and bituminous gravel pavements are of many types, one of the primary differences in construction being the use of one or two applications of the bituminous material. The efficacy of many of the types depends upon the combinations of sizes of broken stone or gravel and the combinations of bituminous materials used when two applications are employed. Variations in types also exist, dependent upon the manner in which the different courses may be filled and the treatment of the filled course prior to the application of the bituminous material. The one-application method is very similar in its simplest form to the construction of a bituminous surface, except that the bituminous material is applied upon a much more open surface. In the case of the two-application method in certain instances an attempt is made to build up a two-course pavement, while in others the second application is in reality used as a seal coat.

Two methods of construction which have given satisfactory results will be cited as examples of modern practice.

When the metaling in the wearing course consists of a naturally graded aggregate ranging in sizes from one-half inch to an inch and one-quarter, it has been found unnecessary to further fill the voids by the application of a finer product before the first application of the bituminous material. The character of the product referred to above is shown by the following mechanical analysis:

Percentage passing ½-in. screen....	18.9
Percentage passing ¾-in. screen....	43.1
Percentage passing 1-in. screen.....	34.4
Percentage passing 1¼-in. screen...	3.6
	100.0

After the wearing course has been thoroly rolled, from one and one-quarter to one and three-quarter gallons to the square yard of bituminous material is uniformly distributed. Stone chips, free from dust, are then distributed to fill the surface voids. After the chips are rolled a seal coat of one-half to one gallon per square yard of bituminous material is applied. The pavement is finished by the rolling of a second application of stone chips.

As the second method will be described what the speaker considers the most satisfactory type of bituminous macadam pavement at present constructed in England. The bituminous pavement referred to is known by the name of "Pitchmac," and was designed by the city engineer of Liverpool, John A. Brodie, M. Inst. C. E. The following description of the standard method employed in Liverpool is given by Mr. Brodie:

"Pitch-grouted macadam has been found to give most satisfactory results in streets of medium and light traffic, and is now being largely used in place of ordinary macadam, and also of more expensive pavements. It is laid to a depth of from 3½ inches to 4½ inches, in two layers. Welsh granite macadam is used, broken to a 2½-inch gage for the lower layer and to 1½-inch for the top surface. Each layer is put down dry and continually rolled before and after the grouting of pitch and sand mixture has been applied, until the surface is thoroly consolidated. The foundation is generally of hand-pitched rock, 10 inches deep, as for ordinary macadam, but in some cases a bed of 6-inch concrete has been used on main roads. Pitch macadam is also being much used as a surface covering for old boulder pavements, many of which still exist in Liverpool in old streets where the traffic is very small. The cost of pitch macadam may be taken at 1s. (24 cents) per square yard per inch of depth."

Bituminous Concrete Pavements.—The simplest type is one having a mineral aggregate composed of one product of a crusher, that is similar to the product in the usual type of portable crushing and screening plant, which passes over one screen and thru the larger holes of the adjacent screen. This broken stone, in certain cases, may be somewhat uniform in size, but usually such is not the case. In the speaker's opinion, an essential element in the construction of this type of bituminous concrete pavement consists in using a product of a crusher which will have a range from an inch to an inch and a quarter in its sizes. As an illustration will be cited a mechanical analysis of a product which was obtained from a plant where the broken stone passed over a ½-inch screen and thru a 1¼-inch screen.

Percentage passing ⅛-in. screen....	1.2
Percentage passing ¼-in. screen....	4.2
Percentage passing ½-in. screen....	34.7
Percentage passing ¾-in. screen....	40.6
Percentage passing 1-in. screen.....	17.3
Percentage passing 1¼-in. screen...	2.0
	100.0

It is apparent that the above product

would not be referred to as composed of uniform sized stone. It is of interest to note that certain bituminous concrete pavements, having a width of 25 feet, constructed with this product of broken stone in 1911, have been subjected to an average daily mixed traffic of 2,000 to 3,000 vehicles, and are at present in excellent condition, with no maintenance charges to date.

This type of bituminous concrete pavement has been constructed for many years by using either one, or, in certain cases, several courses of broken stone mixed with bituminous cement. As an illustration of the latter method will be cited the practice of one large construction company which builds this type of pavement. The first, or bottom, course, of metal coated with bituminous cement, ranges from 1¼ inches to 2½ inches; the second course, from ½ inch to 1¼ inches, and the third course, from ¼ inch to ½ inch. The pavement is finished with a dressing of uncoated chips.

Asphalts, tars and tar-asphalt compounds have been used for the bituminous cement. In some cases one kind of bituminous material has been used in the mix and another kind for the seal coat, one of the most common combinations being the use of tar in the mix and asphalt for the seal coat.

The second type usually consists of the broken stone composing one product of a crusher and sand or other fine mineral matter mixed together with a bituminous cement. The wearing surface of this mix is sometimes finished by rolling in fine stone chips, but generally a seal coat is used, together with fine mineral matter, for a top dressing. When constructed on a commercial scale, the mineral aggregate is always heated and mixed in a specially constructed machine. Usually the same grade and type of bituminous material is used for the mix and the seal coat.

In the third type of bituminous concrete pavement the composition of the mineral aggregate is definitely covered in properly drawn specifications. As an example may be cited the following method of covering the composition of the mineral aggregate of Warrenite, a proprietary pavement of the Warren Brothers Company, which was used by William H. Connell, chief of the Bureau of Highways, in drafting specifications for the city of Philadelphia:

"Material passing 1¼-inch screen and retained on No. 2 sieve, 40 to 60 per cent.; material passing No. 2 sieve and retained on No. 4 sieve, 10 to 20 per cent.; material passing No. 4 sieve and retained on No. 10 sieve, 10 to 5 per cent.; material passing No. 10 sieve and retained on No. 30 sieve, 10 to 5 per cent.; material passing No. 80 sieve, at least 25 per cent. of which will pass a No. 200 sieve, 10 to 5 per cent. The balance to pass No. 30 sieve and be retained on No. 80 sieve."

The 1914 specifications of the state of New Jersey contain the following description of the grading of a bituminous concrete pavement similar to the one given above:

Passing 1½-in. and retained on 1-in. mesh	0 to 15 %
Passing 1-in. and retained on ½-in. mesh	40 to 50 %
Passing ½-in. and retained on ¼-in. mesh	10 to 25 %
Passing ¼-in. and retained on a 10-mesh sieve	8 to 15 %
Passing 10 and retained on a 30-mesh sieve	12 to 22 %
Passing 30 and retained on an 80-mesh sieve	5 to 15 %
Passing 80 and retained on a 200-mesh sieve	3 to 8 %
Passing a 200-mesh sieve	2 to 8 %
Bitumen content	6.5 to 8.5%

As another illustration might be cited the well-known Topeka specification, which covers a definite grading of a mixture of broken stone and sand. The Topeka grading is as follows:

Percentage of bitumen, from	7 to 11
Percentage of mineral aggregate passing 200-mesh screen, from	5 to 11
Percentage of mineral aggregate passing 40-mesh screen, from	18 to 30
Percentage of mineral aggregate passing 10-mesh screen, from	25 to 55
Percentage of mineral aggregate passing 4-mesh screen, from	8 to 22
Percentage of mineral aggregate passing 2-mesh screen, less than	10

In the construction of all types of bituminous concrete pavements, in addition to the requirements covering the properties of the bituminous cement and the quality and character of the mineral aggregate, certain essential features should be given careful consideration. The following citations from the 1914 Report of the Special Committee of the American Society of Civil Engineers are especially pertinent:

"Where the character of the traffic justifies the use of a bituminous concrete pavement, the same conditions demand an extraordinarily strong foundation therefor.

"The amount of bituminous material to be used in any case will depend upon the peculiar conditions of that case, such as the kind of road metal and of bituminous material, the character of the aggregate, the climatic conditions, etc.

"The character of the mineral aggregate to be used may be controlled by local conditions, but the best results can only be obtained by the use of the best materials. Excessive sizes, or excessive variations in the size of the mineral particles, should be avoided, and the utmost care must be taken to avoid the segregation of the different sized particles.

"Mixing machines should be used, and hand-mixing methods should be avoided wherever practicable.

"In the use of a heated aggregate for the construction of a bituminous concrete pavement non-uniformity or excess in the heating of stone should be avoided.

"Where bituminous pavements are laid, the edges should be protected and a sudden transition from the pavement to any softer shoulder material avoided by means of cement concrete or other edgings and such reinforcement of the shoulder material as may be necessary."

Good Roads a Factor in Real Estate Values

According to the *Newark News*, the construction of improved roads and the possibility of other new highways connecting all the important towns of Sussex county, N. J., figure in increase of real estate values at many points in the county. It has a great deal to do with keeping the real estate market going. Some deals result purely from a desire of the purchaser to deal in "futures." The new owners are improving the properties in a number of cases.

Concrete Paving for Buhl, Minn.

After watching a moving picture exhibit of methods of building concrete roads, a meeting of the citizens of Buhl, Minn., decided almost unanimously in favor of concrete roads. The Council used this means of learning the public sentiment, and will do a large amount of work this year. The bill for the portion of the paving between the tracks will be paid by the interurban electric railway running thru the city.

Subway for Buenos Aires

The city of Buenos Aires, Argentine Republic, recently opened the first two-mile section of a subway system which, when completed, will extend eight miles and connect all parts of the city. The running time between the two important plazas connected by the subway has been cut in two and is now 15 minutes. A unique feature is distinguishing stations by finishing each one in different colored tiles, one sky blue, one yellow, one green, etc., there being a station about every three blocks. Transfer tickets between surface lines and subway cost 2 cents.

The City Manager

The Engineer's Club of Cincinnati was addressed May 21 by Henry M. Waite, city manager of Dayton, and formerly city engineer of Cincinnati, on "The City Manager Form of Municipal Government." Mr. Waite said in substance:

"The city governed by a commission and city manager is analogous to any of our large corporations. The people are the stockholders. The commissioners are the directors and the city manager is their representative selected to conduct the business in the most efficient manner possible.

"Since both the commission and the city manager are subject to recall after six months in office, the people have every means to enforce their wishes fully.

"No serious drawbacks in the Dayton charter have yet developed.

"Elimination of politics from municipal affairs eliminates the need for civil service.

"When appointments are made on a strictly merit basis, greater efficiency may be obtained without civil service than with it. Civil service is necessary in the federal form of municipal government in order to eliminate partisan appointments.

"With the advent of the commission-city manager form of municipal government, there has been opened up a new field for the engineer. His is an ideal training for solving most municipal problems. He is a trained economist and efficiency expert. Inquiries come daily to the Dayton commission and city manager from universities, colleges and technical schools, asking for information upon which to base plans for new courses in city management and municipal engineering.

"Cincinnati with its municipal university and its co-operative courses has an ideal opportunity to offer courses for the study of municipal management to its students."

Municipal Lighting Plant for South Hadley, Mass.

A special committee of five, appointed at a special town meeting of the citizens of South Hadley, Mass., to investigate the matter of municipal lighting for the town recently made a report unanimously in favor of the establishment of a municipal lighting plant. Their engineer, William Plattner, of North Attleboro, goes into details concerning all parts of the problem and bases his report of cost on the purchase of the existing private plant and of his recommended improvements, making a total, with salvage, of $27,000. The town has about 250 street lights.

MISCELLANEOUS

British Municipal Ownership

Albert Halstead, United States consul at Birmingham, England, has made a careful and non-partisan report on the operation of public service industries by municipalities in England, which shows the general features and results apparently in a very fair way, which is confined to statements of fact and not of opinion.

There are many more cities in the United Kingdom supplying gas, electricity and street railway service than in the United States, and a fully equal number supply water, public markets, sewerage, etc. Many British cities also build and rent workmen's dwellings, a development which has not yet been started in this country.

Mr. Halstead states briefly the general objections to and points in favor of municipal ownership of public service utilities and the influence of the differences in the conditions in England and America upon success or failure in the one as compared with the other. He states that in some cases municipal undertakings have been managed most unsuccessfully and shown a great loss. Reference is made to undertakings from which a profit should be made under careful management. In these cases there has been slackness in management, waste, or unbusinesslike practices. Such instances have been characteristic only of small undertakings and in localities where it was difficult to get capable experts to conduct them, or where the managing committees seem to have been inefficient. There are also a few and isolated instances in which municipalities, after undertaking to perform such services, have sold their plants to private companies. Real failures are, however, strikingly fewer than the successes, and cases of resale to private companies do not equal those where undertakings have been recently purchased by local authorities.

An examination of the table of deficiencies on trading undertakings shows that the losses on same are very largely confined to the provision of water. In the United States the provision of water might not generally be regarded as a public service on which profit was ordinarily to be expected, but would probably be considered as one that should be classed with ordinary sanitary services, such as sweeping of the streets, removal of refuse, the construction of sewers, etc., for which it is proper, if necessary, to tax the community.

However, the provision of water by American municipalities is not generally a heavy charge, and at times affords a slight profit, and that, too, when the ordinary cost of the water supply to the communities in the United States is much less than the charge made in the United Kingdom. Therefore, where the provision of water causes a charge upon the taxpayers in England to subtract this deficit from the profits of other undertakings might not be regarded as fairly indicating the profitable results of municipal trading. In the case of the City of Birmingham, the cost of the water supply over the revenue obtained for it is exceedingly high, aggregating £74,968 ($364,822) for the last municipal year. That charge, however, is due to the fact that Birmingham, in order to obtain a supply of water to meet present and prospective requirements, was compelled to go eighty miles into Wales, purchase a large area of ground, build very costly aqueducts, receiving reservoirs, etc. When Birmingham was considering making an additional water supply, estimates of the cost were obtained. Unfortunately, the estimates were too small, largely because of the character of country from and thru which the water had to be conveyed, and of the earth structures where dams had to be built. Consequently, the cost of the supply was very heavy. Loans for most of the works had to be for a period of sixty years from the date of borrowing. This makes provision for sinking fund and interest yearly very large, and a heavy charge on the undertaking. Tho water rates are high from the American standpoint, the revenue does not meet unavoidable charges, and hence the large deficit. A further pipe from Wales being required, the cost of the rates of Birmingham water supply promises to be still greater. The water, however, is of most excellent quality.

Workmen's dwellings do not constitute a charge on the rates in Birmingham, or, as a rule, it is said, in other cities. Nevertheless, this is partially a sanitary provision. In the late seventies the City of Birmingham purchased a slum area and constructed a business street through the same, retaining the freehold of the same. For this purpose money was borrowed. The loans have not become due, so the interest charged on the same and the necessity for providing for the redemption of the loan when due constitute a charge on the revenues of the city. However, the construction of this business street, which is now one of the most important in the city, created a ratable or taxable value from which is obtained more than enough in rates and taxable value to pay the interest and sinking fund charges. In the accounts this does not show, so the scheme is made to appear a loss. When the leases fall in, the buildings erected under those leases will become the property of the city, and a very valuable asset, the revenues from which will equal at least £100,000 ($486,650) a year. In these circumstances it is not wholly just to charge the interest and loan redemption expenses of this striking city undertaking—one of the finest examples of town planning—against profits from the gas, electricity, street railway and markets undertakings.

It has been indicated that water rates are higher in England than the United States. On the contrary, those for gas are generally much lower. For short distances in England street car fares, which are based on the distance traveled, are much cheaper; but for long distances considerably higher. Municipal gas and electricity departments show much enterprise. Street car services are good, but, on the whole, the cars are not as good and the services sometimes not up to the American standard.

In the tables accompanying the report are statements of the losses or gains in each municipality from the municipal operation of markets ,gas, water, electric light, tramways, estates owned including municipal housing, and other methods of municipal trading. Of 116 cities included in the column of totals 91 showed profits running from $1,012 in one small town to over $900,000 each in Liverpool and Manchester. If the losses on water supply are not included, five or six cities would move over to the list of those showing profits and some twenty would have their showing of profits increased. The tendency to handle water works as a sanitary measure, with only secondary attention to profits, is shown by the fact that of the 61 water works in the list 25, or over 40 per cent, showed deficits in their operations.

The percentage of unprofitable plants runs about 4 in markets, 10 in electric light plants, 23 in street railways, 8 in housing schemes and less than 2 in gas plants. These figures are interesting from another point of view. Water rates are higher in England than in the United States, but the unprofitable water plants are numerous in England. Gas rates are much lower in Engalnd than in the United States, and there is but one unprofitable plant in the 51 municipal plants listed. Gas rates run from 26 cents per 1,000 cubic feet for domestic lighting in Widnes, population 32,256, profits $1,698 in the year, to 87 cents in Lowestoft, population 34,729, operated by a private company. The highest price reported from a municipal gas plant is 83 cents a thousand cubic feet for domestic lighting supply in Kings Lynn, population 20,200, the financial results of which plant are not reported.

The report in full is published as House Document 710, 63d Congress, 2d Session.

Regulation of Capital and Rates of Public Service Corporation

A report on the regulation of public service companies in Great Britain, with supplementary chapters on the Boston sliding scale and Toronto auction sale and maximum dividend plans, by Robert H. Whitten, Librarian-Statistician, New York Public Service Commission for the First District, New York, is reprinted from annual report of the Public Service Commission for the First District of New York and distributed separately.

This report is the result of some six months' special investigation and study undertaken by Dr. Whitten in behalf of the Department on Regulation of Municipal Utilities of the National Civic Federation. The material having served the purposes of the Federation is now published by the New York Public Service Commission in the hope that it may prove suggestive in the study of a number of the problems in public service regulation.

In this report Dr. Whitten has treated phases of the regulation of public service companies in Great Britain that are of peculiar interest in connection with our own problems. He has selected for special study those phases of control that seem to offer most in the way of suggestion in the solution of American problems. His report is not, however, a mere statement of British institutions but in the case of such important questions as the sliding scale of rates and dividends, the sale of premium shares at auction or by public tender, and the audit of company accounts, it presents a careful and discriminating discussion of the general principles underlying these methods of control and of their applicability to American conditions.

The British sliding scale system for the automatic regulation of the rates of charge and dividends of gas companies is coming to be looked to by many as a remedy for the uncertainties and possible evil effects of our present system of occasional rate regulation. Dr. Whitten's analysis of this important subject is the most complete that has yet appeared. He has made a particularly searching inquiry into the proper basis for the apportionment of the savings or profits between the shareholder and the consumer. Dr. Whitten recommends certain changes in the sliding scale system as applied in England and Boston but on the whole considers that it has important advantages over the American system of occasional rate regulation. He, however, develops a new system of control which he calls "the merit rating method," and which he recommends as superior to either of the above. Under the merit rating method the state commission "will periodically rate the companies on the basis of comparative efficiency in serving the public and allow them to earn dividends varying with such efficiency." This is a new and interesting suggestion and is worthy of most careful consideration by all who are interested in the general problem of public service control.

Public attention has recently been directed to the very large share of the profits of industry that is at present going to the financier. This is particularly true of the public utility industry. Mr. Whitten states that in this country the financier seems to be getting the lion's share of the profits of public utility enterprises. In England, on the other hand, the services of the financial middleman are in large measure dispensed with thru the sale of new securities at auction or by public tender. Under this method a premium stock is sold at its actual market value and all premium realized is used for betterments and additions to plant. The author discusses at length the advantages and reputed disadvantages of this system of financing. He strongly recommends its adoption. In this, British experience is reinforced by the very favorable experience of the Consumers' Gas Company of Toronto.

In connection with financial manipulation and control Dr. Whitten notes the general absence among English public service companies of the holding company and of the intertwining and interlocking of directorships for the purpose of common control. He suggests that the limited voting power of the large shareholder may be responsible for this condition. In various large public service companies there is a prescribed voting scale and no person no matter how large his holdings can have more than the prescribed maximum of votes (5, 10 or 30).

Effective supervision of public service companies has been promoted more by the enforcement of uniform accounting than by any other single factor. In England the practice has developed of having public service company accounts audited each year by an outside public accountant, elected either by the shareholders or by the Board of Trade. In this country the public service laws often give the state commission authority to audit accounts. This is a valuable power but it is recognized that it is impracticable for a commission to annually audit the accounts of all the companies within its jurisdiction. The author suggests the advisability of requiring each company to have its accounts audited by a qualified outside accountant. The proposed model law submitted by the Department on Regulation of Interstate and Municipal Utilities makes a start in this direction by giving the commission power to require a company to have its accounts certified by a public accountant.

Materials of Engineering Construction at the International Engineering Congress, 1915

Among the general subjects to be treated before the International Engineering Congress, 1915, probably the one having the broadest interest is that of Materials of Engineering Construction, which enters into all phases of engineering activity.

The list of topics which will be treated in this section is as follows:

1. Timber.
2. Preservative Treatment of Timber.
3. Substitutes for Timber in Engineering Construction.
4. Brick in Engineering Structures.
5. Clay Products in Engineering Structures.
6. Probable and Presumptive Life of Concrete Structures Made from Modern Cements.
7. Aggregates for Concrete.
8. Slag Cement.
9. Waterproof Concrete.
10. Cements Containing Additions of Finely Ground Foreign Material.
11. Economics of the World's Supply of Iron.
12. The Life of Iron and Steel Structures.
13. The Employment of Special Steel in Engineering Construction.

14. The Place of Copper in the Present Engineering Field, and the Economics of the World's Supply Thereof.
15. Alloys and Their Use in Engineering Construction.
16. Aluminum in Engineering Construction.
17. The Influence of the Testing of Materials upon Advances in the Designing of Engineering Structures and Machines.
18. Cement Testing.
19. Testing of Metals.
20. Testing Full-Sized Members.
21. Proof Testing of Structures.

The papers to be presented from the United States have already been arranged for from the recognized leading authorities no the various topics. Arrangements for the papers from foreign authors are being rapidly concluded, and the aggregation of papers which will be presented will constitute a broad review of the field and be of the highest value.

Marked interest in the congress from foreign countries continues, and there is every evidence that the attendance from abroad will be large. It is hoped that all engineers in this country who have not yet subscribed as members of the congress will give the matter their immediate attention and favorable action.

Full information concerning the congress, the price of subscription and the arrangement for purchase of volumes of the proceedings may be obtained by addressing the Committee of Management, as follows: International Engineers Congress, 1915, Foxcroft Building, San Francisco, Cal.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places, as follows:

June 17, 18: Mining draftsman in Bureau of Mines, Pittsburg, Pa., at $1,080 to $1,200 a year; mechanical draftsman in Patent Office, Washington, at $1,000 a year; Coast and Geodetic Survey aid at $900 with promotions in grades up to $4,000 a year.

June 17: Expert radio aid in navy yard at New York at $6 a day.

June 29: Senior highway engineer at $2,220 to $3,000 a year, and highway engineer at $1,800 to $2,100 a year, in Office of Public Roads, Department of Agriculture.

July 8, 9: Structural engineer and draftsman in office of supervising architect, Treasury Department, at $1,600 to $1,800 a year; first-class structural draftsman in Panama Canal service at $150 to $175 a month.

Technical Societies

The annual ladies' night of the Engineers' Club of Cincinnati, on Thursday, June 4th, at the auditorium of the University of Cincinnati, is devoted to an address illustrated by motion pictures on "Manufacturing of Tubes," given by a representative of the National Tube Co.

A determined effort is being made by the technical press of the South to bring a large representation to the American Road Congress, to be held in Atlanta, Ga., in November. While there are some very excellent roads in the South, the general average is not high. Special attention will be paid in the program of the congress to these problems of road building under the conditions existing in the southern states.

The Philadelphia convention of the American Water Works Association was one of the largest yet held, over 900 having registered. The features of the convention were the day devoted to the active operators of water works plants, the formation of a section by the chemists and bacteriologists, and the large interesting exhibit of water works apparatus, machinery and materials. A proposition to establish permanent headquarters in New York City was not approved. George G. Earl, of New Orleans, was elected president, and Nicholas S. Hill, Jr., of New York, was elected vice-president. Cincinnati will be the next place of meeting.

The Society for Electrical Development, 29 West 39th street, New York City, has opened a competition to employes of members for the best story, article or report on any subject pertaining to commercial electricity, which closes September 1. There are eight prizes, ranging from $250 to $10.

The Northwestern Road Congress, covering mainly the states of Illinois, Michigan, Iowa, Minnesota, North and South Dakota and Wisconsin, will meet in Milwaukee, Wis., October 28 to 31. One of the principal subjects of discussion will be the lines of interstate roads, such as those proposed for improvement from Chicago to Milwaukee, Milwaukee to the Mississippi river, St. Paul to St. Louis, Milwaukee to the northern Michigan peninsula, the Lincoln Highway, etc.

At its meeting, May 25, the New York Electrical Society heard a lecture by Dr. L. A. Bauer, director of the department of terrestrial magnetism of the Carnegie Institution at Washington, on the non-magnetic yacht "Carnegie" and the general magnetic survey of the oceans now under way. There was also a talk by Lieut. J. C. Porte, of the English navy, on aerial navigation, especially regarding the Redman-Wanamaker trans-Atlantic flight, which will soon be undertaken by Lieut. Porte.

Technical Schools

The School of Commerce, Accounts and Finance of New York University, Washington square, New York, announces a tour thru England for the study of commerce and industry to occupy sixty-five days, sailing from Boston on June 27 and including Liverpool, Chester, the Manchester district, Glasgow, Edinburg, Newcastle, Durham, York, Leeds, Sheffield, Birmingham, Oxford, Cardiff, Bristol, London and several model garden and industrial cities and scenic districts. This is separate from the larger tour of Europe announced last month by the same school.

The Indiana University Extension Division will hold a conference in Bloomington, Ind., on June 8, 9 and 10, on the question "Shall a Constitutional Convention be Called in Indiana," a subject on which a vote will be taken at the November election. A program of addresses by experts upon various phases of the question was arranged under Prof. M. E. Haggerty, chairman of the committee on local arrangements.

Road Bee Day in Michigan

Governor Ferris, of Michigan, following the successful road bee day of the Huron Shore Road Association in Eastern Michigan, on June 9 of 1913, has issued a proclamation asking the people of the state to set apart Thursday and Friday, June 4 and 5, as road bee days, and turn out to work the roads under well-planned and competent supervision. As the Michigan Good Roads Association, the Huron Shore Road Association and the West Michigan Pike Association are behind the movement, and the State Highway Commissioner can be called upon for aid, the movement should be a success. Commissioner Frank F. Rogers has issued a brief letter of instruction to road officials, suggesting methods of organization of the work, work that may be done to advantage and things that should not be done.

Tractor on State Roads

Some states, particularly New York and Pennsylvania, have passed very stringent laws regarding the use of tractors and trailers on the new state highways, some of which have not allowed sufficient time to allow changes in the machines to be made to make them conform to the law. Pennsylvania is trying to bridge over the time by granting special privileges to agricultural outfits, such as threshers, balers and the like, as distinguished from heavy tractors used to haul freight and heavy loads.

The difficulty is with the damage done by tractors heavy enough to haul a line of heavy trailers also loaded. As shown in the article on German tractors and trailers, elsewhere in this number of Municipal Engineering, this method of hauling loads is very severe on roads that are not hard and level. Single motors or a motor and one trailer are not so troublesome, but the cleats on wheels that have been necessary with the poorer roads of the past are very destructive of the better roads of the present, especially with heavy trailers to haul.

The economics of the case demand that the comparatively few heavily loaded motors and trains shall modify their methods of construction and operation rather than build roads at immense expense which, if sufficient for such loads, will be much more expensive than is necessary for any other class of traffic. The agricultural engine must be changed in design and construction to conform with the necessities of the case, and the motor trucks must be designed to conform also.

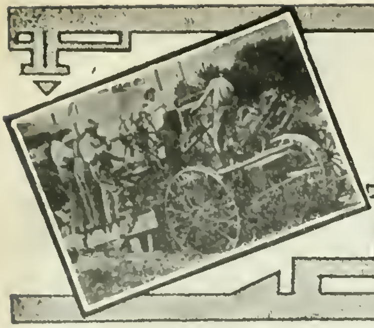
It may be that the laws passed thus far have not been considered sufficiently and are defective. If so, they should be changed and put on a scientific basis before changes in machinery are made which are unnecessary or are not of the right sort to meet the requirements of the highest economy.

Personal Notes

Charles A. Moreno, recently sewer commissioner for the city of St. Louis, Mo., resigned his position to become associated with Seney, Rogers & Co., of Chicago, and to be able to devote attention to his private business.

E. W. Smith has been appointed superintendent of water works at Glens Falls, N. Y. He is also city engineer.

The newly-elected city council of Lufkin, Tex., acting on progressive lines under its new charter of greater Lufkin, covering three times its former area, created an engineering department, which will also have charge of the supervision of buildings, and appointed Col. P. A. McCarthy its city engineer. The new department will have charge of all municipal improvements, which, for the current year, will include street paving, sidewalks, improvements of the water system, including a filter system, and a survey of the whole city. Col. McCarthy formerly served six years as the city engineer under former administrations, and besides conducting a general practice as consulting engineer during the past fourteen years, he handled many important engineering projects in Texas, Oklahoma, Louisiana and New Mexico.



MACHINERY AND SUPPLIES

A Carburetor with One Adjustment

The Huguelet carburetor for Ford cars works automatically, has no springs, has only one adjustment, and can be installed in a half hour. The adjustment mentioned is by means of a thumb screw which is turned to the left for more gas and to the right for less. The claim is made that this carburetor will give more mileage and run slower on high gear than any other. It is made by the Curtis-Ward Company, 28 East Jackson street, Chicago, Ill., who will supply full information concerning it.

A Vacuum Well

A new design in the way of open dug wells, which promises to be of interest and importance to engineers and water works men, is that developed by Mr. J. F. Seiler, of Chicago, concerning installations of which we hope to have reports in the near future.

The design consists primarily of an open caisson carried down into the water-bearing strata, sunk in the usual way. This is lined with a cylindrical steel casing, which is sealed over airtight at about the static head of the underground water. The suction of an ordinary centrifugal or other kind of pump is passed into the so-called water chamber and it is noted that for any water drawn out, there must be an equal amount pass into the chamber on account of the vacuum formed otherwise.

As a rule, where water is not struck until at some distance below its static head, it is possible to seal over the casing below the static head, and if in pumping and drawing in the water, some air passes in, and the head is lowered as a consequence, it is only necessary to stop pumping, open a cock at the top of the casing and allow the water to rise up to its level, the air being forced out.

We understand that the village of Des Plaines, Ill., will install one of these wells under the supervision of Mr. Seiler, and it is estimated the cost of such a well complete will run about $20.00 per foot of depth, giving a capacity up to 1,000,000 gallons per day.

On account of the economic method of pumping which is possible in this well, it is estimated that its entire initial cost will be saved within two years, altho the average consumption of water there will not exceed 100,000 gallons a day.

The Willis-Shaw Machinery Co., Chicago, Ill., are installing these wells, and further information can be obtained from them.

Longer Life For Fire Hose

After many years of experience in the manufacture and use of fire hose, in which he observed the rapid deterioration of the rubber lining, on the lines of the folds in which all hose is stored, Clay Baird has devised a plan of relieving the pressure on the fold which is very simple and effective.

He leaves a band of the rubber lining about the area of the fold free from the fabric of which the hose is manufactured, and cements the tube lining on the flattened areas to the fabric by soft rubber sheet backing, so that it cannot be pulled apart. Then humps at the ends of the flat sides, when in the position of storage, relieve the pressure on the free end areas, so that the rubber takes the form of a circle, approximately, and does not flatten down so as to form a crease at the end. As a consequence the rubber retains the same freedom and elasticity around the area formerly folded down tight that it does in the flat sides and the length of life of the hose is increased to that of the lining as a whole, rather than being limited by being squeezed out along the line of the outside of the fold.

Mr. Baird calls his product bi-lateral lining and the complete hose is bi-lateral hose. Naturally the company selling the hose is the Bi-Lateral Hose Company, tho the goods are manufactured by the B. F. Goodrich Company.

The office of the Bi-Lateral Hose Company is at 326 West Madison street, Chicago, Ill., where further information can be obtained.

Asphalt Plant in Use on Road Work At the Ashokan Reservoir

In the construction of an asphaltic macadam roadway, about 32 miles in length, at the new Ashokan Reservoir of New York City, the contractor, the Continental Public Works Company of New York City, is using an asphalt mixing plant of a type recently brought out. The accompanying illustrations show the mixing unit of the plant, which is made in two sizes, one having a capacity of 750 square yards of 2-inch topping per day and the other of 1,000 square yards of 2-inch topping, or an equivalent of asphalt macadam or concrete.

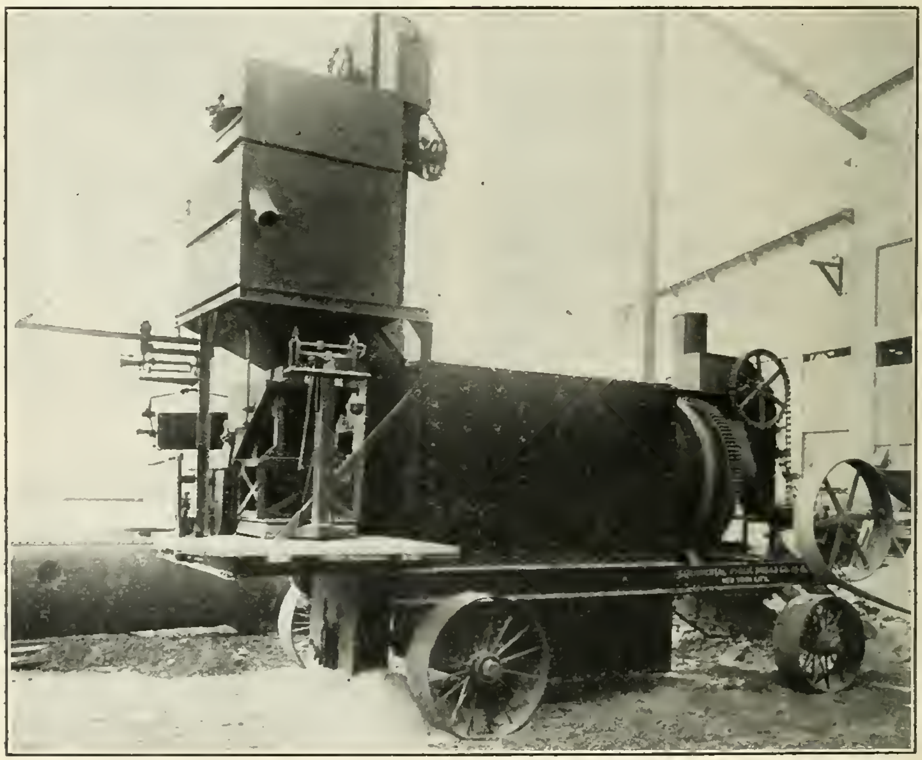
The plant was purchased after a test conducted at the factory in Cleveland. This test was run for one hour and was conducted, using sand and water, which, it is stated, subjected the machine to a test practically equivalent to actual working conditions with the usual materials. The sand contained 7 per cent. of moisture, and an average temperature of 412 degrees F. was obtained at the boot of the drier. During the one-hour test, 10½ tons of mixture were made, which is equivalent to about 1,000 square yards of 2-inch paving mixture per 10-hour day.

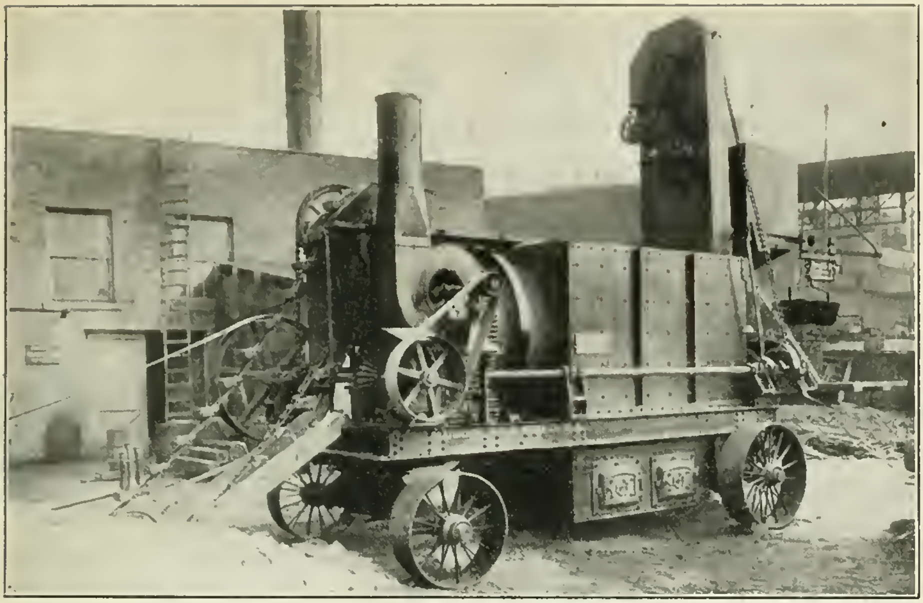
In the following description of the machine the dimensions and capacities given are for the 1,000-yard plant.

The plant consists of three units, the first including the mixing and measuring devices, the second the power plant and the third the asphalt melting kettle. The second unit consists of a 30-horse-power locomotive type portable boiler and a 25-horse-power horizontal engine, mounted together on an all-steel truck. The third unit consists of a portable melting kettle, having a capacity of 10 tons, mounted on an all-steel truck, or two similar kettles of 5 tons capacity each.

The first unit, illustrated herewith, by views of both sides and ends, consists of a sand drum, mixer, sand bin, measuring box and asphalt bucket, with conveying and weighing mechanism, mounted on a steel truck. The sand drum is of the latest Cummer type, having a capacity of 8 tons of sand per hour. The gearing is

CUMMER PORTABLE *asphalt plant in use on road at Ashokan Reservoir, New York City water supply.*





CUMMER PORTABLE *asphalt plant, showing opposite side and end to preceding view.*

of cast steel thruout, and the main bearings are brass-bushed and adjustable. The sand bin has a capacity of 5½ tons, and is equipped with a rotary screen, arranged to permit the mixing of sheet asphalt topping, binder or asphaltic concrete without change. The sand measuring box is on a beam scale and is so arranged that each ingredient can be weighed separately or combined. If desired a 5- cubic foot automatic measuring box can be supplied in place of this. The asphalt bucket is on a double-beam scale, as shown. The mixer is of the batch type with two mixing shafts, and has a capacity of 5 cubic feet.

The trucks are of steel; the front wheels 30 inches in diameter and 12 inches wide, and the rear wheels 36 inches in diameter and 12 inches wide. The plant is driven by a belt from the engine, transmission on the plant being by a main shaft 2 15/16 inches in diameter.

The drum and mixer are connected directly with the main shaft.

The plant can be loaded on a flat car, the top of the bin containing the screen being removed and the upper 4 feet of the elevator, which is hinged, being laid over on its side. When ready for operation the plant is 21 feet over all and 10 feet wide. It requires 20 horse-power to operate it.

The plant is manufactured by the F. D. Cummer & Son Company, of Cleveland, Ohio.

Loss of Time in the Unloading of Stone, Gravel, Sand and Other Materials Is Eliminated

Probably one of the greatest drawbacks the contractor has had to face in securing high efficiency in the unloading of materials from the car to the wagon is the time lost on account of the stalling of teams and idling of drivers.

It is regretfully apparent that this condition obtains generally. We have found that the contractor, in estimating, will often figure 25 to 50 per cent. below the actual cost of unloading from the car. This is no reflection on his ability to estimate, but is due wholly to the fact that he has no time-measure by which to allow for the stalling situation, and his estimate must be based on theoretical cost, which offers no solution of the difficulty.

Happily, however, for the contractor, there is a very simple yet practical solution of the entire problem, as statements which we have from contractors, township trustees and highway commissioners testify. Thomas M. Roche, 829 Monadnock building, Chicago, Ill., is distributer for what is known as the quick unloading car chute. It is a very simple device, as the following description will show:

It is a steel box, attached to the outside of a car, either gondola or box car. It is open on the end towards the shoveler and the sides are high enough so that he can easily see where to throw the material. On the end farthest from the car is an end-gate, the full width and height of the chute. Chutes are made in ¾-yard, 1-yard and 1½-yard sizes. Two or three chutes full can be dumped into the wagon or automobile, if it happens to be convenient to do so. The chute is made of sheet steel and angle iron, and is hooked over the top of the car side with two large hooks. Two men easily handle a chute. It comes from the factory all ready for use; no assembling of any kind is necessary. A chute weighs from 225 to 325 pounds, according to size. By carrying it to the car in the wagon and setting it down with the hooks up and taking a short lift, the hooks may be placed over the top of the car. When a car is empty the chute may be transferred to a loaded car by placing it on the last wagon load and letting the team draw it along to the next car.

C. D. Buys, highway commissioner of Emmett county, Michigan, states that these chutes have fully demonstrated their efficiency and have proven a good Investment for that county in the handling of gravel and crushed stone.

As a factor in the reducing of teaming costs we have the statement of C. L. Baker & Son, contractors, of Quitman, Ga., that "one team will move as much material in a day using these chutes as three teams would previously loading by hand."

The Bitulithic and Contracting Company, Ltd., Grand Forks, N. Dak., explain that they used these chutes last summer, while other contractors in that city followed the old "idle team" method, and "the comparison was so obvious as to be nearly pathetic."

The Canals and Concrete Mixers

One hundred million people are spending $400,000,000 on the Panama canal that will carry 10,600,000 tons.

Eight million people of New York state are spending $100,000,000 on the Erie canal to carry 4,000,000 tons.

Fifty private citizens are spending $12,000,000 on the Cape Cod canal to carry 12,000,000 tons.

Had the fertile brains of the modern mud mixers failed to find the mechanical method for mixing concrete, how much more would these canals cost? This question should set most men thinking of the great importance of the concrete mixer.

In the shadow of this national business of building irrigating dams, canals, railroads, national highways, bridges, dikes, buildings, there is bound to creep in a lot of unreliable makers of machinery—bound to be disappointments in the material used in making this machinery, and sure to be lack of genius in their construction.

There is a wide range of results to be expected in buying these machines, but one fact stands out: It is not easy to equal a Koehring mixer.

Ask the builders, the constructors on the Erie canal. They know.

Economy

The Development of Expanded Metal for Reinforcing Concrete Construction

The first steel used in reinforced concrete construction consisted of small round rods. Very shortly after the first concrete construction had been completed, someone conceived the idea of using deformed reinforcing, i. e., bars which had lugs on them or which were twisted so as to grip the concrete more effectively than would the plain bar.

The next step was the production of a fabric reinforcing, which was a considerable improvement over the deformed rods or bars.

The first fabric reinforcing placed on the market was Expanded Metal. This has been perfected so that it now consists of a fabric of steel having diamond-shaped meshes 3 inches by 8 inches. Smaller sized meshes are also manufactured, but are not as efficient for reinforcing concrete.

Although the method of manufacturing "Econo" expanded metal is very simple, one of the very best qualities of this fabric is due to this method. The material is expanded cold from sheet steel of different gages varying from No. 16 to No. 7. Gages lighter than 16 are used in producing expanded metal for plastering lath, but do not give a sufficient steel area to be used as reinforcing.

The meshes are formed at one operation, which cuts the steel and also stretches the strands so that the steel forming two sides of each diamond is 2 inches longer in the completed fabric than it was in the original sheet. This stretching increases the strength of the material and has an effect very similar to annealing. It is necessary to use the very best grade of medium steel in the manufacture of expanded metal, because no other grade will expand without breaking. Medium steel does not have a very high elastic limit, but after it has been manufactured into expanded metal the stretching of the strands increases the elastic limit to approximately 60,000 lbs. per square inch.

Experienced engineers prefer to use this reinforcing because of the fact that the very process of manufacture insures them getting only the very best grade of steel.

The recent rapid increase in the construction of cement pavements and roads has opened a new field for fabric reinforcing. The amount of steel required in this work is very small, yet it is necessary that it should be perfectly reliable and efficient if satisfactory results are to be obtained.

"Econo" reinforcing is furnished in a special weight which is particularly adapted for this class of work. The material is shipped in sheets 4 or 6 feet wide and 8 or 12 feet long, which are sizes that can be easily and quickly placed. The sheets being flat, do not require any straightening out after they are on the job, and one man can not only place all of the reinforcing, but will have time to do a considerable amount of other work.

The flat sheet insures the placing of the reinforcing at proper places in the concrete. Some portion of the reinforcing will not be near the top when it should be at the bottom.

Goodyear Announces Decline in Block Tire Prices

The Goodyear Tire and Rubber Company has just announced a reduction of approximately 5 per cent in the price of Goodyear individual block motor truck tires.

According to advice received from the factory at Akron, this was made possible by the constantly increasing demand for this type of tire by motor truck operators. Raising the production volume lowered the cost to an extent sufficient to warrant a 5 per cent decrease in selling price, which puts the block tire on the same basis as the endless tire. In other words, a truck owner can now buy a block tire at the same price he would have to pay for a demountable or pressed-on tire.

This should be welcome news to many truck operators who have heretofore hesitated to equip with block tires because of their higher price, and also to those who have so equipped in spite of the cost.

Immense success has attended this Goodyear block tire since its introduction on the market about two years ago. It can truly be called "individual." Each block is a unit and is held to the wheel by individual plates and bolts, making it a simple job to remove or replace any block on the wheel without molesting any of the others. A block can be changed in a very few minutes with practically no loss of running time to the truck.

In addition to the above feature, the block tire, of course, has positive traction and non-skid qualities that are not found in any other type of tire.

Some Modern Developments in the Asphalt Industry

The asphalt industry has witnessed many changes during the past five years. The demand for good roads occasioned by automobile traffic is in a large measure responsible, but many other factors have contributed to the increased growth of the industry. A large number of small cities and villages, which at one time were content with slovenly streets, now demand the best type of pavements. This is co-ordinate with the higher standard of living in connection with modern conveniences which the present-day American enjoys and demands.

The application of asphalt to various other industries has also been an important force in the development of the business. For the past two decades asphalt has been increasingly employed in roofing and waterproofing, in mastic floors for railroad station platforms, sidewalks and cellars.

Comparatively new fields for asphalt have been found for insulating, pipe dip and the manufacture of rubber, while additional uses are constantly being discovered in other directions.

For many years asphalt paving was in the hands of a few large companies and it was the prevailing idea that the laying of asphalt pavements was beyond the activities of the ordinary contractor. Today this is all changed. The larger companies have, in part at least, retired from the actual paving business and where once there were only a few asphalt paving contractors, there are now hundreds of firms engaged in this class of work.

Also, the sources of asphalt were limited.

In the past ten years developments have occurred which give the world much greater supplies of asphalt.

The base of asphalt is a very heavy maltha, which is found, amongst other places, in the State of Vera Cruz, Mexico, from twenty to forty miles inland from the Gulf Coast.

The maltha from which Aztec Asphalt is produced is a very heavy, thick material, which, after slight distillation, produces a plastic asphalt. Aztec Asphalt is refined to whatever consistency may be required to meet the condition for which it is to be used and it is not necessary to add other oils. It is, therefore, really a natural asphalt.

In the special methods followed for refining Aztec Asphalt, the greatest care is taken to produce a material that is uniform and to retain all the essential qualities that nature gave it. The refineries are equipped with all the latest devices of science and with appliances expressly designed to insure perfect control over the refining process.

For paving purposes an asphalt must be a binder. It should be cementitious and tenacious. It must have ductility to provide for expansion and contraction caused by heat and cold.

Ductility is, to a certain extent, coordinate with cementing value and adhesiveness. Asphalt must not be readily affected by the extremes of heat and cold. It must be stable and, therefore, not harden perceptibly when subjected to severe heat. This is important since asphalt when being mixed for paving purposes is subjected to a high heat. Aztec Asphalt possesses these essential properties.

Aztec Asphalt is refined to consistencies suitable for any of the various types of construction, such as sheet asphalt, asphaltic concrete or asphaltic macadam; also for various patented pavements, such as Amiesite, Bitulithic, Warrenite, etc.

Aztec Road Binder is produced especially for the penetration process. This material is ideal for the penetration method, because it leaves upon evaporation ninety per cent. of asphalt in the road, forming a binder that is durable and fully able to withstand the action of the elements and the demands of traffic. It should be borne in mind that Aztec road binder is a straight asphaltic product thruout and does not contain fluxing oils.

Aztec Asphalt is laid in street pavements and roadways in many of the most important sections of the American continent. It withstands the cold in far northern cities and the heat in the southern cities. It withstands the vehicular traffic of the metropolitan cities and that of the motor cars on country roads. It has received unqualified endorsement from all independent asphalt experts and from a host of public officials and contractors who have actually used it.

Aztec Asphalt is laid in sheet asphalt work on some of the most prominent streets in the boro of Manhattan, city of New York, including

72nd street, between West End avenue and Columbus avenue.

38th street, between Broadway and Sixth avenue.

40th street, between Broadway and Seventh avenue.

East and west side of Gramercy Park.

About thirty miles of pavements have been constructed with Aztec Asphalt in Philadelphia during the past two years. In Pittsburgh nearly twenty miles of asphalt re-surfacing work has been laid with Aztec Asphalt during 1913. Among other prominent cities where splendid examples of Aztec Asphalt can be seen are Baltimore, Norfolk, Buffalo, Providence, Chester, Scranton, Detroit, Newark, Paterson and Passaic.

Aztec Asphalt has been laid extensively on the state highways of New York, Pennsylvania and New Jersey.

More than three million square yards of streets and roadways have been constructed during the past two years with Aztec Asphalt.

Aztec Asphalt is making great progress in the southern states; it has been laid in Norfolk and Portsmouth, Va.; Raleigh, Charlotte, Henderson and Lumberton, N. C.; Atlanta, Ga.; Birmingham, Ala., and additional contracts have been closed to lay it in Ginter Park, Va., and Jacksonville, Fla.

A Tractor With a Heavy Load

Notwithstanding the claim in an article on German motor truck trains, elsewhere in this number of MUNICIPAL ENGINEERING, that the motor hauling a train is not successful, and that a motor road train must have motive power on the axles of trailers as well as motor truck, the accompanying photograph shows a Knox-Martin tractor hauling a long string of lumber buggies on a highway, perhaps the longest train and heaviest load ever hauled in this way.

The Standard Lumber Co., of Sonora, Cal., is reported to haul its lumber generally in this way, tho not always in such large quantities in one train.

Durability of Southern Yellow Pine Timber

The "View Plan and Situation of the Church and Churchyard of the Church in Georgia, erected A. D. 1749, and humbly dedicated to the honorable trustees for establishing the Colony of Georgia in America, by the committee appointed for erecting thereof," was recently found in England.

In addition to the above title, there is a sketch of the exterior of the church, the architect's plan and specifications including the following:

"The frame of the church is of wood, so strong (Georgia Southern yellow pine) that it will last for many years; between the studs is a wall of clay 8 inches thick, supported in the center of the clay with pieces of wood 3 inches thick, let into the studs by a groove. The outside is rough cast with lime and gravel, appearing like stone. The inside is plastered, whitewashed and arched; the roof supported by two columns, as per plan, which we propose to have handsomely ornamented."

The old building was moved from its original site, the same as that of Fort Cornwallis, in Augusta, Ga., to the Broad and Pollock street corner, reconstructed and used for commercial purposes until the present time, and is now being demolished. Many of the large Georgia pine timbers are hewn instead of sawn, and the nails are wrought out in a blacksmith shop. Its frame work and timbers are in a remarkable state of preservation still.

Joint Protector for Concrete Pavements

Albert Moyer, New York, is out with a circular descriptive of the Moyer concrete pavement joint plate, whose special feature is a turning down of a strip along the lower edge of the protection plate in sections to form legs about 8 inches long, projecting some 4½ inches below the bottom of the concrete, the legs of the two plates required for each joint being wired together and the tar paper filler being clamped between the plates. These legs are driven into the earth, so that the joint protectors can be set ahead of the concreting and used as guides to the form of the concrete surface.

Trade Notes

The Coldwell Lawn Mower Co., of Newburg, N. Y., has by invitation become a members of the Rice Leaders of the World Association, composed of the leading manufacturers in their respective lines in the world.

The general sales office of the Trussed Concrete Steel Co. is now located at their extensive plant in Youngstown, O., where the closer co-operation of all departments will give even greater efficiency than this excellent organization has developed in the past. A competent engineering and selling organization is retained in Detroit.

As considerable publicity was given last fall to a suit brought by George E. Blakeslee against International Motor Company et al., the company has issued a statement from its office to the effect that on May 14, 1914, Mr. Justice Manning handed down a decision which appears effectively to end the litigation. In dismissing the complaint against International Motor Company, because no facts were shown sufficient to constitute a cause of action against International Motor Company, he says, concerning Mr. Blakeslee, that "his status as a stockholder of the International Motor Company gives him no special privilege not enjoyed by other holders of its shares, and his charges against the latter company fall far short of an actionable complaint for the abuse of fiduciary powers on the part of officers and directors of the International Motor Company. The rights of others are to be conserved and preserved as well as those of the plaintiff, and courts are not prone to attempt the settlement of business policies in the management of corporations except where fraud and gross dereliction of duty is clearly charged and susceptible of proof." The company feels gratified over the satisfactory and conclusive action of the court.

John Baker, Jr., has removed his Chicago office to the Otis Building, 10 South LaSalle street, Room 540.

Trade Publications

The Bituminized Road Co., of Kansas City, Mo., issued a circular descriptive of the national pavement laid on Colborn street, Iola, Kan., by their process.

The annual number of *Contract Record and Engineering Review*, published by Hugh C. McLean, Toronto, Ont., has over 300 pages and seems to cover the Canadian contracting and contractors' mechinery and material field completely, particularly in its advertising pages. A new feature is a reference list of the constructional activities of Canadian cities arranged alphabetically.

"Breaking Home Ties" calls attention to the "Tiger" steel bunks of the Haggard & Marcusson Co., Chicago, Ill.

The Antakwa Company, 403 Chamber of Commerce, Chicago, Ill., have issued a booklet descriptive of their dampproofing, waterproofing and technical paints and telling how to specify them.

Municipal Improvements for 1914.

Following is a classified list of the information regarding improvements during the year 1914, which have been contracted for, or ordered, or are contemplated, which has come to hand since the publication of the April number. This list, added to that in the April number, covers almost every important city which will be active in improvements in 1914, and shows what they now expect to do. Additional work will undoubtedly be done, as the citizens in many cities are quite slow in making their wants known, and many projects do not reach the active stage until quite late in the season.

ROADS AND PAVEMENTS.

Alabama—

Mobile: 20,400 sq. yds. 2-in. asphaltic concrete pavement; 14,200 lin. ft. granite curbing.

Arkansas—

Lonoke: 11 miles macadam road, cost, $60,000.

Paragould: 14,200 sq. yds. brick, 20,800 sq. yds. bitulithic, 12,400 sq. yds. bitustone and 720 yds. gravel.

Star City: 22 miles macadam and gravel roads; cost, $125,000.

California—

Fairfield: 30 miles cement concrete, 5 miles oiled macadam in Salano county.

Marysville: 8½ miles asphalt macadam, 8 miles road grading, 1½ miles cement sidewalks, and 1½ mile concrete curb, in Yuba county.

Placerville: 16 miles waterbound macadam state highway construction, and 4 miles county road grading.

Redlands: 30 miles oiled roads, 1 mile cement sidewalks, 1 mile cement gutter and 1 mile granite curb.

Santa Barbara: 132,000 sq. yds. asphalt, 17,600 sq. yds. gravel and oiled, and 6 miles concrete curb and gutter.

San Jose: 10 miles asphalt, 3 miles asphalt concrete, ¾ mile gravel, 1 mile macadam, 10 miles cement sidewalks, 10 miles concrete curb and gutter.

San Luis Obispo: 2 miles asphalt in city, 60 miles cement concrete, 3 miles gravel, 65 miles road grading and 1 mile cement sidewalks.

Santa Rosa: 70 miles cement concrete and 100 miles road grading in Sonoma county.

Stockton: 2 miles asphalt macadam, 3 miles gravel, 1 mile macadam and 20 miles road grading.

Colorado—

Boulder: 4,000 sq. yds. cement concrete and 14,000 sq. yds. gravel.

Connecticut—

Hartford: Mexican asphalt; cost, $54,000.

Florida—

Jacksonville: 71,700 sq. yds. asphalt concrete, 53,466 sq. yds. brick, 4,826 sq. yds. cement concrete, 12,000 macadam and 26,141 sq. yds. granitoid brick on sand base.

Georgia—

Athens: 20,000 sq. yds. cement concrete, 2 miles cement sidewalks, 5-ft. wide.

Idaho—

Boise: 48,860 sq. yds. asphalt and 4,940 lin. ft. concrete curb.

Illinois—

Alton: 35,000 sq. yds. brick pavements, 2 miles cement sidewalks, 2 miles concrete curb, 5 miles concrete curb and gutter and 15,000 ft. limestone curb.

Cairo: 100,000 sq. yds. asphalt macadam, 40,000 cu. yds. street grading, 10,000 sq. ft. cement sidewalks, 80,000 lin. ft. concrete curb and gutter and 500 lin. ft. limestone curb.

Chicago: 750,000 sq. yds. asphalt, 250,000 sq. yds. asphalt concrete, 350,000 sq. yds. asphalt macadam, 450,000 sq. yds. brick, 60,000 cement concrete, 40,000 granite, 150,000 wooden block, 200 miles cement sidewalks, 30 miles cinder sidewalks, 300,000 lin. ft. concrete curb, 600,000 lin. ft. concrete curb and gutter and 20,000 lin. ft. sandstone curb.

Collinsville: 11,900 sq. yds. vitrified brick paving, 9,200 ft. gravel, concrete curb and gutter.

Danville: 4 miles of brick pavement and 1 mile limestone curb.

Delevan: 32,300 sq. yds. reinforced concrete pavement, 15,900 lin. ft. concrete curb, 11,500 cu. yds. excavation.

Flat Rock: $11,000 to be expended.

Harrisburg: 9,430 sq. yds. vitrified brick paving.

Highwood: 9,300 sq. yds. concrete pavi

Joliet: 40,000 sq. yds. asphalt, 30,000 yds. bituminous macadam, 20,000 sq. yds. brick, 4 miles cement sidewalks and 10,000 lin. ft. concrete curb and gutter.

Mattoon: 15,000 sq. yds. brick, 10,000 sq. ft. cement.

Monmouth: 20 or 30 blocks to be paved

Oak Park: 43,628 sq. yds. asphalt, 130,061 sq. yds. asphalt concrete, 15,924 sq. y brick, and 118,215 lin. ft. concrete curb and gutter.

Pana: 14,312 sq. yds. brick pavement, 9,937 lin. ft. curb and gutter.

Rushville: 10,000 sq. yds. brick pavement, 3,120 cu. yds. grading, 6,420 lin. ft. straight combined concrete curb and gutter, 2,921 sq. yds. 6-in. reinforced Portland cement concrete pavement, 2,158 lin. ft. straight concrete curbing.

Sheldon: 3,978 sq. yds. macadam bound with water binder, and 16,645 sq. yds. bound with approved binder.

Springfield: 100,000 sq. yds. brick, 57,000 lin. ft. sandstone pavements, 3 miles street grading in city and 7 miles cement concrete and 150 miles road grading in Sangamon county.

Streator: ¾ mile brick and 2,500 lin. ft. sandstone curb.

Taylorville: 39,994 sq. yds. vitrified block paving and 3,538 sq. yds. reinforced armored concrete pavement.

Indiana—

Bedford: 10 gravel roads in Lawrence county.

Bloomfield: 15,000 sq. yds. brick pavement and 8,300 ft. concrete curb.

Bluffton: 47,000 sq. yds. sheet asphalt.

Crown Point: 6 gravel roads in Lake county.

Elkhart: 28,000 sq. yds. of paving, kind not specified.

Goshen: 3,080 ft. cement concrete and 24 miles gravel road in Elkhart county.

Indianapolis: $200,000 to be expended for street paving.

Kokomo: 13 gravel, stone and brick roads in Howard county.

LaGrange: 350 miles of road grading in county.

Laporte: About 23,000 sq. yds. brick or clay block in city.

Michigan City: 4,000 ft. asphalt, 3,000 relay and widen brick, 6,000 new brick, 1,500 cement concrete, 2,000 ft. sidewalks, 6,000 ft. concrete curb and 8,000 ft. concrete curb and gutter.

Plymouth: Four streets to be paved.

South Bend: 25,000 sq. yds. brick pavement, 10,000 sq. ft. cement sidewalks.
Terre Haute: $500,000 to be expended street paving.
Vincennes: 20,000 sq. yds. brick, 1 mile street grading, 4 miles cement sidewalks, 4,200 ft. concrete curb, 2,000 ft. limestone curb and 2,000 ft. marginal curb.
Winamac: 4,600 cu. yds. brick paving.

Iowa—
Chariton: 32 blocks of paving voted.
Cresco: 24,000 sq. yds. cement paving and 15,500 lin. ft. of curbing.
Harlan: 25 blocks with intersections.
Iowa City: 21 blocks of bitulithic paving and 4 blocks of brick.
Leon: 8,000 sq. yds. brick.
Missouri Valley: 24,850 sq. yds. of pa 8,020 lin. ft. curbing.
Nevada: 21,000 sq. yds. concrete, brick or asphaltic concrete pavement.
Pella: 37,700 sq. yds. bitulithic paving, 3,378 ft. curb and gutter.
Buena Vista county.
Storm Lake: 13 miles road grading in
Waterloo: 27,000 sq. yds. asphalt, 52,00 sq. yds. brick, 5,000 sq. yds. cement concrete, 25,000 lin. ft. cement sidewalks and 5,000 ft. concrete curb and gutter.
Waukon: 21,150 sq. yds. brick paving and 4,600 lin. ft. concrete curb.

Kansas—
Eldorado: 11,473 sq. yds. brick pavement on 4-in. concrete base.
Fort Scott: 20,000 sq. yds. brick pavement, 2 miles street grading, 2 miles cement sidewalk and 1,100 ft. concrete curb and gutter.
Leavenworth: 8,365 sq. yds. vitrified brick pavement and 2,114 cu. yds. excavation.
Manhattan: 3 miles street paving with asphalt.
McPherson: 36 blocks of pavement.
Pittsburg: 26,200 sq. yds. brick pavement. 15,500 ft. concrete curb and gutter and 12,000 cu. yds. excavation.

Kentucky—
Covington: 12,200 sq. yds. asphalt, 6,000 sq. yds. bituminous macadam, 10,000 sq. yds. brick, 8,000 sq. yds. granite, 3,000 sq. yds. wooden block, 6 miles cement sidewalk, 5,000 ft. brick gutter, 10,000 ft. concrete curb and gutter and 20,000 ft. limestone curb.

Louisiana—
Alexandria: 5,000 sq. yds. bitulithic pavement and 26,000 sq. yds. vertical fiber vitrified brick pavement.
Breaux Bridge: 12,000 sq. yds. cement walks with curbing.
Donaldsonville: 19 miles gravel road, first road district.
Lake Charles: 12,000 sq. yds. asphaltic concrete pavement and 7,300 lin. ft. concrete curb and gutter.
New Orleans: $500,000 to be expended on state highway construction.

Maine—
Bangor: 3,000 sq. yds. wood block paving.

Massachusetts—
Boston: $500,000 to be expended on suburban street improvements.

Maryland—
Frankfort: 14,500 sq. yds. street pavi concrete curbs and sidewalks; cost, $57,000.

Michigan—
Alpena: 12,000 sq. yds. cement concrete pavement, ½ mile cement sidewalks and 7,000 lin. ft. concrete curb.
Bay City: 300,000 sq. ft. cement sidewalks.
Eaton Rapids: Paving of three streets.
Grand Rapids: 40,000 sq. yds. of brick or clay block, 6,000 sq. yds. concrete and 25,000 sq. yds. bituminous concrete.
Ludington: 11,000 yds. street pavement.
Menominee: 5,000 sq. yds. macadam pavements and 500 ft. concrete curb and gutter.
Saginaw: 2 miles asphalt pavement, 10 miles cement sidewalks, 4 miles brick gutter and 4 miles concrete curb.

Minnesota—
St. Cloud: 9,000 sq. yds. cement concrete, 1,500 sq. yds. cement sidewalks and 30,000 ft. concrete curbs.
St. Paul: 23,588 sq. yds. asphalt resurfacing, 8,780 sq. yds. bituminous concrete, 20,000 sq. yds. of brick, 3,000 sq. yds. cement concrete, 8,690 sq. yds. sandstone block, 242,027 sq. yds. creosoted wooden blocks, 15 miles street grading, 75,000 lin. ft. cement sidewalks and 87,754 lin. ft. concrete curb.
Thief River Falls: 1,37т cu. yds. grading, 26,600 lin. ft. turnpiking and 5,000 cu. yds. of gravel in county.
Walker: 23 miles state rural highway.

Mississippi—
Clinton: 2,000 yds. concrete sidewalks.
Vicksburg: 2 miles cement sidewalks.

Missouri—
Boonville: 15,000 sq. yds. brick or clay block pavement and 14,000 sq. yds. concrete.
Hannibal: 10,000 sq. yds. asphalt macadam, 2,000 cu. yds. bitulithic, 2,000 sq. yds. brick, 40,000 sq. yds. cement concrete pavement, 2 miles street grading, 8 miles cement sidewalks and 3 miles concrete curb and gutter.
Kansas City: 9 miles asphalt concrete, 4½ miles asphalt macadam, 4 miles brick, 15 miles cement concrete, 2½ miles sandstone, 4 miles wooden block, 30 miles street grading and 36 miles cement sidewalks, 34 miles concrete curb and 3½ miles concrete curb and gutter.

Montana—
Butte: 24,300 sq. yds. bitulithic pavement, 130,000 cu. yds. grading, 7 miles cement sidewalks.
Helena: 32,000 sq. yds. bitulithic, 40,000 sq. yds. brick, 25,000 cu. yds. street grading, 200,000 sq. ft. cement sidewalks, 50,000 lin. ft. concrete curb.
Philipsburg: 3 miles gravel road construction in county.

Nebraska—
Dundee: 25,000 sq. yds. asphalt, 14,500 lin. ft. cement curb and 2,400 lin. ft. stone curb.

New Hampshire—
Laconia: 5,000 sq. yds. bituminous and 1,000 ft. granite curb.

New Jersey—
Bayonne: 5,000 lin. ft. cement sidewalks, 5,000 lin. ft. stone sidewalks, ½ mile concrete curb, 2 miles Bluestone curb, ½ mile concrete curb and gutter.
Bloomfield: 1 mile asphalt, 1 mile asphalt macadam, 2 miles granite pavements, 2 miles cement sidewalks, 2 miles stone sidewalks, 2 miles concrete curb and gutter and 5 miles Bluestone curb.
New Brunswick: $50,000 to be expended on concrete, asphaltic concrete and brick pavements.

New Mexico—
Albuquerque: 3,000 ft. cement sidewalks.

New York—
Brooklyn: 606,800 sq. yds. sheet asphalt, 180,954 sq. yds. granite, sandstone or other stone block, 17,000 sq. yds. creosoted wood block, 5,700 sq. yds. of other pavements.
Cortland: 1,500 ft. bituminous macadam, 12,000 yds. brick, 2,000 ft. oiled macadam, 4,000 ft. sandstone curb and 3,000 ft. sandstone curb and gutter.
Fonda: 4 miles of gravel, 3 miles macadam road construction and 120 miles road grading in Montgomery county.
Johnstown: 4,000 sq. yds. asphalt block, 8,000 sq. yds. bituminous macadam, 10,000 sq. yds. oiled macadam, 2 miles brick

sidewalks, 4 miles cement sidewalks, 17,000 ft. concrete curb.

Troy: 6,000 sq. yds. asphalt, 22,560 sq. yds. bitulithic, 32,190 sq. yds. brick, 21,400 sq. yds. granite relaid, 6,000 ft. Hassam, 9,000 sq. ft. cement sidewalks, 17,000 lin. ft. concrete curb.

Utica: 30,000 sq. yds. asphalt, 17,000 sq. yds. asphaltic concrete, 44,000 sq. yds. bitulithic, 2.5 miles cement sidewalks, 11,000 lin. ft. concrete curb and gutter and 11,000 ft. sandstone curb.

North Carolina—

Charlotte: 70,000 sq. yds. asphalt, 30,000 sq. yds. cement sidewalks and 5 miles concrete curb.

Durham: 20,000 sq. yds. bituminous macadam, 17,000 sq. yds. street grading and 17,000 ft. concrete curb and gutter.

North Dakota—

Grand Forks: 2 miles cement sidewalks and 4 miles concrete curb.

Ohio—

Akron: 15 miles brick, 1 mile wooden block, 30 miles cement sidewalks, 15 miles concrete curb and gutter and 15 miles sandstone curb.

Centerburg: 13,300 sq. yds. brick paving and 8,000 ft. stone curb.

Chardon: 5 miles concrete road construction and 5 miles road grading in county.

Chillicothe: 5,100 sq. yds. brick pavement, 16,000 sq. ft. cement sidewalks and 3,500 ft. concrete curb.

Cincinnati: 8,100 sq. yds. asphalt, 38,700 sq. yds. bituminous macadam, 95,000 sq. yds. brick, 83,000 sq. yds. granite, 29,800 sq. yds. gravel, 58,560 sq. yds. wooden block, 18 miles street grading, 200,000 sq. ft. cement sidewalks, 38,280 lin. ft. concrete curb and 80,000 lin. ft. granite curb.

Dayton: 1 mile bituminous macadam, 8 miles brick, 30 miles gravel and 8 miles road grading in county.

Elyria: 35,000 sq. yds. street pavements and 26,200 ft. concrete or stone curbs.

Ironton: 3 miles of brick construction, 5 miles cement sidewalks.

Massillon: 250,000 sq. yds. brick or clay block and 2,500 sq. yds. gravel.

Sandusky: 12,000 sq. yds. asphalt, 20,000 sq. yds. brick, 7,000 sq. yds. cement concrete, 10,000 cu. yds. street grading, 15,000 sq. ft. cement sidewalks, 4,000 sq. ft. stone sidewalks, 6,000 lin. ft. concrete curb, 8,000 lin. ft. concrete curb and gutter and 5,000 lin. ft. sandstone curb.

Steubenville: 2 miles of brick, 40,000 sq. yds. street grading, 3 miles cement sidewalks, 4 miles concrete curb and gutter and 1,000 lin. ft. sandstone curb.

St. Paris: $30,000 to be expended.

Urbana: 22,500 sq. yds. pavement.

Versailles: 10,100 sq. yds. brick pavement; cost, $36,000.

Woodstock: $3,000 to be expended on macadam pavement.

Oklahoma—

Arnett: 4 miles gravel road construction, 1,000 ft. cement sidewalks, 1,000 ft. concrete curb in Ellis county.

Collinsville: 34,000 sq. yds. brick or asphalt pavement.

Marietta: 20,000 sq. yds. bitulithic.

Tulsa: 15,000 ft. cement sidewalks, 5 miles asphalt pavement and 1½ miles asphalt concrete pavement.

Ontario, Can.—

Jarvis: 10,624 sq. yds. street paving.

Stratford: 12,000 sq. yds. concrete pavement and 12,650 lin. ft. concrete curbing.

Oregon—

Portland: 29,575 lin. ft. asphalt, 27,550 lin. ft. asphalt concrete, 8,960 lin. ft. bitulithic, 33,560 lin. ft. gravel, 43,802 sq. yds. brick, 12,000 lin. ft. cement concrete, 22,000 lin. ft. Hassam, 34,000 lin. ft. stone blocks, 23,000 lin. ft. bitulithic redress, 100,882 lin. ft. street grading, 1,104,522 sq. ft. cement sidewalks and 378,173 lin. ft. concrete curb.

Pennsylvania—

Allentown: 70,000 sq. yds. asphalt, 30,000 sq. yds. bituminous concrete, 1,000 sq. yds. brick, 1,800 sq. yds. granite, 9,000 cu. yds. street grading.

Beaver Falls: 4,000 sq. yds. paving and 2,400 ft. curbing.

Kingston: 5,500 sq. yds. brick pavement, and resetting 2,100 lin. ft. stone curb.

St. Marys: 9,000 sq. yds. vitrified brick, 1,000 lin. ft. concrete curbing, 9,000 lin. ft. concrete edging.

Williamsburg: 15,000 sq. yds. reinforced concrete and 7,600 lin. ft. concrete curb.

York: 4 miles pavement, 65,000 sq. ft. cement sidewalks and 8 miles concrete curb and gutter.

Porto Rico—

Ponce: 2 miles asphalt, 2 miles bituminous concrete, 25 miles road grading, 8 miles concrete curb.

Saskatchewan, Can.—

Regina: 113,000 sq. yds. pavement.

South Carolina—

Charleston: 60,000 sq. yds. creosoted wood block, sheet asphalt or asphaltic concrete.

Greenville: 5,000 sq. yds. sidewalk pavement.

Sumter: 5,550 sq. yds. Bessemer pavement.

South Dakota—

Sioux Falls: 50,000 sq. yds. either cement, concrete or granite; 30,000 cu. yds. street grading, 6,000 lin. ft. cement sidewalks and 10,000 lin. ft. concrete curb.

Watertown: 22,500 sq. yds. Portland cement concrete, vitrified brick, asphaltic concrete or creosoted block pavement.

Tennessee—

Knoxville: 60 miles road grading and macadamizing, 30 miles.

Texas—

Austin: 3,250 sq. yds. asphalt concrete, 16,268 sq. yds. bitulithic, 5,000 sq. yds. cement concrete, 10 miles cement grading, 37,304 lin. ft. cement sidewalks and 41,409 lin. ft. concrete curb.

Belton: 80 miles road work in Bell county.

Houston: Paving of 12 streets.

Liberty: 20 miles shell road; cost, $100,000.

Marshall: 15 miles bituminous macadam, 5 miles concrete curb and 5 miles concrete curb and gutter.

Mart: 17,400 sq. yds. pavement and 4,560 lin. ft. combined curb and gutter.

McKinney: $200,000 to be expended.

Utah—

Salt Lake City: 64,000 sq. yds. asphalt, 2½ miles bitulithic, 1 mile cement concrete, 20 miles brick and cement sidewalks and 22 miles concrete curb a.. gutter.

Vermont—

Rutland: 1 mile brick, 2 miles gravel, 2 miles macadam, 1 mile tar concrete sidewalks and 2 miles stone sidewalks.

Virginia—

Fairfax: Grading and graveling 32 miles state highway.

Washington—

Asotin: 1 mile cement concrete road, 1,000 ft. cement sidewalks, 5 miles road grading in county.

Everett: 4 miles cement concrete, 5 miles gravel, 30 miles road grading in county.

North Yakima: 10,000 sq. yds. asphalt concrete, 2,000 sq. yds. macadam an. 2,000 ft. concrete curb and gutter.

Olympia: 12 miles gravel and 10 miles road grading in county.

Pasco: 7 miles highway construction and 5 miles graded roadway.

Seattle: 54,000 sq. yds. brick road construction and 75 miles road grading.

Walla Walla: 40,000 sq. yds. bitulithic, 4

miles concrete curb and gutter and about 2 miles hard surface pavement.
Waterville: 5 miles gravel, 4 miles macadam and 18 miles road grading in Douglas county.
Wenatchee: 20 miles gravel roads construction and 20 miles road grading in county.

West Virginia—
Charleston: 10 miles macadam road construction in Jefferson county.
Marlinton: 2½ miles macadam, 1 mile of oiled macadam in Pocahontas county.
Parkersburg: 3½ miles brick, 20,000 sq. yds. cement sidewalks and 25,000 ft. concrete curb.
Proctor: 115 miles road grading, 1,200 sq. yds. brick sidewalk construction in Wetzel county.
Sisterville: 7,500 sq. yds. brick pavement, 5,350 lin. ft. concrete curbing.

Wisconsin—
Eau Claire: 9,400 sq. yds. asphalt macadam, 1,000 sq. yds. brick, 3,500 sq. yds. cement concrete, 1,700 sq. yds. wood block and 3,000 lin . ft. concrete curb and gutter.
Fond du Lac: 15,279 ft. cement concrete, 30,000 ft. concrete curb and gutter and 6 miles cement sidewalks.
Janesville: 4,224 sq. yds. asphalt macadam, 7,020 sq. yds. macadam, 4½ miles concrete curb, 1½ miles cement sidewalks.
Lake Geneva: 21,000 sq. yds. creosoted wood block pavement.
Rice Lake: 20 miles road grading in Barron county; cost, $38,000.
Richland Center : 4 blocks concrete pavement.
Sparta: 1 mile cement concrete, 16 miles macadam, 7 miles oiled macadam and 20 miles road grading in Monroe county.

SEWERS.

Alabama—
East Lake: 4 or 5 miles sanitary sewer; cost, $17,500.
Mobile: 19,500 ft. storm sewers, 36 manholes, 60 inlets, 12 special basins.
Opp: Sanitary sewer system.
Thomasville: Sewer system; cost, $8,000.

Arizona—
Tempe: Vitrified pipe sewer system; cost, $32,000.

California—
Berkeley: Four sections of sewers.
El Centro: Outfall sewer for El Centro and Imperial.
Los Angeles: Sewer system; cost, $662,000.
Reedley: Sewer system; cost, $27,768.
Sanger: Sewer and water system; cost, $56,000.
San Jose: 1 mile reinforced concrete and 1 mile vitrified pipe sewers.
Santa Barbara: 3 miles vitrified pipe and 30 manholes.
South Pasadena: Sewer system; cost, $51,476.

Connecticut—
Hartford: Sewer system.

Georgia—
Augusta: Changing courses of sewers at four streets; cost, $100,000.
Jackson : Sewer system ; cost, $13,400.

Idaho—
Lewiston: Sanitary sewer in District No. 4; cost, $28,500.

Illinois—
Alton: 1,662 ft. 6-in. house connections, 973 ft. 8-in. pipe, 410-ft. 10-in. pipe, 1,206 ft. 12-in. pipe, 800 ft. 15-in. pipe, 13 manholes, 18 catchbasins, 2 inlets, 1 lamp hole. Sanitary Sewer District No. 2—32,400 lin. ft. 6-in. house connections, 38,730 lin. ft. 8-in. pipe, 11,440 lin. ft. 10-in. pipe, 1,160 lin. ft. 10-in. pipe, 6,500 lin. ft. 12-in. pipe, 4,503 lin. ft. 15-in. pipe, 1,460 lin. ft. 12-in. cast iron pipe, 1,430 lin. ft. 16-in. cast iron pipe, 144 manholes, 21 flush tanks and 18,400 lin. ft. of repaving trenches.
Centralia: Seventh South Street Sewer District—2,680 lin. ft. 12-in. vitrified clay sewer pipe, 900 lin. ft. 10-in. clay sewer pipe, 4,460 lin. ft. vitrified clay sewer pipe, 7,220 cu. yds. excavating and refilling trenches and 20 brick manholes with cast iron covers.
Chicago: Sewers in various streets.
East Moline: Sewers in Watertown addition; cost, $13,600.
East St. Louis: Rebuilding Illinois street sewer; cost, $13,700.
Elgin: Sewer system; cost, $437,000.
Gridley: Sanitary sewer system; cost $10,000.
Joliet: About 3 miles vitrified pipe sewers.
Peoria: South end sewer system; cost, $636,137.50.
Rankin: Sewer construction; cost, $14,660.
Springfield: 10,800 lin. ft. brick sewers, 10,000 lin. ft. 18-in. vitrified pipe and 60 manholes.
Toulon: Sewer system; cost, $20,000.

Indiana—
Angola: Sewer system for north side and District No. 22; cost, $43,000.
Chesterton: Sewer system; cost, $19,000.
Connersville: Vitrified tile sewers.
Fort Wayne: Sewers in various streets.
Greencastle: Sewer system; cost, $60,000.
Huntington: Vitrified clay tile sewers.
Indianapolis: Sewers; amount indefinite.
Knox: Three sewers across Gold ditch in Stark county.
LaPorte: One sewer district.
Michigan City: 7,500 ft. brick, 9 ft. to 3 ft., 6-in.
Middletown: 2.61 miles 8-in. to 18-in. vitrified pipe sewers, cut 5 ft. to 16 ft.
Muncie: Sewers; amount indefinite.
Peru: Sewers in various streets.
Richmond: Sewer system in Morton Park, about 2¾ miles 8-in. to 24-in. diameter.
Thorntown: West end sewer system.
South Bend: 5,000 ft. of 8, 10, 12, 15 and 18-in. vitrified pipe sewers.
Vincennes: Storm water sewer; length, 9 miles; cost, $47,310.
Winchester: Sanitary sewer.

Iowa—
Burlington: Extension of Hawkeye sewer and construction of Prospect Hill storm and sanitary sewer.
Dubuque: Sanitary sewer.
Osage: Sewer system; cost, $96,000.
Guthrie Center: Sewer system; cost, $40,000.
Sioux City: Storm water sewers.
Sumner: 4 miles sewers.

Kansas—
Council Grove: 23,800 ft. lateral sewers; cost, $16,000.
Dodge City: Sewer construction; cost, $13,964.
Fort Scott: 3 miles vitrified pipe and 50 manholes.
Pratt: Sewer system; cost, $4,000.

Kentucky—
Covington: 1,100 ft. 7x9 ft. concrete plain, 2,500 ft. vitrified block, 5,000 ft. vitrified pipe, 60 manholes and 180 catchbasins.
Paducah: Sewer District No. 3; cost, $200,000.

Maryland—
Baltimore: Sanitary sewers.
Frederick: 2,110 ft. brick, 1,860 ft. vitrified block, 7,600 ft. vitrified pipe sewers, 14 manholes and 20 catchbasins.

Massachusetts—
Boston: Sewers for Davenport brook.
Fitchburg: Sections 5 and 6 of intercepting sewer.
Franklin: Sewers; amount indefinite.

Michigan—
Highland Park: Sewers; amount indefinite.
Ludington: 6,000 ft. trunk sewer, either brick, concrete or segment block tile.
Lyons: Sewer system in business district.
Menominee: 3,000 ft. vitrified pipe, 6 manholes and 7 catchbasins.
Otsego: Sanitary sewers with laterals.
Saginaw: 4 miles, mostly 12-in. concrete pipe sewers.

Minnesota—
Austin: 4,074 ft. 8-in., 766 ft. 12-in., 1,785 ft. 15-in. and 672 lin. ft. 18-in. sanitary sewers.
Mankato: 1,700 ft. reinforced concrete, 2,000 ft. vitrified pipe sewers, 15 manholes and 6 catchbasins.
Ortonville: Sewer system; cost, $11,000.
St. Paul: 40 miles of sewers, from 9-in. to 78-in.; cost, $660,000.

Montana—
Butte: 400 lin. ft. reinforced concrete, 9,000 lin. ft. 8-in. concrete and vitrified pipe sanitary sewers, 35 manholes and 16 catchbasins.
Fort Benton: Sanitary and storm sewer system.

Missouri—
Caruthersville: Sewer system; cost, $40,000.
Hannibal: Sewer District No. 300; cost, $30,000, including 4,000 ft. concrete plain, and 70,000 lin. ft. vitrified pipe sewers.
Poplar Bluff: Vitrified pipe sewers in District No. 4, 35,439 ft.; cost, $22,000.
Webster Grove: 19,200 ft. 8, 10, 12-in. sewers; cost, $20,000.

Nebraska—
Fremont: Sewer main, length 6,800 ft., cost $10,000.
Laurel: Sewers, amount indefinite.

New Jersey—
Bloomfield: 5 miles vitr. pipe, 50 manholes and 10 catchbasins.
Newark: Sewers in various streets.
Plainfield: 17 miles 16-in. c. i. pipe, 1.3 miles 27-in. vitr. pipe and 20 manholes.
Ventnor City: 3,460 lin. ft. intercepting sewer and 8,300 lin. ft. 14-in. c. i. sewage force main.

New York—
Brighton: Sewers in District No. 1.
Cortland: 1,500 ft. 8-in. vitr. pipe.
Elmira: 11 sewers.
Glen Cove: 15 miles vitr. pipe sewers, 6-in. to 16-in.
Holly: 6½ miles pipe sewers.
Johnstown: 1 mile 8-in. vitr. pipe and two catchbasins.
Troy: 10,000 ft. vitr. pipe, 300 manholes, 125 catchbasins.
Utica: 5,000 lin. ft. 8-in. to 15-in. vitr. pipe sewers, 20 manholes, and 45 catchbasins.
Wappingers Falls: Sewer system.
Yonkers: 12 sewers.

North Carolina—
Durham: 20,000 ft. 8-in. to 12-in. vitr. pipe sewers.
Mooresville: $100,000 to be expended in sewer improvements.

North Dakota—
Grand Forks: 1 mile vitr. pipe sewers, 10 manholes and 6 catchbasins.

Ohio—
Akron: 2,000 ft. 6-in. vitr. pipe, and 500 ft. 10-in. vitr. pipe, 12 manholes, 6 catchbasins.
Bucyrus: $15,000 to be expended on sewers in various streets.
Cincinnati: 41,900 lin. ft. brick or concrete plain. 59,000 lin. ft. vitr. pipe and 11,320 ft. other types.
Chillicothe: 670 ft. vitr. pipe laterals, 20-15-18-in., 2 manholes, 9 catchbasins.
Dayton: Sewers in sewer district No. 6.
Findlay: 2 miles 10-in. and 24-in. vitr. pipe sewers, 51 manholes, and 112 catchbasins.
Kenmore: Sewer system, cost $113,163.
Kingston: 775 ft. 18-in. sewer pipe.
Lancaster: $12,000 to be expended on storm sewers.
Lowellville: Sewer system, cost $19,000.
Maumee: Main and outlet sewers in Key St. sewer district.
Newcomerstown: Sewer system for principal streets, cost $72,600.
Sandusky: 7,000 lin. ft. 36-in. brick, 4,000 lin. ft. 36-in. concrete plain, 1,000 lin. ft. 36-in. concrete reinforced, 4,000 lin. ft. 30-in. vitr. block, 10,000 lin. ft. 12-in. to 24-in. vitr. pipe, 125 manholes and 200 catchbasins.
Steubenville: 1 mile vitr. pipe sewers, 30 manholes and 60 catchbasins.
Toledo: Two new sewer districts.

Oklahoma—
Tulsa: 10,000 ft. 8-in. vitr. pipe sewers.
Sulphur: 54,700 ft. 6-in., 3,900 ft. 8-in. pipe sewers, 118 manholes, and 1,160 yds. rock excavation, cost $50,000.

Pennsylvania—
Carlisle: 2,000 ft. vitr. pipe sewers.
Harrisburg: $85,000 to be expended on sewer construction.
Meadville: Sanitary sewers.
Norwood: Branch terra cotta pipe sewers.
Reading: Sewer construction Section 1 and 2.
Sunbury: System of intercepting sewers.
Westchester: 20,000 ft. lateral sewers 8-in., 10-in. and 12-in. terra cotta.
York: Sanitary and storm sewers.

South Carolina—
Lancaster: 11 miles 8 to 15-in. sanitary sewers.

South Dakota—
Armour: Sewer system.
Britton: 4 miles sewers.

Tennessee—
Chattanooga: Sewer system in eleventh ward, cost $13,000.
Greenville: Sewer system, cost $30,000.

Texas—
Houston: Storm sewers.

Utah—
Salt Lake City: Main outlet sewer, length 18,000 ft., cost $270,000; 8-in. to 30-in. concrete pipe and vitr. pipe sewers, cost $1,500,000.

Vermont—
Rutland: 1 mile plain concrete sewers.

Washington—
Centralia: 2 miles trunk sewer with laterals, cost $160,000.
Walla Walla: 1½ miles vitr. pipe sewers, 25 manholes.

Wisconsin—
Chippewa Falls: Main street sewer, cost $11,000.
Fond du Lac: About 3 miles vitr. pipe sewers.
Merrill: 3,000 ft. 48-in. reinforced concrete sewers, cost $30,000.

SEWAGE DISPOSAL PLANTS.

Indiana—
Greencastle: Sewage disposal plant, cost $5,000.
Kendallville: Sewage disposal plant.

Iowa—
Sumner: Sewage disposal plant, cost $15,000.
Greene: Sewage disposal plant.
Waterloo: Sewage disposal plant, cost $13,000.

Massachusetts—
Boston: Sewage works for Davenport Brook.

Michigan—
Cadillac: Sewage disposal plant, 3 septic

Roads around New National Museum, Washington, D. C. Constructed with "Tarvia X".

This road is three years old—

HERE is a Tarvia-built road that for three years has carried the heavy traffic of sightseers to the New National Museum in Washington.

Ordinary macadam would have lasted but a few months in this location.

The addition of "Tarvia X" as a binder, when the road was constructed, has been sufficient to keep the surface in splendid condition for three years, with the prospect of very little maintenance expense in the near future.

Tarvia is a dense, viscid coal tar product of great bonding power. It introduces an element of plasticity in the roadway and binds the stone in a tough matrix. Internal friction under heavy loads is prevented. Water runs off the surface instantly, and the tarviated macadam will not ravel on slopes. The surface is automobile-proof, producing no dust.

Tarviated macadam in the end costs no more than ordinary macadam—its first cost is a little higher, but its maintenance cost is very much lower.

Tarvia is made in three grades: "Tarvia X" is suitable for building Tarvia-macadam roads; "Tarvia A" and "Tarvia B" are thinner grades suitable for roads already in use, to preserve them and make them dustless.

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TRADE B MARK

tank units, 6 contact filter units, one sludge bed, cost $27,000.
Highland Park: Sewage plant, cost $39,000.

Nebraska—
Laurel: Sewage disposal plant.

New Jersey—
Ventnor City: Sewage disposal works.

New York—
Brighton: Disposal plant for sewer district No. 1.
Glen Cove: Sewage disposal works.
Holley: Sewage disposal works.
Rochester: Sewage disposal plant in Irondequoit, cost $333,855.

Ohio—
Canton: Sewage disposal plant.
Delphos: Sewage treatment plant.
New Philadelphia: Sewage disposal works.
Urbana: Sewage treatment plant.

Pennsylvania—
Elwyn: Sewage disposal plant consisting of Imhoff tank, etc.

South Dakota—
Britton: Sewage treatment plant.

WATER WORKS.

Arizona—
Wickenburg: Water works system, including 100,000 gal. reinforced concrete water tank, 1,600 ft. 6-in., 8,000 4-in. pipe, and 2,000 2-in. galvanized pipe. 25 h. p. gasoline engine, 4-in. 2-stage centrifugal pump, 13 hydrants, gate valves, connections, etc.

California—
Montague: Water works system, cost $20,700.
Reedley: Extension of water system, cost $12,000.

Colorado—
Lamar: 2 miles water mains.
Walsenburg: Water works, cost $22,000.

Florida—
Jacksonville: Remodeling and extending pumping station.
Wauchula: Water works system.

Georgia—
Ball Ground: Water works plant.
Milledgeville: Water works system.

Illinois—
Carpentersville: Water works system, cost $20,000.
Deerfield: Water works system, cost $11,600.
Freeburg: Water works system.
Joy: Water works system, cost $21,000.
Kincaid: Water works distribution system.
Princeville: 22,350 ft. 4, 6, 8-in. pipe, 43 hydrants and valves.

Indiana—
Beech Grove, Indianapolis: Water works system.

Iowa—
Coin: Water works system, bond issue $12,000.
Des Moines: Water works system.
Mitchellville: Water works system.
Slater: Water works, cost $10,000.
Valley Junction: Water works system, cost $33,000.
Woodbine: Water works improvement.

Kansas—
Arkansas City: Water works and improvement extensions, cost $86,000.
Council Grove. Water works improvements.
Derby: Water works system.
Esbom: Water works plant.
Jetmore: Water and light plant.
Larned: Water works.
Manhattan: $10,000 to be expended on a water works improvements.

Louisiana—
Hammond: Water system.

Kentucky—
Campbellsville: Water works system, cost $35,000.
Sebree: Water works system.

Massachusetts—
Duxbury: Water system including 14 miles mains.

Michigan—
Grandville: Water works system, cost $12,000.
Highland Park: Water supply system, including 3,000 ft. 36-in. intake pipe, 1 submerged crib, 58,200 ft. 36-in. supply pipe, trenching, laying, back filling, etc.
Midland: Water works system.

Minnesota—
Alexandria: Water works system.
Hibbing: Improvement to water system, cost $950,000.
St. Paul: Improvement to water system.
Sanborn: Water works system.

Mississippi:
Tunica: Water works system including 50,000 gal. tank, etc.
Vicksburg: Water works plant.

Montana—
Columbus: Water works to be c. i. distributing system with 8-in. steel pipe.

Missouri—
Butler: Water works plant.
LaGrange: Water works system.

Nebraska—
Bruning: Water works system and light plant.
Dorchester: Water system, cost $13,000.
North Loup: Water works and electric light system, cost $19,300.

New Jersey—
Allendale: Water works system, cost $37,000.
Moorestown: Water works improvement.

New Mexico—
Raton: Water works system.

New York—
Arkport: Water works system.
Buffalo: Treatment plant for water supply.
Lackawanna: Water works system, cost $250,000.
Red Creek: Water works system, cost $25,000.
Rochester: 8 miles 27-in. c. i. pipe.
Sea Breeze: Water works system including 6 miles 6-in. and 4-in. c. i. pipe, hydrants and valves.
Sidney: Water works system, cost $125,000.
Williamson: Water works system, cost $27,900.

North Carolina—
Asheville: Water system.

Ohio—
Columbus: Alum plant for water purification works.
Granville: Water works and light plant.
Springfield: Purification plant.

Oklahoma—
Henryetta: Water works improvement to cost $20,000.
Morris: Water works system, bond issue $42,000.

Ontario, Can.—
Lambeth: Water works system, cost $10,000.
Leaside: Water works system.

Pennsylvania—
Harrisburg: Water works system.

South Carolina—
Mt. Pleasant: Water works system, bond issue $18,000.

South Dakota—
Veblen: Water works system.

Tennessee—
Brownsville: Water works plant, bond issue $12,000.
Jonesboro: Water works system.
Tiptonville: Water works system, cost $17,500.

Texas—
Aransas Pass: Water works and light plant, cost $30,000.
Rosenberg: Water works plant and distributing system at $18,000 and drainage system at $11,000.

Washington—
North Yakima: Water system, cost $15,000.
Pullman: Water works system improvement, cost $20,000.

West Virginia—
Wheeling: Rapid sand or mechanical filtration system, cost $240,000.

Wisconsin—
Two Rivers: Intake into Lake Michigan, cost $40,000.

BRIDGES.

Alabama—
Birmingham: Reinforced concrete bridge, cost $6,000.

Arizona—
Wickenburg: Reinforced concrete bridge, cost $10,000.

Arkansas—
Murfreesboro: Five steel bridges in Pike county.
Newport: Reinforced concrete bridge.

California—
Butte City: Bridge across Sacramento river in city.
Fairfield: Ten concrete bridges and one subway for Solano county.
Fresno: Bridge across canal, cost $7,000.
Marysville: One concrete bridge, length 2,200 ft. and three concrete bridges, length 50-ft. in Yuba county.
Placerville: One single arch concrete bridge in Eldorado county.
Redding: One steel bridge, Shasta county.
Redwood City: One bridge.
Sacramento: Reinforced concrete and timber trestles in Yolo county; one steel draw-bridge over Sacramento river and five concrete arches over American river in Sacramento county.
San Luis Obispo: Four steel girder and 12 concrete bridges in county.
San Barbara: $75,000 to be expended this year.
Willows: Protection work at Orland bridge.
Yuba City: Concrete girder bridge on Colusa road, cost $60,000.

Colorado—
Boulder: Four concrete bridges in city.
Canon City: Reinforced concrete and steel viaduct, cost $27,000.
Ft. Morgan: Reinforced concrete bridge in county.

Connecticut—
Hartford: One stone arch bridge, cost $9,500 in city.

Florida—
Fernandina: One plate girder draw-bridge over Amelia river.
Jacksonville: Three concrete bridges in Duval.

Georgia—
Covington: One steel bridge, length 300 ft., and one concrete arch bridge in city.

Illinois—
Bellevidere: Repairing State St. bridge.
Biggsville: One reinforced concrete bridge in Henderson county.
Cambridge: One reinforced concrete bridge in Henry county.
Chicago: One steel girder bridge, one swinging bridge and four bascule bridges.
El Paso: One reinforced concrete bridge in Woodford county.
Geneseo: Reinforced concrete bridge, span 60-ft., Henry county.
Grafton: Reinforced concrete bridge in Jersey county.
Harrison: Dobson bridge.
Herrick: Two reinforced concrete bridges in Macoupin county.
Momence: Bridge over Kankakee river.
Monticello: Bridge over Sangamon river, cost $7,000.
Pekin: One reinforced concrete bridge in Tazewell county.
Peoria: Approach to Kickapoo creek bridge.
Rockton: One reinforced concrete bridge.
Roscoe: One reinforced concrete bridge.
Springfield: Two bridges in Liberty Twp., Effingham county.
Stockton: Zink and Allison bridges.
Swansea: Reinforced concrete bridge, St. Clair Twp., St. Clair county.
Winchester: One reinforced concrete culvert in Scott county.

Indiana—
Anderson: Three bridges in Madison county.
Bloomfield: Bridge in Center Twp., Green county.
Bluffton: 18 bridges in Wells county.
Boonville: Eleven bridges in Warwick county.
Brownstown: Two steel bridges in Jackson county.
Connersville: Construction of four bridges and repair of two bridges.
Corydon: Bridge in Webster Twp., Harrison county.
Crown Point: Ten bridges in Lake county.
Greenfield: Bridge in Brown Twp., Hancock county.
Indianapolis: Several culverts and bridges in Marion county; bridge over White river at Washington St. in city, length 800 ft.; steel plate girder bridge over Pleasant Run at Minnesota St. in city.
LaGrange: Five steel and concrete girder bridges, LaGrange county.
LaPorte: Several bridges in LaPorte county.
Lebanon: Several bridges in Boone county.
Marion: Four bridges in Grant county.
Mishawaka: Steel and concrete br two 80-ft. arches and one 116-ft. arch over St. Joseph river in city.
Newcastle: Fourteen bridges, arches and repairs.
Peru: One bridge and repair of another in Miami county.
Portland: Twenty-four new bridges, nine repair jobs, and one stone wall.
Salem: Seven concrete bridges in Washington county.
Shelbyville: Several bridges and culverts in Shelby county.
Vernon: Concrete bridge across Big creek.
Vincennes: Four bridges.
Wabash: Bridge over Eel river in city.
Winamac: 18 bridges in Pulaski county.

Iowa—
Cedar Rapids: Paving of B Ave. bridge.
Davenport: Several steel and reinforced concrete bridges.
Dennison: 25 concrete and steel brid
Hampton: 20 highway bridges.
Knoxville: 90 reinforced concrete culverts and eight small steel bridges.

Lake City: Bridge over Coon river near city.
Marshalltown: Two reinforced concrete bridges.
Mason City: 14 concrete bridges.
Oskaloosa: 16 bridges.
Sioux City: 31 county bridges.
Tipton: One 70-ft. steel span; one concrete deck girder bridge, and several concrete box culverts.

Kansas—
Emporia: One steel girder bridge, five concrete arch bridges, and 40 concrete bridges in Lyon county.
Marion: Nine bridges in Marion county.
Newton: Four concrete bridges in Harvey county.
Pittsburg: Six combination steel and concrete bridges in Crawford county.

Kentucky—
Henderson: Bridge over Highland creek in Henderson county.

Louisiana—
Lake Charles: Two swing bridges over Intercostal canal.
Plaquemine: Bridge at Indian Village.

Maine—
Foxcroft: One reinforced concrete bridge at Lincoln St.

Massachusetts—
Boston: Steel bridge at Granite Ave.
Maynard: Concrete bridge and retaining walls on Florida road.
Newburyport: Rebuilding Newburyport turnpike bridge.

Michigan—
Bay City: Five bridges in Bay county.
Grand Rapids: Bond issue $138,000 for Pearl St. bridge.
Lansing: Ten highway bridges.

Minnesota—
Bemidji: 33 steel bridges.
Luverne: Two bridges on State road No. 5.
New Ulm: Steel and concrete bridge in town of Stark.
Sartell: Reinforced concrete bridge over Mississippi river.

Mississippi—
Aberdeen: Steel span bridge on Okolona road.
Greenville: Bridge across Deer creek in Washington county.
Natchez: Nine steel bridges in Adams county.

Missouri—
Kansas City: Rebuilding viaduct at 19th St.; new viaduct at 23d St., and concrete girder bridge in county.

Montana—
Dillon: One steel bridge over Big Hole river.
Glasgow: One steel girder and four concrete bridges in Valley county.
Missoula: 80-ft. concrete arch bridge at Cedar St.

Nebraska—
Beaver City: Several steel bridges.
Cambridge: Reinforced concrete bridge, cost $18,000.
Clay Center: Six bridges in county.
Imperial: Several bridges in county.
North Platte: Concrete girder bridge across North Platte river, in Lincoln county.
Omaha: 240-ft. span bridge in Douglass county.
St. Paul: High truss con steel bridge across Middle Loop river in Howard county.

North Carolina—
Reidsville: County bridge over Dan river, cost $12,500.
Winston-Salem: Iron bridge over Yadkin river, cost $31,000.

New Jersey—
Burlington: Pearl St. bridge, cost $15,000.
Mt. Holly: Reinforced concrete arch bridge at Pearl St.

New York—
Albany: Crescent bridge over Mohawk river, cost $185,000; reinforced concrete highway bridge over Black river at Lyons Falls, Lewis county.
Fonda: Six concrete bridges and 100 culverts in Montgomery county.
Mt. Vernon: Bridge at Fulton Ave., cost $47,000.
Ogdensburg: One concrete steel arch bridge in city.
Silver Springs: Four reinforced concrete bridges in Janesville.
Yorkville: Half-way bridge.

Ohio—
Canton: Bridge across Ohio canal; concrete bridge across Black creek, 2 spans.
Cincinnati: Four concrete bridges and three reinforced concrete viaducts.
Columbus: Several reinforced concrete bridges in Franklin county.
Coshocton: Denham steel bridge, floor and tubular piers, cost $17,000.
Dayton: Six steel girder bridges, one concrete arch bridge, and several culverts.
Eaton: Superstructure of bridge across Browers Run.
Elyria: $1,500,000 to be expended on elevated tracks or roadways.
Hamilton: Bridge at High St. over Miami river.
Lorain: East 28th St. subway.
Piqua: Concrete bridge over Miami river at Union St., cost $98,000.
Steubenville: Protection wall on Mingo pike, and concrete abutment for bridge No. 23.
Tiffin: Three reinforced concrete bridges in city.
Troy: Ten steel girder and 25 concrete bridges in Lincoln county.
Zanesville: Suspension bridge at Dresden; and steel bridge over Muskingum river at 6th St.

Oklahoma—
Arnett: 22 concrete culverts in Ellis county.
Fairview: Six steel girder and two concrete bridges in Major county.
Hobart: Nine steel bridges, one concrete bridge in Kiowa county.
McAlester: One concrete bridge in city.

Oregon—
Oregon City: Steel bridge spanning Eagle creek, cost $5,000.
Portland: Bridges 3, 4, 5 and 6 on Columbia highway at $40,050, and bridges 1, 2, 7 and 8 at $37,000.

Pennsylvania—
Ebensburg: Three reinforced concrete bridges.
Ford City: Bridge to cost $24,000.
Harrisburg: Wasser bridge across Shenango river, Mercer county.
Hooversville: Three steel bridges in Somerset county.
Lock Haven: Concrete, slag or wood floo on bridge in Clinton county.
McKees Rock: Bridge No. 2 over Chartier creek.
Monessen: 24 concrete steel bridges in Rostraver Twp.
Phoenixville: Bridge across Schuylkill river.
Reading: Reinforced concrete between Amity and Union Twps.
Warren: Bridge across Allegheny river in city, cost $95,000.

South Carolina—
Marion: One steel girder and four cc crete bridges in county.

Tennessee—
Memphis: Steel approaches to J. T. Harahan bridge at $500,000.

Nashville: Reinforced concrete viaduct at Cleveland St.

Texas—
Amarillo: Steel bridge across Canadian river, cost $15,000.
Angleton: Steel draw span bridge over Bastrop Bayou.
Belton: Two steel bridges over Nolan creek in city.
Cameron: Port Sullivan and Wild Cat bridges.
Houston: Several county bridges.
San Antonio: 11 culverts and ten girder bridges reinforced concrete in county, and concrete bridge at Houston St. in city.
San Angelo: Approaches to Christoval bridge.
Seguin: One concrete bridge in county.
Smithville: An 807-ft. steel bridge.
Sommerville: A 700-ft. steel bridge in county.
Waco: Rebuilding suspension bridge, cost $52,000.
Wharton: Two bridges.

Utah—
Salt Lake City: Suspension bridge to span Grand River Dewey.

Virginia—
Fairfax: Three concrete bridges in county.
Marion: 115-ft. bridge in Smyth county.

Vermont—
Northfield: Reinforced concrete bridge in city.

Washington—
Bellingham: One pile trestle, length 624 ft.
Chehalis: Steel bridge at Riverside, cost $14,000.
Conconelly: Bridge across Okanogan river at Melot.
Everett: Two steel bridges and one concrete bridge in county.
Olympia: Five steel girder bridges in Thurston county.
Wenatchee: Two large concrete bridges in Chelan county.

West Virginia—
Clarksburg: Concrete bridge, length 580 ft. and one steel bridge 450-ft.
Proctor: Three concrete bridges in Wetzel county.

Wisconsin—
Green Bay: Bridge over Fox river at $152,000.
Janesville: Six concrete bridges and one steel girder bridge in Rock county.
Milwaukee: Bridge across Milwaukee river in city, bond issue $350,000.

Wyoming—
Sheridan: One steel reinforced concrete bridge over Little Goose creek in city.

LIGHTING.

Alabama—
Gadsden: Municipal light plant.

California—
Redlands: Two miles ornamental lighting.
Sacramento: Municipal light plant, cost $115,000.

Colorado—
Colorado Springes: Municipal light plant, bond issue $150,000.

Connecticut—
East Norwalk: Appropriation of $25,000 made for light plant.

Florida—
Jacksonville: Lamps for municipal light plant, number indefinite.

Idaho—
Boise: 232 cast iron poles and 232 luminous arc lamps.

Illinois—
Chicago: Light and power system in 22d St. pumping station and in Harrison St. pumping station; 1,000 ornamental incandescent gas mantle lamps on certain streets to be installed.
Elgin: Municipal light plant. Appropriation $162,000.
Sterling: Boulevard lighting system to be installed.
Ottawa: 168 arch lights.

Indiana—
Anderson: Lighting system on Main and Meridian Sts.
Ft. Wayne: Addition to municipal light plant.
Huntington: Rebuilding and enlarging present city light plant.
Lafayette: Installation of boulevard lights along Main St. levee.

Kansas—
Atchison: Installation of number of lights.
Pittsburg: Ornamental lighting system, cost $13,000.

Louisiana—
Eunice: Electric light plant.

Manitoba, Can.—
Shoal Lake: Electric light system.

Maryland—
Baltimore: $30,000 to be expended for installation of 500 additional "White Way" lamps.

Massachusetts—
Seekonk: $500 voted for installation of "White Way."

Michigan—
Lapeer: Municipal light plant.
Unionville: Electric light plant to cost $8,000.

Minnesota—
Virginia: Gas plant, cost $75,000.

Montana—
Great Falls: 50 5-cluster ornamental lighting posts.
Helena: 675 electroliers, series Tungsten and Nitrogen.

Missouri—
Bevier: Municipal light plant in Callao.
Hale: Electric light plant in connection with ice plant.

North Carolina—
High Point: Arc light system.

New York—
Spencerport: $16,000 voted for electric light system.
Warsaw: Lighting in business section.

Ohio—
Painesville: $5,000 voted for lighting improvement.

Pennsylvania—
Butler: 175 three and five clusters of ornamental lights. 190-200 c. p. gas Tungsten lamps, and 310 80-c. p. Tungsten lamps.

Texas—
Austin: 100 cast iron poles and 100 series Tungsten lamps.
Houston: Municipal light and power plant.

Virginia—
Kenbridge: Electric light plant.

Wisconsin—
Juneau: $9,000 voted for electric light transmission line and distributing system.

AUTOMOBILES—FIRE APPARATUS.

Alabama—
Montgomery: Patrol wagon.

California—
Redlands: 80 h. p. 6-cylinder combination truck.
San Francisco: Appropriation of $450,000 recommended for motor vehicles.

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San Jose: One chemical wagon, two combination trucks, two horse-drawn patrol wagons, and one motor police patrol.
Watsonville: Auto fire apparatus recommended.

Connecticut—
Hartford: 5,000 ft. of hose, and $125.0 recommended for motor driven apparatus.
Willimantic: New hose.

Idaho—
Boise City: One combination chemical and hose wagon; one 4-wheel chassis combination wagon; one chassis for No. 1 steamer.

Illinois—
Bloomington: Auto patrol wagon.
Cairo: Auto for police department.
Chicago: 2-ton electric truck; two light automobile trucks; 5,000 ft. 1-in. chemical hose; and 50,000 ft. 2½-in. cotton rubber lined fire hose.
Joliet: Auto patrol; one combination chemical and hose; and one fire engine.
Moline: Bond issue $34,500 for motor apparatus.

Indiana—
Ft. Wayne: One motor truck power street flusher.
Logansport: One combination fire truck.
Vincennes: 500-ft. hose, and one automobile.

Iowa—
Cedar Rapids: Two 2-passenger autos for Department of Parks.
Clinton: Motor tractor for Central fire truck.
Dubuque: Triple combination motor pumping engine, and combination patrol and ambulance automobile.
Waterloo: One combination auto fire apparatus.

Kansas—
Ft. Scott: One patrol wagon motor-driven.
Topeka: Auto tractor for aerial truck.

Kentucky—
Clay: Chemical engine and other equipment.
Paducah: Triple combination automobile engine hose and ladder truck.

Louisiana—
Morgan City: Combination motor driven chemical and hose wagon, hook and ladder truck 1,000 ft. 2½-in. fire hose, and one 15-box alarm system.
Shreveport: Tractor.
Washington: 1,000 ft. 2½-in. 3-ply multiple woven fiber fire hose.

Maryland—
Baltimore: Rebuilding of fire engine No. 17.

Massachusetts—
Boston: Two 5-ton auto trucks for sanitary department.
Danvers: Purchase of additional fire equipment.
North Adams: Auto chemical and hose car.

Michigan—
Crystal Falls: One piece of motor fire apparatus.
Kinbe: Additional fire apparatus.

Minnesota—
Bemidji: 3-ton auto fire truck, cost $5,800.
Mankato: Fire hose.
St. Paul: 3,000 ft. hose, four chiefs' cars; one auto truck; four patrol wagons; one auto supply wagon; one auto for police department; two 5-ton auto trucks; one 4-passenger auto; and one 2-passenger auto for engineer's department.

Missouri—
Hannibal: One auto patrol wagon, and auto fire apparatus.

Mississippi—
McComb: Additional supply of hose and motor fire apparatus.

Montana—
Helena: One fire engine and one auto truck.

North Carolina—
Durham: Aerial truck; cost $10,000; motor police patrol, cost $3,000.

New Jersey—
Glen Ridge: Motor driven city service hook and ladder truck.
Newark: One fire engine.
Plainfield: Auto patrol and ambulance.
South Orange: Motor drawn apparatus.

New York—
Albany: Two-passenger runabout automobile for street dpartment.
Bronx Borough: One 7½-ton motor dirven truck and two 5-ton motor driven fire trucks.
Cortland: Two piece or auto fire apparatus.
Dunkirk: Motor driven hose and chemical wagon.
Green Island: Fire alarm system to be installed, and 60-gal. chemical tank, shut-off nozzles, etc.
Jamestown: Combination pump chemical and hose car.
Johnstown: One combination auto chemical hose and ladder truck.
Manhattan Borough: Two touring cars for police department; seven motor-driven hose wagons, and three gasoline automobile ambulances for department of health.
Sodus: $1,000 voted for hose and hose carts.
Utica: 2,000 ft. fire hose; one combination hook and ladder truck.

Ohio—
Cincinnati: Motorization of entire fire department by equipping present steamer engines with tractors.
Chillicothe: One combination automobile pumping engine and hose wagon, and one combination hose and chemical wagon.
East Liverpool: Motor driven patrol wagon.
Girard: Motor truck for fire department.
Lima: One auto fire wagon.
Marion: 1,000 ft. 2½-in. fire hose.
Pioneer: Chemical engine.
Ulrichsville: Motor fire truck.
Steubenville: $5,500 issued for chemical automobile hose and fire truck.
Youngstown: Five passenger automobile for engineering department.

Oregon—
Portland: Auto truck, cost $3,000.

Pennsylvania—
Allentown: Three automobiles for fire department.
Butler: One patrol wagon and extension ladders.
Harrisburg: Combination chemical and hose wagon; one or more tractors for steam fire engines and 3,000 ft. fire hose.
Pittsburg: 10,000 ft. fire hose, and motor lawn mower.
Scranton: Two tractors for steam engines $7,000; three triple pieces, $21,000; two combination chemical, $10,000, and one aerial truck, $7,000.
Sharon: 950 ft. fire hose.
Wilkesbarre: Three tractors, and three auto combination wagons.
Williamsport: Triple combination motor pumping engine.

Puerto Rico—
San Juan: 1,000 ft. hose, new chemicals and electric signal system.

Quebec, Can.—
Montreal: One auto salvage wagon; four automobile tractors; two automobile hose

wagons; one 85-ft. aerial ladder, automobile truck; and one auto fire engine.

Rhode Island—
Providence: Three fire trucks, cost $23,500.

Saskatchewan, Can.—
Moose Jaw: One motor truck; two motor combination hose and chemical wagons; one 75-ft. aerial truck; one motor triple combination; and one 2-wheel tractor.

Tennessee—
Knoxville: Auto police patrol.
Nashville: Auto engine for East End District and fire hose.

Texas—
Houston: One 3-ton motor driven truck for street department, one 5-ton m combination street flushing and sprinkling machine; one 4-ton motor driven combination street flushing and sprinkling machine; one 3-ton motor driven combination street flushing machine; one auto ambulance. For Precinct No. 1. Harris county, one automobile.

Vermont—
Rutland: One chemical wagon.

Washington—
Hoquiam: 1,000 ft. 2½-in. hose, and 1,000 ft. 3-in. hose.
Port Angeles: 1,000 ft. 2½-in. fire hose.
Seattle: 8,000 ft. 2½-in. fire hose.
Spokane: One auto truck, and 2,000 ft. 2½-in. double-jacket rubber-lined fire hose.
Tacoma: $17,000 appropriated for apparatus.

Wisconsin—
Sheboygan: One combination auto patrol and ambulance.

West Virginia—
Wellsburg: Auto fire truck.

Wyoming—
Cheyenne: 1,000 ft. fire hose.

GARBAGE DISPOSAL.

Florida—
Pensacola: Crematory.
St. Petersburg: Garbage and refuse incinerator.

Illinois—
Cairo: Two garbage wagons or carts.
Chicago: 200 steel garbage boxes.
Joliet: Garbage crematory.

Indiana—
Logansport: Destructor plant.

Michigan—
Pontiac: Number of garbage cans and a reduction plant.

Missouri—
Hannibal: Four garbage wagons or carts.

New Jersey—
Plainfield: Garbage and refuse disposal system.

Ohio—
Marion: Garbage disposal plant.
Sandusky: Incinerating plant to cost $15,000.

Pennsylvania—
North Braddock: Two garbage wagons.
Reading: Reconstruction of two units of garbage disposal plant.

STREET SIGNS.

California—
Redlands: 200 enamel street signs.
Vallejo: 1,000 street signs.

Canada—
Winnipeg: Street name posts and name plates. Amount not specified.

Colorado—
Boulder: Metal street signs.

Illinois—
Chicago: 500 street sign posts on concrete foundations and name plates.
Peoria: 400 enamel steel plates.
East St. Louis: 1,900 street signs.
Waukegan: 400 street signs.

Indiana—
Logansport: 2,000 street signs and 3,000 house number plates.

New York—
Schenectady: About 50 sheet steel r signs in county.

North Carolina—
Charlotte: 1,012 blue enamel street signs.

Ohio—
Akron: 3,400 blue and white enamel street signs.
Sandusky: 4,000 metal street signs.

Oregon—
Portland: $5,000 to be expended on street signs.

West Virginia—
Proctor: 50 metal road signs for Wetzel county.

Wisconsin—
Wenatchee: Probably 100 plain painted road signs boards in Chelan county.

BUILDINGS.

Alabama—
Huntsville: City hall.

Arkansas—
Argenta: City hall, cost $75,000.
Hot Springs: Rebuilding Garland county court house, cost $35,000.

California—
Bakersfield: Remodeling court house, at $25,000; and constructing 2-story county jail for Kern county.
Berkeley: Two-story fire station, cost $30,000.
Oakland: City hall, bond issue $32,000.
Oakland: Bond issue $500,000 for completion of municipal auditorium, and $80,000 for erection of Clawson school.
Richmond: City hall.
Santa Monica: Municipal auditorium, bond issue $150,000.

Florida—
Bartow: Jail for Polk county.
Jacksonville: Court house annex, cost $15,000.
Tampa: City hall, cost $183,000.

Illinois—
Chicago: Shelter houses for four playgrounds; two freight and passenger buildings for harbor district; 10-story and basement building in business district for police department; 21 police stations in outer districts.
Edwardsville: Court house, cost $193,000.
Olney: Court house, cost $70,000; township high school building.

Indiana—
Anderson: Remodeling city hall.
Bloomington: City hall, cost $25,000.
Bluffton: County hospital: cost $35,000.
Elkhart: City hall; school building for Noble county.
Indianapolis: Repairing shelter house in Riverside park.
Kendallville: City hall, cost $30,000.
Monon: Public library.

Iowa—
Pilot Mount: City hall, cost $5,000.
Rock Rapids: Court house.
Tama: City hall.

Kansas—
Horton: 2-story fire station.

Kentucky—
Paducah: Remodeling of court house.
Taylorsville: Court house, cost $30,000.