SCIENTIFIC AMERICAN

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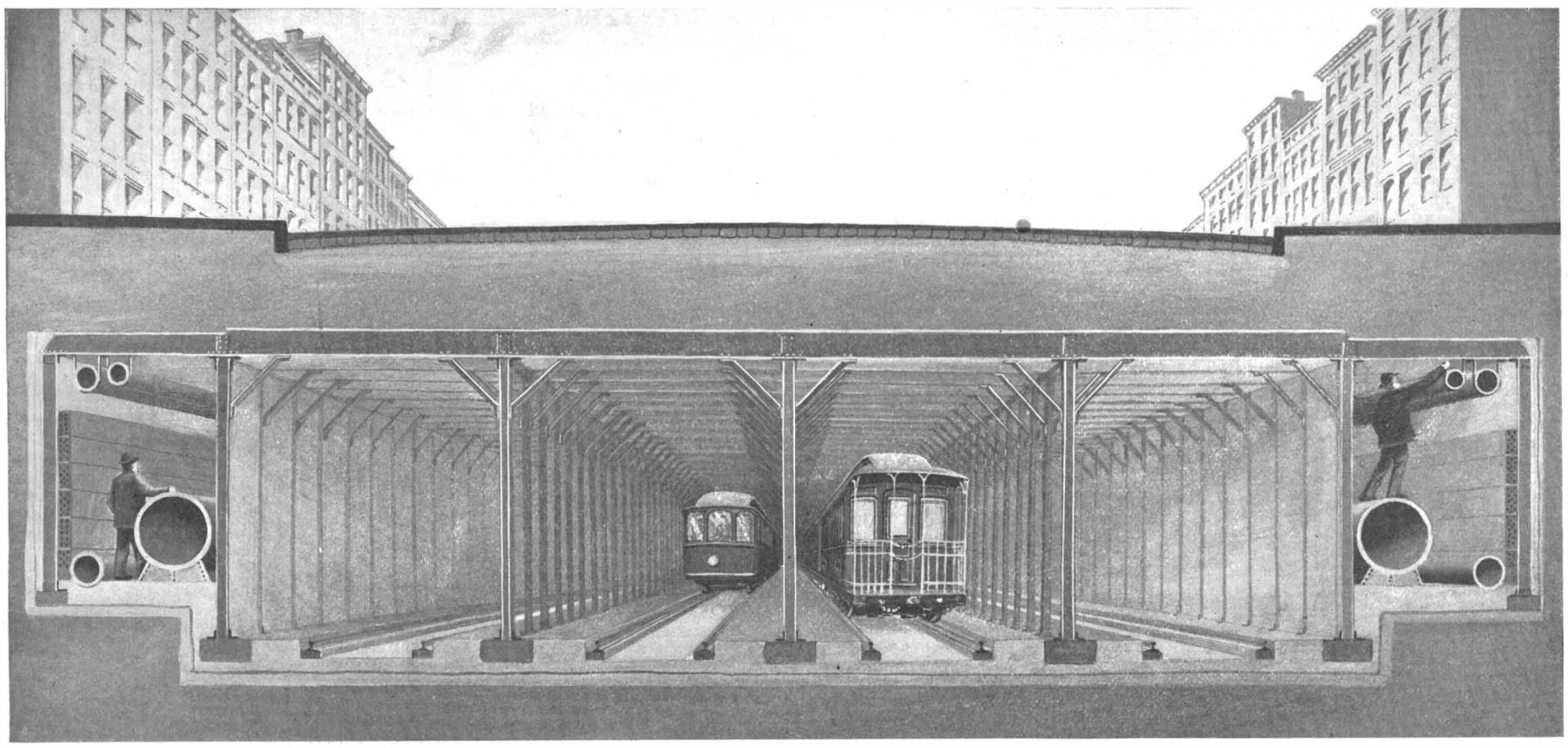
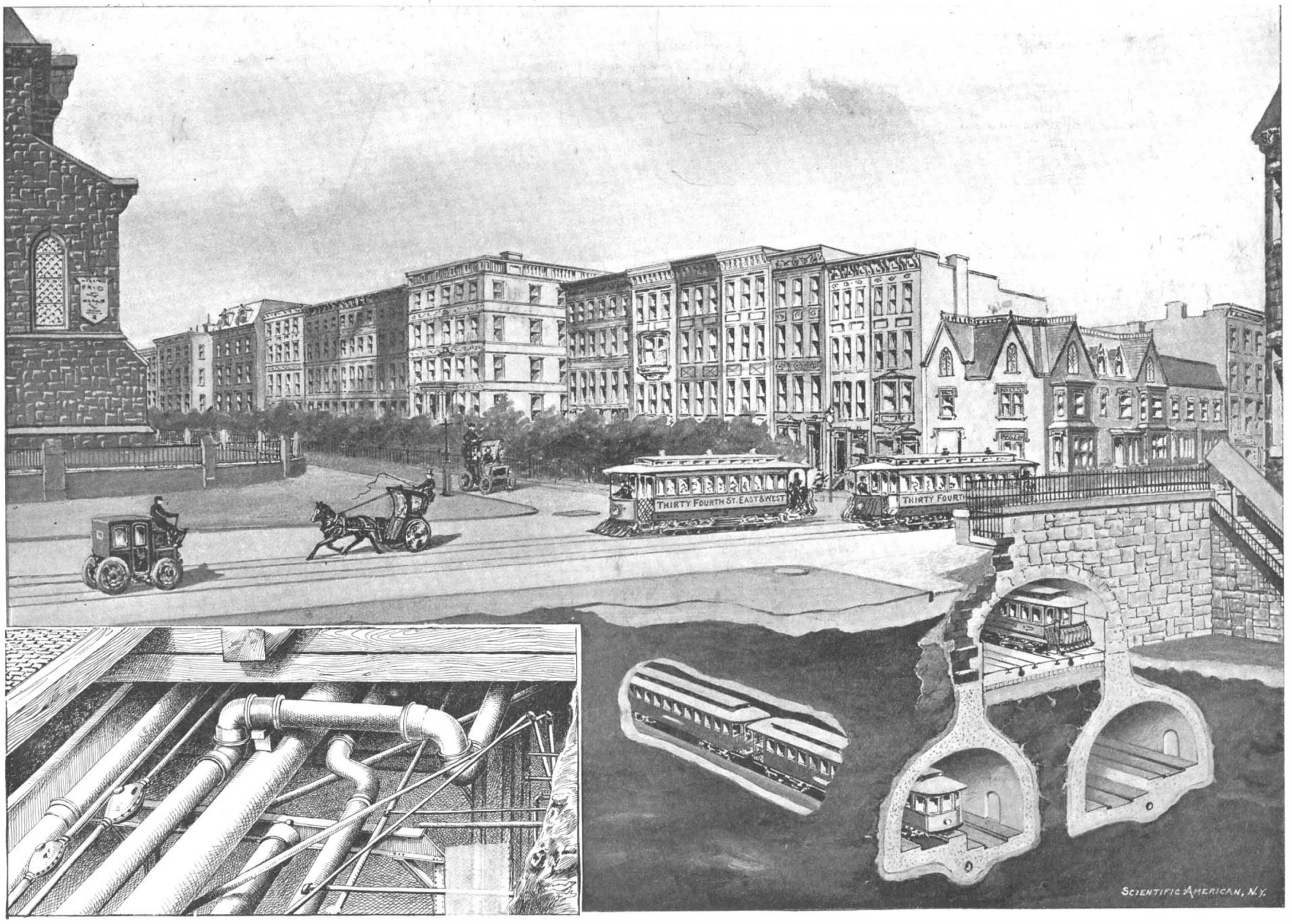


Typical Section through the Subway, Showing the Pipe Galleries as they should be Constructed.



Antiquated Method of Laying Pipes at Present A
(View at Nineteenth Street and Fourth Avenue.)

Sectional View at Thirty fourth Street and Park Avenue, Showing Eight Tracks at Three Different Levels.

SOME FEATURE HE NEW YORK RAPID TRANSIT TUNNEL.—[See page 327.]

Scientific American.

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NEW YORK, SATURDAY, MAY 25, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PIPE GALLERIES FOR THE RAPID TRANSIT SUBWAY.

The construction of the rapid transit subway afforded an opportunity for making proper provision for the mass of electric cables and gas and water pipes, which lie beneath the streets of the city, and are the cause of endless annoyance in the way of excavations for repairs and relaying. The opportunity to build along one or both sides of the subway special galleries to contain these pipes appealed at once to the engineers in charge of the scheme. As we have shown elsewhere, plans were drawn up which made adequate provision for present and future needs, and $35,000 was spent in their construction. It is to be regretted that the pipe galleries have been abandoned, chiefly, it would seem, as the result of pressure of a semi-political nature brought to bear upon the Railroad Commission. The municipal engineers chiefly affected by the erection of pipe galleries have, for various reasons, so bitterly opposed their construction that, rather than entangle the whole tunnel contract with legal complications, the Commission has abandoned the galleries, at least for the present. We are of the opinion that the question of the construction of these galleries is second only in importance to the construction of the subway itself, and that it is absurd even to suggest that there are any insuperable difficulties in making adequate provision of this kind for the water pipes, gas pipes, electric cables and other lines which at present lie buried beneath our main thoroughfares. The present interruptions to traffic, the interminable and absolutely stupid way in which our choicest streets are dug up, relaid and dug up again, is a perpetual and obtrusive nuisance, which would not be tolerated in any provincial town, and cannot be too soon removed from the streets of the second greatest city in the world.

REMARKABLE RESULTS AT SANDY HOOK.

One does not need to be an artillery expert to appreciate the great significance of the results obtained during the last two or three weeks at Sandy Hook in a series of government tests of the new high explosive Maximite. It is safe to say that just now there is no problem of greater interest in naval and military circles than that of carrying charges of high explosives in shells through armor-plate, and bursting them within a fort or battleship. We have heard a great deal of late about the English explosive Lyddite, which is, like Maximite, a picric acid compound, but is altogether wanting in the remarkable insensitiveness to shock shown by the latter explosive. When the battleship "Majestic" fired Lyddite shells against the "Belleisle" last summer, the shells passed through the skin plating of the vessel and burst within it; but whenever they struck the armor, which was of an old and easily penetrable type, they exploded harmlessly on the outside. Elsewhere in this issue it is told how at Sandy Hook shells of all sizes, from 6-pounders up to 12-inch, carried their loads of the new explosive through armor-plates of from 3 inches to 12 inches in thickness, and either exploded the charge in the plate or just beyond it. No such results as these have hitherto been obtained at any proving ground, either here or in Europe. When it is remembered that the new compound is far more powerful than wet guncotton; that it has an explosive value equal to that of nitro-gelatine and picric acid; that not only can it be fired from powder guns at the highest velocity with safety, but that it will withstand the far greater shock of penetrating any armor-plate that the projectiles themselves can get through, we can well understand that the ordnance officers are much gratified with the results. These Sandy Hook tests show that in the matter of high explosives the United States government has a long lead over any other.

THE GROWTH OF LONDON AND NEW YORK.

The census returns for the city of London, which have recently come to hand, afford a basis for comparison between the two great cities of the Old and New World. In each there has been a rapid increase during the past decade; but there is something prophetic of the future in the fact that not only has the rate of increase of New York city been very much greater than that of London, but that the actual increase has been two hundred and fifty per cent greater. In 1891 the population of London was 4,433,220 and in 1901 it has increased to 4,803,342, an increase in ten years of 370,122. In the year 1890 the population of what is now Greater New York was 2,492,591 and by the year 1900 it had increased to 3,437,202, an increase during the decade of 944,611. Fifteen years ago London was growing at the rate of 50,000 a year, whereas the increase of the past decade only averages slightly over 37,000 per year. As against this, a comparison of the census of the last two decades in this country shows that Greater New York increased from 1,901,000 in 1880 to 2,492,591, an increase of 591,246 or thirty-one per cent; while the increase of 944,611 from 1890 to 1900 was at the rate of thirty-seven and eight-tenths per cent. Assuming a rate of only forty per cent during the next ten years, the population in 1911 should be equal to that of London at the present time. It is likely, however, that the rate of increase will be nearer fifty than forty per cent, and should the rate at which London is growing continue to decrease, it is quite possible that by the time the next census is taken the population of the two cities will be about the same.

Outside of New York, the census shows that there are two cities (Chicago and Philadelphia) whose combined population is 2,992,272, while the increase during the decade has been 845,458, and the rate of increase 39.3 per cent, or slightly higher than the rate for New York. The greater increase has been that of Chicago, which has grown at the rate of 54.4 per cent, the rate of increase in Philadelphia being only 23.5 per cent. There are in this country three cities of between 500,000 and 1,000,000 inhabitants, five of from 300,000 to 400,000, and eight of from 200,000 to 300,000 inhabitants. The rate of increase in these three classes ranges from 28.5 to 23.2 per cent.

In looking at these figures, there is food for reflection in the fact that, as a rule, the larger the city, at least as far as the United States is concerned, the greater seems to be the rate of increase. At the same time it is reassuring, in the presence of this centralization, to bear in mind that improved means of transportation are rendering it possible for the teeming millions of the great cities of the world to be scattered over an increasingly wide area of outlying suburbs.

FORESTRY IN INDIA AND CANADA.

Canada might well learn a lesson regarding forest preservation from India. The government of the latter country found that as a result of the destruction of forests by ax and fire, vast tracts of land had been desolated, and there was danger that the whole country would become barren if the work of destruction were allowed to continue, for a country without forests is likely to be afflicted with alternate floods and droughts.

The work of protecting the forests was begun in India in 1844 and gradually extended, but it has been placed upon a thoroughly scientific basis only during the last twenty years. The service is divided into 210 departments under the direction of expert foresters, most of whom have been trained in Germany and France. They are assisted by a number of subordinate officials, many of whom are natives of India. A training school for these officials has been established near Dehra, and it is intended to have similar training schools at all the local centers, as it is desired to have none but expert foresters in the service. Promotions are made according to merit, and it is expected that in a few years about twenty per cent of the superior positions will be in charge of natives selected from subordinate positions. The foresters have to guard against fires, see that there is no waste in cutting, and that the smaller trees are not destroyed; also to provide for the maintenance of seed-bearing trees and the reforestation of sections denuded of trees. In each province there are state forestry reserves, and altogether these reserves cover an area of more than 80,000 square miles, which will eventually be largely extended. Forest revenue is raised by the sale of timber or other products, and by the issue of permits to graze cattle, cut timber, make charcoal, and gather firewood, bamboos, canes, and other minor forest produce. These permits are issued at specified fees. In the Central Provinces, where the reserved forest area is computed at 19,115 square miles, 1,950,000 cattle were grazing last year, and of these only 5,500 were allowed in the reserves without payment of fees. A large revenue is derived from the forests by the government of India and it is expected that it will steadily increase. In Canada it is pointed out that the time has arrived for the various governments to establish systems of scientific forestry. The officials of the Dominion experimental farms began some time ago to encourage tree-planting by farmers, especially in the treeless regions of the Northwest, but it is said it is to the provincial governments, which control the crown lands in all the provinces with large forest areas, that the people must look for forest legislation. Many districts altogether unsuited for agricultural purposes have been denuded of trees, and if the provincial governments had profited by the experience of other countries, these districts would have been maintained as forest reservations and would now yield a large annual income. It is not, however, too late to begin the reforestation of many of these districts, although it will take a long time to restore them to their former condition; but it is in the districts where the forests still remain standing that scientific forestry can accomplish the best results. There are still vast areas of forest lands which may be made a permanent source of wealth to the people and yield a large annual revenue to the provincial governments as well as affording employment to many thousands of men. Much of the land now covered by forests is well suited to agricultural purposes, and it would be a mistaken policy to keep the whole of it as a forest reserve; but in opening the country for settlement, experts should examine each district and determine what lands should be maintained as forests and what should be offered to settlers. One of the conditions of land grants to farmers should be that a certain number of acres should be kept permanently covered with trees. Germany is most advanced in the science of forestry, and the government derives an immense annual revenue from the forests.

NEW PROCESS FOR PLASTER OF PARIS.

The subject of the formation of plaster of Paris, which, as is well known, is produced by the baking of gypsum, has received considerable attention in Europe of late, and especially in France, where the researches of Prof. Le Chatelier, of the College de France, have been followed by some improved methods for producing the plaster. Prof. Le Chatelier found that the dehydration of gypsum presents two distinct phases, the first at a temperature in the neighborhood of 130° C., and the second near 165°. Below 160° C. the gypsum loses only 15.6 per cent of water to form the normal plaster (the gypsum having 21 per cent for the formula $CaSO_4,2H_2O$) which then contains but 5.4 per cent of water of combination and corresponds to the formula $CaSO_4,\frac{1}{2}H_2O$. It is important, therefore, that in the baking of gypsum the temperature should be thus regulated in order to secure the normal plaster; however, in the usual practice this is far from being the case. The process usually employed for building plaster in France, and especially in the region of Paris, which is very rich in gypsum, is to carry out the baking in a special form of oven. The oven is itself constructed of gypsum blocks in the form of vaulted chambers, which are then loaded with gypsum; between the blocks are left air-spaces, and a fire is lighted under the vaults, which have been partially filled with combustible. The baking is thus quite irregular, and the lower parts nearest the fire are calcined and lose completely their water of combination, and the others are blackened by the smoke and lose more or less water according to the distance. In this way the resulting mixture contains but a small proportion of normal plaster, and, besides, is never white. To obtain the best plaster, such as is used for modeling, another process is used. The gypsum is carefully picked and freed from impurities. Several months after its extraction from the quarries, the stone, which is then sufficiently dry, is broken in small pieces as regular as possible and heated in a furnace resembling a baker's oven, in the same way in which bread is cooked. Under these conditions the plaster is white and is normally dehydrated, but its price is very high, this being $12 to $16 per ton, while that of the ordinary plaster is $3 to $4. A number of furnaces have been recently devised for producing a plaster which shall be normally dehydrated and white, and at the same time cheap. The Périn furnace is one of the best of these, and has the advantage of needing but little hand-work and of pushing the dehydration to the desired point by the introduction of hot gases; besides, as it makes 8 furnacefuls in 24 hours, the production is rapid, and one of its main advantages is a great economy of combustible. It consists of a heating furnace and a baking chamber; the furnace, heated by coke or other smokeless combustible, communicates by a conduit with the chamber, which is formed of a metallic cylinder revolving about its axis upon mechanically operated rollers, and contains the pulverized gypsum, which rolls upon itself by the continuous movement of the drum, so that its particles are successively exposed to the hot gases which traverse it. Above the drum is the charging-bin, in which the gypsum is heated previous to its introduction, being surrounded by a series of tubes which are heated by the discharge gases. When one charge is baked, it is let fall into

a lower chamber by a trap, and a new supply fed in from the charging hopper. The latter is kept supplied from the grinding mills by a bucket conveyor. A company is being formed to work this process, with a capital of $300,000, and it has obtained possession of an extensive gypsum bed situated in Algeria, on the banks of the Oued-Harbel.

WILD ANIMALS IN WINTER.

BY CHARLES FREDERICK HOLDER.

The devices of animal life to bridge over the winter season, and their ways and habits during this time, present an interesting, indeed fascinating, page of nature. Why certain forms should defy the elements and roam abroad, seeking a precarious livelihood, while others, much stronger and apparently better equipped by Nature to survive the struggle, enter the strange and remarkable winter sleep with all their functions in abeyance, and sleep away the winter, is one of the problems that is of more or less interest. The fox well illustrates the former with its winter habit of prowling over the snow.

At the approach of winter, animals are affected in various ways. In the North all the reptiles—snakes, lizards, frogs and toads, a vast concourse—disappear in a most miraculous manner. The snakes enter holes and crevices, projecting themselves as far into the earth as possible, and, coiled tightly, assume a condition, a state of coma, in which they remain until the heat of the sun comes to waken them the following spring, when they appear voracious, and eager for prey to rehabilitate them physically after months of fasting. The frogs plunge down into the mud of the ponds where they have made music during the long summer; and the same is true of turtles. Lizards affect the same places as snakes, and when taken out at this time are apparently lifeless. In some marvelous manner the functions of life are arrested. There appears to be a minimum consumption of tissue; Nature apparently making an exact calculation, the functions of life being so almost completely arrested that they are enabled to lie in this quiescent state without food or water, or until the food supply comes again and the conditions are favorable to outdoor life.

This is the case with the reptiles of the Eastern and Middle States, or wherever there is a cold winter, ice and snow; but on the Pacific slope, in Southern California, in the same latitude as the above, a different condition holds. Here—and the San Gabriel Valley may be taken as an example—the lizards are subjected to a winter and summer every twenty-four hours. There is no snow, the days are bright and beautiful, resembling a cool Eastern summer, and insect life does not disappear. All winter I have found lizards basking in the sun on these bright days, but as the winter day wears on and four o'clock approaches. there is a very material change—a strange chill that affects reptilian life at once. It is their winter, and just as the Eastern lizard creeps down into the earth for shelter and enters its winter sleep, so this California lizard crawls out of sight beneath rocks, into crevices or under the bark of trees, and enters what is the equivalent of a state of coma. It seems to shrivel, becomes seemingly intensely cold, often stretches out its entire length, and lies, to all intents and purposes, dead and lifeless, in this way passing the night until nine or ten o'clock in the morning, when the rays of the sun slowly bring it back to life.

This curious night coma is, so far as appearances go, identical with the winter sleep of eastern lizards. The functions are in abeyance for the time and life is at its lowest ebb. In observing these sleepers I have found them by turning over the piles of stones early in the morning, and have often found a row of them, limp, cold and apparently dead, lying in the sun, to watch the gradual return to life. It came very gradually; those lizards placed on their backs first showing signs of life by a quivering of the limbs, which were then drawn up; then the long tail would move, and finally the little sleeper would clumsily roll over into an upright position; and as the direct rays of the sun struck and warmed it into life its eyes would grow brighter, and suddenly, as though touched by some magic wand, its head would be lifted high, the blue breastplate gleamed in the light, and with an air of astonishment and alarm this sleeper awakened would dash over the ground and escape, once more a living creature, a type of activity, a menace to insect life. Every night in the Californian winter this occurs, and the condition can easily be superinduced by subjecting the animals to artificial cold. The bears in Southern California are found abroad at all times, while in the northern part of the State and in the East they enter into a complete state of hibernation, going into their winter sleep well conditioned and fat, evidently living on the latter until spring, when they emerge lean and ugly.

The change in color of animals at the approach of the winter season is one of the remarkable features of life. The ermine as an example and several others assume a white coat, the change being a protective feature. The ptarmigan has a similar habit, a change which renders it inconspicuous to its various enemies.

At the approach of winter the birds perhaps present the most remarkable spectacle. With some few exceptions they move away from the conditions which threatened them; and in what is popularly called the departure and return of the birds we contemplate a wonderful migration, in which the highest instinct of self-preservation appears to have been developed. The birds of the coast have a definite line of migration; the shore line at this time constitutes a bird highway, over which tens of thousands are passing—in the autumn to the South, where there is a food supply; in the spring to the North, to the fields they know so well, and the nesting places where the young are to be raised. Much of this migration is carried on at night high in air, and during storms myriads of birds are often confused and killed by dashing blindly into the lighthouses that mark the highway. At Heligoland Light the ground in the morning is frequently strewn with birds, from ducks and geese to the smallest songsters. In the interior the birds follow valleys and the mountain ranges.

On the Pacific coast the Coast Range and Sierra Nevada Mountains constitute a well defined line of travel. In Southern California the flight of cranes and geese along this pathway is a remarkable sight. The birds, especially the cranes, cover long distances by soaring, gradually reaching within rifle shot from the ground; then they stop and begin a spiral movement, turning in graceful curves, flashing like silver dollars in the sunlight as they turn and disappear, rising ever higher until they are a mile or more above the valley, or above the summit of the Sierra Madre; then, as though at the command of the leader, they turn, and in long lines soar away with remarkable velocity, literally sliding down hill, covering six or seven miles or more before the maneuver is repeated.

The winter finds the trees, groves and gardens deserted except by the few forms which defy the cold. The birds are in the South—Florida, Cuba and even South America; the reptiles are housed underground; insect life has been destroyed or is hibernating, and will spring into life in the spring. The only animals abroad are the mammals; the deer, elk, caribou, fox, cougar, wild rat, lynx and other forms, which wander over the barren wastes and in the deep snows of the woodlands, finding a precarious living until the spring comes, the wanderers return and all life takes on a new meaning.

NEW TRANS-PACIFIC CABLE.

It has at last been decided to construct the Trans-Pacific telegraph cable connecting Australia direct with England via Canada. The contract has been placed with the Telegraph Construction and Maintenance Company, is to be completed by 1902, and will cost $8,975,000 to construct, exclusive of preliminary surveys and other incidental expenses which will amount to about another $900,000. The cable will run from England to Vancouver, thence to Queensland, and New Zealand, via Fanning Island, Fiji, and Norfolk Island. It is impossible to estimate the importance and commercial value of this route, since it will enable the most distant colonies to communicate with England, independently of the lines that pass through or near Europe, while messages will be conveyed at a cheaper tariff, and commercial activity will be considerably stimulated.

The growth of telegraphic business between Australasia and England has developed remarkably during the last twenty-seven years. In 1873 the International line was opened, and during the first year 8,952 messages were transmitted to and from the colonies. In 1884 this total had grown to 48,896 messages, which is equivalent to an annual increase of 40 per cent.

The present scheme has been under consideration for several years, but it was not until 1886 that the enterprise first assumed any tangible shape. In that year the Agents-General for the colonies, in a deputation to Sir Charles Tupper, who was High Commissioner for Canada at that time, declared that after careful investigation they had concluded that such a cable could be laid for a total annual subsidy of $500,000, extended over twenty-five years. For several years the scheme was then permitted to remain in abeyance, but six years ago an expert estimate was prepared as to what amount of business might be anticipated from such a cable. It was then calculated that the gross earnings at an average tariff of 50 cents per word would amount to $550,000 for the first year; for the second year, $632,500; and for the third year, $715,000; while a surplus of $772,500 would be yielded during those first three years' working.

Regarding the construction of the cable, it has been apprehended in some quarters that great difficulty would be encountered in laying the cable at certain points of the route, notably at Fanning Island, the approach to which is rather steep. In the opinion of cable engineers, however, this is considered of small moment, since there are several stations of other cable companies which are approached by equally steep gradients, and yet the cables have never suffered any disturbance of any kind. The cable will be laid in deeper water than has previously been the case, since, whereas the greatest depth for such work has been 2,500 fathoms, in this instance it will be for the most part 3,200 fathoms. It is not anticipated, however, that any trouble will be encountered in this direction, since various types of cables have been designed for varying depths. They will be most carefully made, and in the deepest water the cable will be of small diameter. It is expected that the transmission of a message between London and Australia will occupy twenty minutes.

No decision has yet been made regarding the tariff. The Eastern Telegraph Company at present charges 87 cents per word, which in course of a few years, will be reduced to 62 cents per word. Fourteen years ago the tariff was $2.70 per word, so that some estimate may be gathered of the development of telegraphic communication between England and Australia to permit of such a large reduction.

SCIENCE NOTES.

Berlin was treated to zero weather during January. The River Spree was frozen over so suddenly that the ice caught thirteen of the city's swans, and the Fire Department was called out to release them.

Cocaine sniffing is on the increase in the South among the negroes. The drug is sniffed up the nose and the results produced are somewhat the same as those obtained by smoking an opium pipe.

A dispatch from Cardiff states that an electrician named Smith has invented two X-ray tubes which he claims do not produce any bad results upon the subject, one of them actually tending to heal burns and wounds, says the New York Sun. It is said that one of them makes bones and not flesh visible on a photographic plate, while the other makes neither visible, the plate only showing foreign substances.

To promote uniformity in results and to secure accuracy and to give legal value to the evidence of X-rays it is necessary to standardize methods of doing the work. To this common benefit all X-ray experts are asked to contribute for the general good of the cause. The Roentgen Society has issued a circular giving a list of standards which it is desired to establish. A copy of this circular can be obtained from S. H. Monnell, M.D., 47 West 27th Street, New York city.

"Synthol" is a chemically pure substitute for absolute alcohol. It may be used for every purpose for which alcohol is used except for internal consumption. Being chemically pure it does not have as much odor as absolute alcohol from grain or wood. It is perfectly free from color, is non-irritant to eyes or skin and has ten to fifteen per cent more solvent power than ordinary alcohol. As a killing, fixing or hardening agent it is in every respect equal to the best absolute alcohol and can be used as a substitute for it in the preparation of stains, reagents, etc. As a preservative it is superior to any alcohol, as alcohol becomes tinged with color on exposure to light, while synthol retains its absolute colorlessness under all conditions.

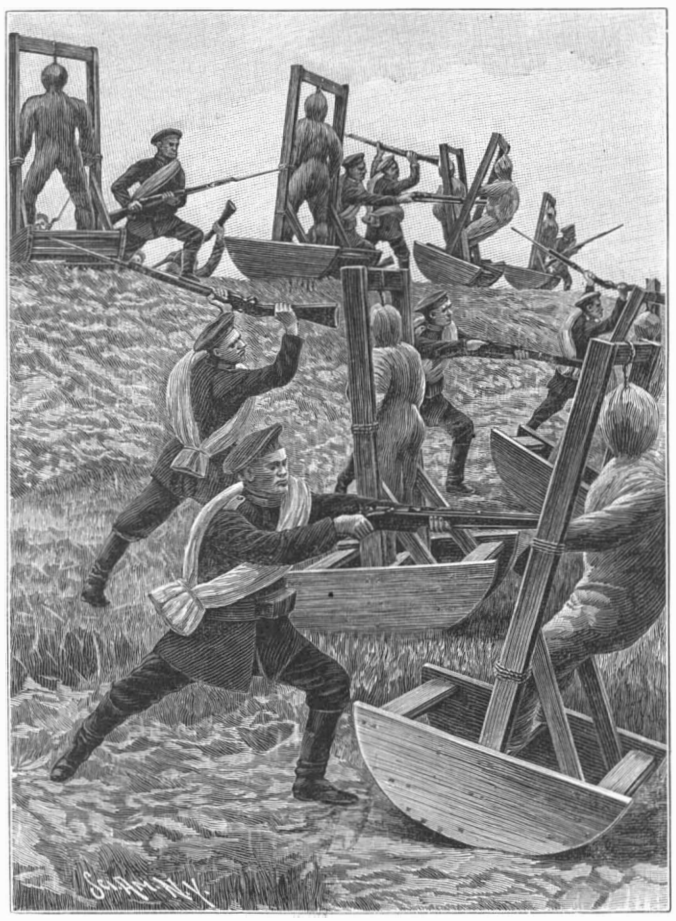
The Germans have invented a new description of glassware, specimens of which have been on exhibition in England. This cloisonné glass, as it is called, is similar to stained glass, but is claimed to be superior. The design is prepared in double brass wires, and the interstices are filled with small pieces of colored glass. This design is then mounted upon a large sheet of plain glass, to which it is firmly attached by means of a translucent cement. Another similar sheet of glass is then placed upon the top of the design in the same way, so that the colored glass is inserted between two sheets of glass. By this means the cloisonné glass is smooth on either side. It cannot be bent or loosened, and in view of the thinness of the brass wires more light is admitted than is the case with stained glass, owing to the thickness of the leaden framework in the latter.

Sir Harry Johnson, Special Commissioner to Uganda, reports the established existence in the Semliki forests of a peculiar ruminant thought to be long extinct, says the New York Sun. Fossilized remains of this animal have been found plentifully in Greece, and it has been called hitherto helladotherium. A complete skin and two skulls are now on their way to England for the British Museum. The natives call this animal the okapi. It is a giraffe-like creature, and is closely akin to the ox in size. The neck is a little longer, proportionately, than that of a horse; the ears like those of the ass, with silky black fringes; the head taper-like, and the nostrils like those of the giraffe. The forehead is a vivid red, and the neck, shoulders, stomach and back a deep reddish brown. Parts of the animal are almost crimson and others blackish in hue. The hind quarters and legs are boldly striped in purplish black and white. The animal is hornless, although there are traces of three horn-cores.

RUSSIAN BAYONET EXERCISES.

Since January 13, 1874, military service has been rendered obligatory in Russia on all men from their twenty-first year. Out of about 870,000 young men reaching their majority every year, some 287,000 are taken in to the active army, and the remainder are inscribed partly in the reserve and partly in the second reserve, or "Zapas." The term of service is in European Russia five years in the active army, thirteen years in the reserve, and five years in the "Zapas"; seven years in the active army and six years in the reserve, in Asiatic dominions; and three years in the active army and fifteen years in the reserve, in Caucasia. In case of need the Minister of War has the right of keeping the men under the colors for another six months. College men, doctors and teachers are exempted, and certain privileges are granted on account of education. The lowest estimate which can be made of the peace strength of the Russian army puts the number of officers at 36,000 and of the rank and file at 860,000 men, the total number being 896,000. In war the total strength is approximately 63,000 officers and 3,440,000 men, the total being 3,500,000.

Even with such a vast army it is, of course, necessary to maintain the same efficiency as in smaller armies, and in Russia, as in Germany, many unique exercises have been adopted, among them being the one shown in our engraving, which represents a bayonet exercise with oscillating dummies. These oscillating dummies are placed on the top of the intrenchments which the soldiers scale. After the men have delivered their blows they go down the other side, at the bottom of which another row of similar dummies has been placed. Their attack is rapid, and the soldiers, going through the ranks of their silent victims, place themselves in skirmishing order. The dummies consist of wooden cradles to which are secured uprights and cross pieces; figures simulating men are secured to the top piece and the side rails. At first the appearance is rather grewsome, suggesting a series of gallows.



BAYONET EXERCISE WITH OSCILLATING DUMMIES IN THE RUSSIAN ARMY.

THE POPOFF-DUCRETET APPARATUS FOR WIRELESS TELEGRAPHY.

As long ago as the time of the advent of the first apparatus for telegraphing without wires, the question was asked whether it would ever be possible to perceive signals at distances great enough to render the system practical. The improvements that have been introduced since then relate to the power of the transmitting and the sensitiveness of the receiving apparatus. The experimenters that have occupied themselves with the question are very numerous. One of them, M. A. Popoff, in conjunction with MM. Ribkine and Troitsky, officers of the Russian corps of engineers, while making some experiments last May between two islands situated near Cronstadt, finding that the receiving apparatus had ceased to operate, conceived the idea of introducing a telephone into the circuit of the radio-conductor and battery, in order to verify the passage of the current, and was astonished to find that the signals of the transmitter could be distinctly heard. From this he concluded that the electric waves produced in the radio-conductor variations of resistance that were directly perceptible at the telephone, and that it was possible to simplify the receiving apparatus by suppressing the relay and the automatic decoherer. It will be remembered, in fact, that the receiving apparatus usually employed up to the present are based upon the use of the Branly tube, the metallic filings of which become conductive after they have been reached by the electric wave, and would remain so, were not the tube struck in order to decohere them. Hence the necessity of certain complications in order to obtain the shock automatically immediately after the passage of the wave. According to M. Popoff's experiments, this is not necessary with the telephone. The filings, under the influence of the electric waves, undergo different states of conductivity, and the current of the local battery that traverses them is sufficiently modified to produce in the disk vibrations that are probably very feeble, but perceptible to the ear. The radio-conductor must, however, undergo certain modifications in order that its sensitiveness may reach a maximum, and the form that has therefore been finally given it is that of a microphone consisting of steel needles resting through their extremities upon plates of carbon. The apparatus that M. Popoff has studied and constructed in order to render the application of the apparatus very easy consists of a wooden box, which contains a dry battery, the radio-conductor and the telephone. For the carriage of the apparatus, the radio-conductor is placed in the interior of the box at *M*; but for use it is fixed at its upper part, at *A*, and the connections with the battery and telephone are made by spring-jacks which may be quickly put in place. A hinge permits of ascertaining at what inclination it presents the greatest sensitiveness. By means of a special device, *D*, and a flexible cable, the apparatus is connected with the yard of the mast that has been previously established, while a flexible cord, starting from a terminal, *E*, establishes a communication with the earth.

The local circuit of the battery is closed upon the radio-conductor and telephone by means of a small commutator, and the telephone is put to the ear. As soon as the transmitting station operates there are very distinctly heard sounds that are now short and now long, and that correspond to the signals of the Morse alphabet. The sensitiveness of the apparatus is such that upon taking as a transmitter a Ruhmkorff coil that gives a spark of but 4 mm., M. Ducretet has been able to establish communication between his shops upon Rue Claude-Bernard and another station situated upon Boulevard Port-Royal, at 500 meters distance.

Last winter M. Popoff made a most interesting application of his apparatus in the Gulf of Finland. A Russian armorclad was stalled among the rocks upon the coast of Hohland Island, and her somewhat critical position forced her to winter there, no communication with the continent, 47 kilometers distant, being possible.

M. Popoff was commissioned to establish communication by wireless telegraphy, and so a station was installed on Hohland Island, another near the city of Kotka, and a third upon the ice-breaking ship "Ermack." By the end of January everything was finished and regular exchange of dispatches was begun. These permitted of saving the lives of twenty-seven fishermen who had floated off on a cake of ice, the position of which it was possible to signal in time to the "Ermack." The transmissions were not interrupted, even when the snow was falling so fast that it was impossible to distinguish an object at a distance of two meters. It seemed, on the contrary, as if the electric wave was propagated more easily under such circumstances. Up to the month of April, the epoch at which the armorclad was saved, 440 dispatches were exchanged.

This new apparatus will not supersede those already in service that permit of the inscription of dispatches with the Morse receiver, but will prove useful alongside of them for cases in which they might not operate. On account of its great simplicity and sensitiveness, it will serve for stations that it might prove convenient to install for temporary use. In the service of wireless telegraphy it may be considered as playing the same rôle as does the "speaker" in telegraphy with wires.—La Nature.

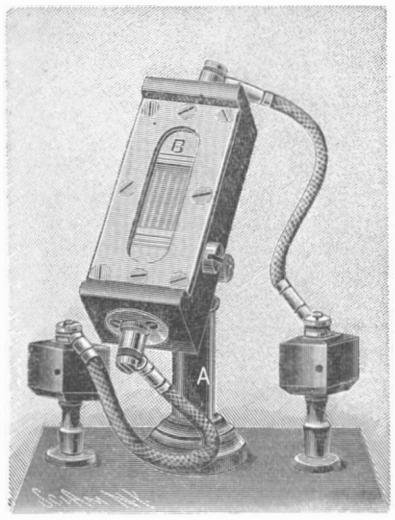


Fig. 2.—DETAILS OF THE POPOFF-DUCRETET RADIOCONDUCTOR.

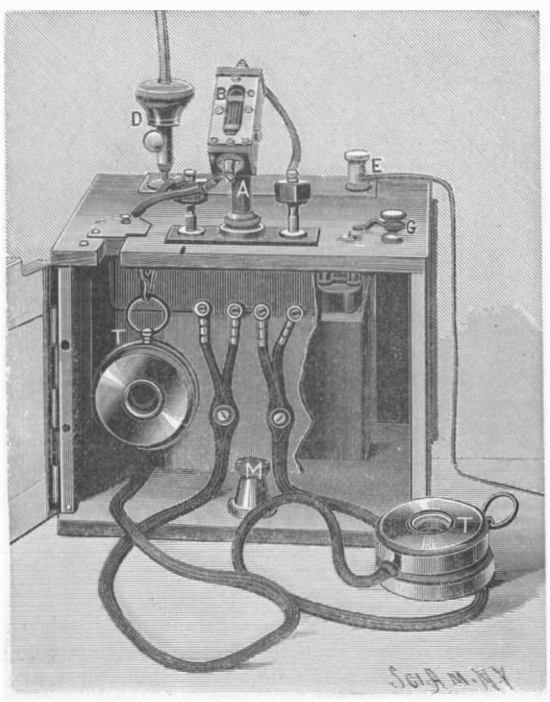
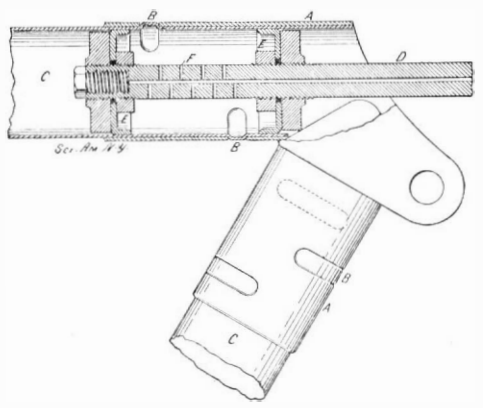


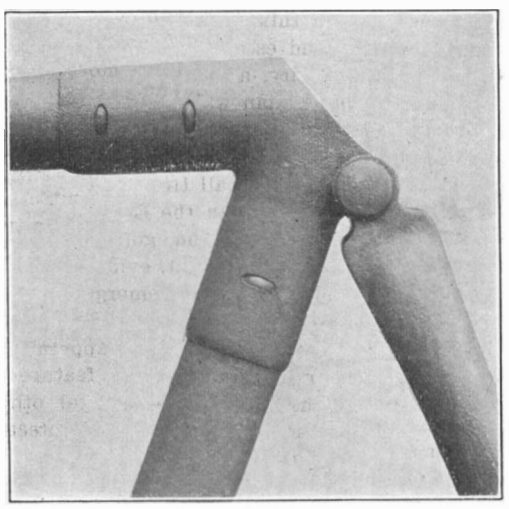
Fig. 1.—GENERAL VIEW OF THE POPOFF-DUCRETET TRANSMITTER.

A HYDRAULIC BICYCLE JOINT.

The prevailing method of joining the various sections of a bicycle frame possesses many disadvantages. The thickness of the tubes which are utilized for this purpose are necessarily thin to insure the desired lightness. In brazing, when it is heated the steel loses its strength, and if the workman carelessly applies the spelter to the part, so that the joint is not well made, the rigidity and solidity of the machine is seriously impaired. In the cheaper machines little attention is paid to the completeness of the attachment, and the result is that after the bicycle has been in use for a short time, the vibration detaches the small areas that are attached by the spelter, with the result that the machine collapses. Considering the great speed at which bicycles are driven, it is highly essential that the joints of the frame, the most vital parts of the cycle, should be firmly and thoroughly effected. Then again, after the brazing, in the



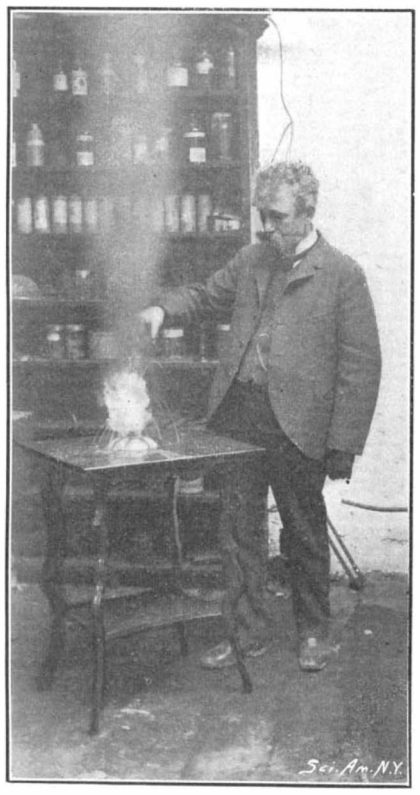
SECTIONAL VIEW OF TUBES, SHOWING TOOL IN POSITION.



A BICYCLE JOINT MADE HYDRAULICALLY.

final filing away of the superfluous spelter, the thickness of the steel tubing is further reduced. It is computed by engineers that the brazing process weakens the steel to the extent of 45 per cent in the best class of work, and consequently this percentage is far greater where the work is imperfectly performed. Of course, care is exercised to guard against this deficiency in strength by the utilization of extra metal, but even such a precaution does not adequately compensate the reduction in the strength of the material.

In view of these drawbacks, the invention of Mr. Birtwhistle, of Manchester, England, by which the various portions of the bicycle frame are joined together by a hydraulic process, instead of by brazing, should prove highly valuable. In this method the metal does not have to be heated at all, but is treated



The Inventor Pouring Molten Iron Upon Maximite.

in its cold state, so that the strength of the steel is not affected in the slightest degree. A number of small slots are cut in the outer tube and the metal of the inner tube forced outward so as to occupy the space in the slots. How this is accomplished may be comprehensively realized by referring to the sectional diagram of a joint.

This figure illustrates the joining together of the two tubes forming the pillar lug, together with the simple hydraulic appliance for performing the operation. The lug is represented by *A*, and the small slots which have been cut through the metal tube are marked *B*. The two sections of the tubes of the frame which are to fit into and to be attached to this lug are marked *C*. These inner tubes are inserted, and then the hydraulic tool attached. This consists of a small pipe, *D*, of sufficient strength to withstand the high-water pressure that is necessary to force the metal into the slots. To this pipe are fitted two cup leathers, at either end of the lug, marked *E*, inserted in a strong clamp which prevents the outer tube from bursting. A pressure of 7 tons to the square inch is exerted, and the metal of the inner tube immediately beneath the slots of the lug is forced by the pressure into the holes of the outer tube until the whole cavity is filled. The stretched metal cannot protrude above the level of the lug, owing to the outer clamp. The operation also serves to expand the inner tube until it presses tightly against the inner surface of the lug. By this means the two sections, to all intents and purposes, are converted into one homogeneous whole.

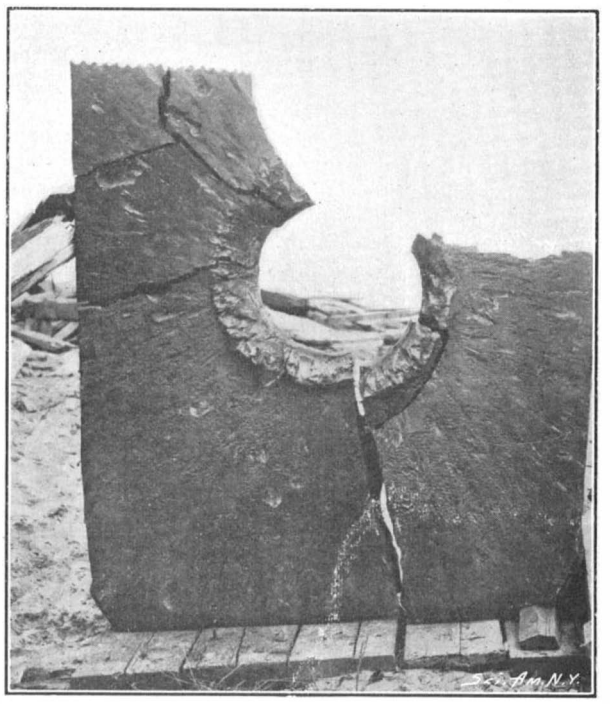
The operation is extremely simple, and one salient characteristic of the process which should recommend its adoption is that it is not essential that skilled labor should be employed to accomplish the work, as in the case of brazing, since it is almost impossible to attach the parts imperfectly. The parts can also be fitted much more quickly than heretofore. Several tests have been carried out with frames joined together in this manner, and they have proved to be stronger than those frames which were attached by the brazing process. Some sections of the frame are modified in design somewhat, in order to permit the hydraulic tool to be inserted.

The Birtwhistle Hydraulic Jointing Syndicate, of Manchester, who are operating the invention, have also devised a unique method of prolonging the life of a cycle. The tubes utilized by them for the frames are enameled on the interior as well as externally. Rust is the most insidious foe of the cyclist, since it weakens the metal very rapidly. By this precaution, however, the steel is better protected, and although it does not render the metal absolutely rust-proof, it protects the metal to a considerable extent.

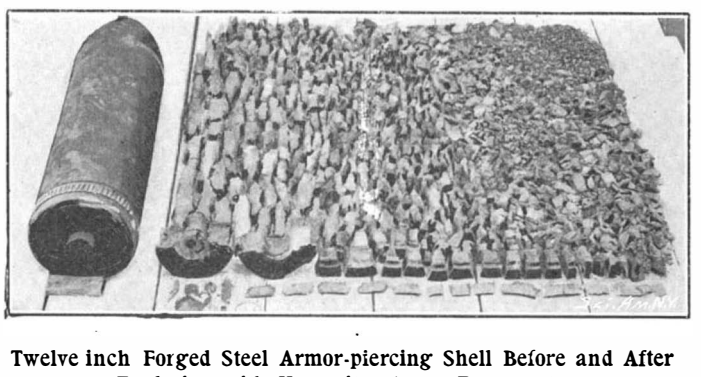
GOVERNMENT TESTS OF MAXIMITE AT SANDY HOOK.

In our last issue we gave a fully illustrated description of the Gathmann gun, and the preliminary tests which have been made of the Gathmann system to determine its military value. We now present an equally interesting set of photographs illustrative of a remarkable and successful series of tests of another method of discharging shells charged with a high explosive. The Gathmann gun is designed to throw an extremely large amount of high explosive from a high-velocity gun of great caliber. The shell is not designed with a view to the penetration of armor-plate, it being judged sufficient to deliver this great quantity of guncotton at the face of the plate and explode it on contact. The Maxim system, which is named after the inventor of the new explosive, Hudson Maxim, seeks to provide a high explosive which can be loaded into a service, armor-piercing shell, and, on account of its insensitiveness to shock, can be carried through any thickness of armor that the shell can penetrate, and be exploded by a time-fuse at the rear of the plate.

The accompanying photographs show results of tests with Maximite, which have been going on for about a year at the Government Proving Grounds at Sandy Hook. The most important of these results have been attained during the last three weeks, and this is the first time that the data have been given to the public. Although the exact composition of Maximite is a government secret, we may say that it is a picric acid compound, consisting mainly of a picrate. Its temperature considerably below that of boiling water, namely, 174 deg. Fahr. as against 252 deg. Fahr., the fusion point of picric acid. If heat be applied to the explosive, it first melts and then evaporates, until the whole of it has disappeared. A valuable feature is that it is impossible to heat Maximite rapidly enough to produce an explosion. Set on fire in the open, it burns like pitch, and one of the illustrations represents the inventor pouring molten cast iron upon a block of the explosive.



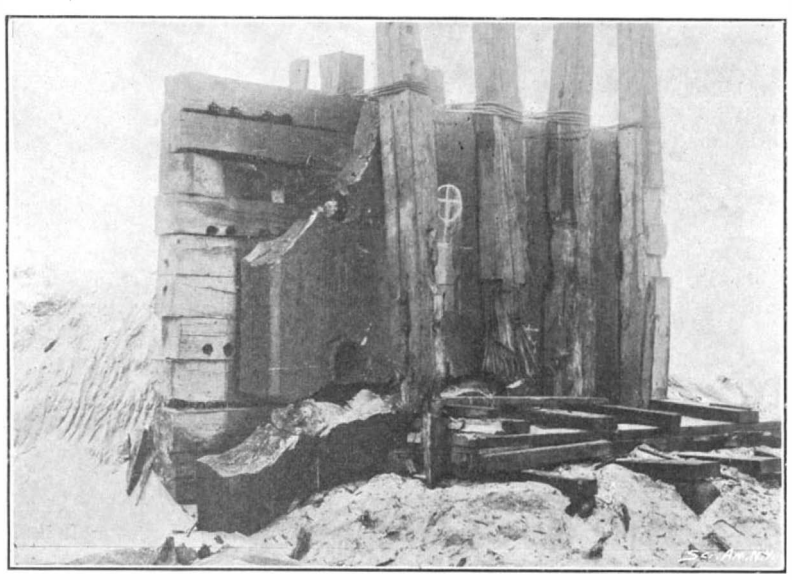
Armor-plate 5¾ inches Thick, After Penetration by 12-inch Shell Carrying 70 Pounds of Maximite.



Twelve inch Forged Steel Armor-piercing Shell Before and After Explosion with Maximite; 7,000 Fragments.

Among the first tests of this material by the Ordnance Board was the firing of a 5-inch, armor-piercing projectile through a 3½-inch, nickel-steel, armor-plate. The projectile was recovered intact from the sandbutt behind the plate. It was then armed with a fuse, buried in the sand, and exploded for fragmentation. The sand was sifted, and over 800 fragments recovered.

About the same time, a 12-inch armor-piercing shell was filled with Maximite, buried in the sand, and exploded for fragmentation. The shell, before and after explosion, is shown in the accompanying photographs. More than 7,000 fragments were recovered. Following this test, a 12-inch, armor-piercing forged steel shell, containing 70 pounds of Maximite, was fired through a 7-inch Harveyized nickel steel plate, and was recovered from the sand behind the plate. This 12-inch shell and the 5-inch shell above-mentioned were, of



Twelve-inch Armor-plate and Support, Before Firing 12-inch Armor-piercing Shell, with Fuse, Carrying 23 Pounds of Maximite.

Wreck of 12-inch Plate After Penetration and Explosion of 12-inch Shell.

GOVERNMENT TESTS OF MAXIMITE AT SANDY HOOK.

inside the end of the inner tube. The pipe at *F* is pierced with a number of holes through which the water passes, as it is forced from the hydraulic pump to which it is attached, into the chamber between the two cup leathers. The lug and tube are then placed

products of combustion are almost entirely gaseous, and as the heat developed on detonation is very great, it possesses, as the result of its high gravity, a very high explosive value. Some of the qualities of the new compound are remarkable. It may be fused at a

course, fired from the gun without a fuse, as the test was one for insensitiveness only, to ascertain if the explosive would stand the shock of penetration of armorplate.

The next test was to fire a 12-inch, armor-piercing shell, carrying 70 pounds of Maximite, and armed with a fuse, through a 5¼-inch, Harveyized, nickel-steel plate. The fuse used in these tests is the invention of an army officer, and it has shown itself capable of standing the shock of penetration of armorplate as thick as the projectile itself will stand to pass through. But it is difficult to always get just the exact amount of delay action, so that the shell will explode the moment that it has passed through the plate, and not either in the plate or 100 yards beyond. The timing is gaged to hundredths of a second. It is better to explode when half or two-thirds of the way through the plate than to explode too far beyond it. Hence it is preferable that the shell should go off a little too soon than too late. This 12-inch shell exploded when it was about half way through the plate. The violent effect of the explosion upon the plate, shattering it into fragments, with the destruction of the abutment where it was supported, is shown in the accompanying photograph, in which the deep scoring of the rear face by the flying fragments of the shell should be noted.

It should have been stated that preceding the last two tests above-mentioned, something like half a dozen six-pounder armor-piercing shells filled with Maximite, and without a fuse, were fired, in competition with shells similarly filled with fused picric acid, against plates of varying thickness. The picric acid detonated on impact when fired at a plate 1½ inches in thickness, while the Maximite shells, of course, did not explode. The Maximite shells were then fired at a plate three inches thick, some of them passing through and others sticking in the plate. The accompanying photograph shows the points of two of these shells, one just through the plate, and the other about half way through. None of the Maximite shells exploded, and they still remain in the plate, filled with the explosive. One of the Maximite shells which struck this plate penetrated about half way through, upset so that it was shortened nearly two inches, and burst open at the side, the Maximite unexploded, being forced through the rupture, and the shell rebounded from the plate about 200 feet and struck in front of the gun, without exploding. In an accompanying photograph this distorted shell is shown beside one in its original shape and length.

Perhaps the most remarkable of all these tests that have been made at Sandy Hook were the last three, as described below.

On May 1st a 12-inch, armor-piercing projectile, known as the armor-piercing shot, and carrying 23 pounds of Maximite, was fired, without a fuse, through a 30-ton Harveyized nickel-steel plate, 12 inches thick. The shot was recovered in perfect condition, its load of explosive having stood this terrific shock without explosion.

Following this test, a similar shot, also holding 23 pounds of Maximite, and armed with a fuse, was fired through the same plate, exploding when about two-thirds through, the fuse being about the two-hundredth part of a second too quick. Two of the accompanying photographs show the abutment before and after the projectile exploded in the plate, the second showing the plate broken, the fragments strewn around, and one, weighing several tons, resting upon the top of the structure.

A very interesting test was the last one of the series, and which took place on Tuesday, the 7th inst., when a 12-inch mortar shell, known as the torpedo shell, was fired from a 12-inch sea-coast rifle at full velocity and pressure, with a charge of brown prismatic gunpowder. This shell carried 143 pounds of Maximite, was armed with a fuse, and fired through a sand-crib faced with heavy timbers. The velocity of the projectile was probably about 2,100 feet per second, and as the column of explosive was four feet long, the shock of acceleration upon the Maximite must have been very severe, although not comparable, of course, with the shock on even a much shorter column in penetrating heavy armor plate. This was the largest charge of high explosive ever thrown from a powder gun in a service shell, and at service pressure and velocity. The projectile exploded just as it emerged from the back side of the crib. The projectile was broken into very small fragments, averaging from the size of a rifle ball to several ounces. A crow and a ground sparrow were struck upon the wing and brought down from the sky by the flying fragments, and fell near the sand crib, the sparrow falling directly into the crater, a result which suggests the completeness of the fragmentation.

Electric power generated on the Yuba River is being transmitted to Oakland, a distance of 140 miles, and street cars were operated with it on April 28. Current is transmitted at a pressure of 40,000 volts and the loss is very slight. Power is also to be transmitted to San Francisco, a distance of 190 miles.

Automobile Week at Nice.

The "Grande Semaine," or automobile week of Nice, is one of the leading events of the year, and this year it was unusually brilliant. The great number of visitors who are assembled at Nice during the season make this event of special interest; it is also one in which many of the records of the year are established. In consequence Nice was filled with a crowd composed of notabilities of all kinds, and all the leading "chauffeurs" made it a point to be present, with the latest types of machines. The series commenced on the 24th of March with a fête in which the automobiles, gayly decorated with flowers, defiled before the throng of spectators. On Monday, the 25th, were run the two races known as the "Speed" and the "Tourists' Race." The former covered the route Nice-Aix-Senas-Nice, or 277 miles. The weather was unfavorable, and the rain had made the roads in a bad condition. The race was run in three series, for motocycles or automobiles up to 550 pounds, vehicles of two places, 550 to 880 pounds, and those above 880 pounds. The first series was won by Demester on a Gladiator motocycle of 8 horse power, in 6h. 54m. 56s., with Gleizes second (De Dion motocycle), in 7h. 11m. 41s. The series of light machines was won by Farman (Darracq machine of 12 horse

3-Inch Plate with 6-Pounder Shells Embedded Without Exploding.

A 6-Pounder Armor-piercing Shell, Filled with Maximite Before and After Firing Through a 3-Inch Armorplate. The Shell Upset and Rebounded Without Exploding.

power), in 8h. 8m. 35s., followed by Edmond, in 8h. 18m. 41s. In the last series E. Werner came first in a Mercedes machine of 50 horse power, time 6h. 45m. 48s., with Degrais (Rochet, 24 horse power) second, in 7h. 11m. 58s. Out of 23 starters, counting all the series, 14 were able to finish. It is satisfactory to note that all the records of the previous year were beaten. On the same day was run the "Tourists' Race," from Nice to Draguignan and return, a distance of 116 miles; it was divided into five series. The best records in each are as follows: A. Motocycles of less than 550 pounds; winner, Cormer (De Dion machine), in 3h. 24m. 23s. B. Automobiles of two places, from 550 to 880 pounds; winner, Théry (Decauville machine), in 3h. 46m. 19s. C. Four-place machine up to 1,430 pounds; winner, Koechlin, in 3h. 11m. 11s. D. Machines up to 2,200 pounds; winner, Serpollet (steam automobile), in 2h. 42m. 37s. This is the best time of the "Tourist" series and M. Serpollet carried off the honors, showing the good performance of the steam-propelled machines. The last series, heavy machines of six places and above 2,200 pounds, was won by Knapp, in 3h. 40m. 10s. On the whole, of 28 machines in all classes, as many as 20 were able to finish the race, which is a very satisfactory performance. On Tuesday and Wednesday an automobile exhibition was held in the buildings of the Nice Club. On the following day, the 28th, two races were held, the Mile Race and the Kilometer (0.6 mile) Dash for the Henri de Rothschild Cup. The mile race was reserved for the machines which had finished the Speed Race preceding. The records are as follows: Motocycles—First, Osmont, in 1m. 22 3-5s.; second, Demester, in 1m. 27s. Voiturettes—Edmond, 1m. 32 1-5s.; Marcellin, 1m. 37 3-5s. Automobiles—Werner, 1m. 16 4-5s.; Lorraine-Barrow, 1m. 17 2-5s.; Serpollet, 1m. 17 4-5s. The Rothschild Cup was won by M. Serpollet, who made the dash in 35 4-5s., followed by Werner and Prince Lubecki, in 41 4-5s. and Lorraine-Barrow and Knapp, in 42 3-5s. and 42 4-5s., respectively. The latter race was very exciting, and M. Serpollet again carried off the honors. The Nice-Turbie race, which was run on the following day, is one of the principal events of the season. The route from Nice to the fort of Turbie, situated at a considerable elevation, has very steep grades, and is a severe trial for the machines. In consequence, the leading "chauffeurs" have tried to make a record upon this route. The best times for this year are as follows: Series A. Machines below 550 pounds, Beconnais (motocycle), 17m. 21s. B. Two-place machines, to 880 pounds, Barras (Darracq 12 horse power machine), 19m. 40 2-5s. C. Four-place machines, to 1,320 pounds, Koechlin (Peugeot 7 horse power machine), 28m. 35 4-5s. D. Two-place machines, over 880 pounds, Werner (Mercedes, 12 horse power), 18m. 6 1-5s. E. Four-place machines, 880 to 2,200 pounds, Katzenstein (Panhard, 12 horse power), 28m. 20s. F. Machines over 2,200 pounds, six places, Thorn (Mercedes, 35 horse power), 21m. 46s. G. Steam vehicles, Serpollet, 24m. 11s. Nearly all the records previously made over this famous course have been beaten this year, and some of them quite considerably; thus the time of 19m. 2s. for heavy machines, made by Levegh last year, is lowered to 18m. 6 1-5s.; for light machines, last year's record of 31m. 21s. is beaten by Koechlin, in 28m. 35 4-5s. As to motocycles, Beconnais made 17m. 21s., over last year's record by Gaste, 20m. 10s.

Automobile News.

A contract has been awarded for carrying the mails between the Pan-American Exposition grounds and the Buffalo post office to an automobile company. The vehicle used will have a carrying capacity of 1,000 pounds, besides the driver and attendant, and it will be required to cover 60 miles a day.

A novel spectacle is said to be promised London in the near future, when the Chinese Ambassador carries out his intention to use an auto-car for official visits to the Foreign Office. According to the Autocar, Sir Chih Chen Lo-feng-luh has already placed his order for an automobile with one of the leading makers.

Builders of motor cars in France are strongly convinced that the future of the industry lies in the utilization of alcohol, and while nothing can be urged against the economy of the new vehicle, it cannot be overlooked that in Paris, where the octroi duties on petrol are so high, the cost of working an automobile is much greater than it might be. Owners, however, have little hope of petrol being cheapened to any considerable extent. They are looking, says the Auto-Car, for further economy to alcohol, the utilization of which will not only save them a great deal of money, but will revive a languishing national industry at the expense of imported petroleum.

The new machine with which Levegh is to run in the Gordon Bennett cup race has lately been finished. It is of the Mercedes type, and has a petroleum motor of four vertical cylinders, rated at 28 horse power nominally, but it will no doubt give much more. The ignition is by magneto-machine, and the spark-breaking arrangement is worked by a shaft carrying cams and a series of levers. The radiating tubes are placed in front between the wheels. Four speeds are provided for this machine; the second represents 27 miles an hour, while the maximum speed is claimed to be 60 miles an hour. The total weight is about 2,400 pounds. The new machine has made its first trials and has been found quite satisfactory.

Two Englishmen have invented an improved pneumatic tire for auto-cars and other vehicles. The tire comprises an exterior cover of thick, hard rubber vulcanized upon canvas, in the shape of an arch. Inside this is placed the tube which is inflated. The cover is attached to the periphery of the wheel by two detachable flanges of steel or iron, which clamp the cover on to the wheel by bolts fastened on one side of the wheel by countersunk nuts. The outside edges of the wheel and the inside of the flanges are serrated, and this, together with the bolts which go right through rim and cover, prevent the cover and tube moving through friction. It is stated by the inventors that the tire can be manufactured at a price 25 per cent cheaper than any other pneumatic tires, and it is stated to be unpuncturable.

SOME FEATURES OF THE NEW YORK RAPID TRANSIT TUNNEL.

It is questionable whether the citizens of New York appreciate what a truly splendid system of transportation will be at their command when the Rapid Transit Tunnel is put in operation. The new system will not merely add four new lines of track to the already large number of north and south lines which extend the full length of Manhattan Island, but it will provide a service of express trains which, in point of frequency and speed, will be positively without a rival. This is a fact that is not by any means realized, and when the road is opened it is going to come as a most agreeable surprise to the traveling public.

From the very first it has been the policy of the engineers of the road to make it a *sine qua non*, that the rapid transit road must be essentially a high-speed system, which will not merely possess an enormous carrying capacity, but will also transport passengers at a speed that has never been approached by any other road on the island. From the present terminus at City Hall Park, express trains are to be dispatched during the rush hours at two minutes' intervals. They will make stops at Fourteenth, Forty-second, Seventy-second, Ninety-sixth Streets, and the whole run to One Hundred and Fifty-seventh Street will be made in 16½ minutes. The fastest traveling at present provided for the public is by the express trains on the Ninth Avenue Elevated Railroad, on which the run, by actual timing, from Franklin Street to One Hundred and Thirty-fifth Street is made in about half an hour, the time between the same points by the local trains being forty minutes. The average running speed of the Rapid Transit express trains, including stops, will be 38 miles per hour; and this means that, at times, the speed will rise to 50 miles an hour, and occasionally over that. The local trains will have an average speed of 18 miles per hour, which is about 50 per cent greater than that of the present local trains on the Manhattan elevated roads. The express stations will be located at intervals of a little less than 2 miles, while the local stations will average about four to the mile. At one time the question of increasing the number of express stations was mooted; but the Rapid Transit Commission, by advice of its engineers, wisely decided that, since the system was to provide, primarily, an express service, it would defeat the end in view to multiply the stops. It was further urged that the high speed of 18 miles per hour of the local service rendered it unnecessary to multiply the express stations, the passenger being able to quickly cover the distance between the express stations and his own particular stopping-place, by the fast local service. That an average speed of 18 miles per hour can be maintained with stations only a quarter of a mile apart is due to the rapid acceleration which is possible by electric traction, and also to the fact that the local stations are placed a few feet above the average grade of the line—an arrangement under which gravity assists the retardation of the train in approaching the station, and increases the acceleration when the train is running down hill at starting.

Since the opening of spring weather, progress all along the line of the tunnel has been quite rapid, and the whole system presents, from end to end, a very animated appearance. There is much work now being done, moreover, of which but little evidence appears at the surface, particularly where the line runs in tunnel proper and the excavation is being carried out by drifting. Our lower front-page illustration shows one of several stretches of work of this character. The sectional view is taken at the intersection of Thirty-fourth Street and Park Avenue, at the entrance of the tunnel which is now used by the electrical cars of the Metropolitan Street Railway system. That portion of the underground road which lies south of the entrance to the tunnel is contained in one four-track subway as shown in the sectional view at the top of the page. Shortly before Thirty-fourth Street is reached, the four tracks diverge somewhat, and are carried in pairs through two separate tunnels which are located beneath and somewhat to the right and left of the old surface tunnel. This arrangement is shown in our sectional view, which is taken at the point where the Thirty-fourth Street station will be located. It will be noticed that the two tracks of each tunnel are at different elevations, the outer or local tracks being 4 feet higher than the inner express tracks. This difference of level is due to the fact that Thirty-fourth Street is not an express station, and the express tracks are therefore carried through at the normal grade of the line, the local tracks being carried at a few feet higher elevation, according to the method employed at local stations, as already explained. The Park Avenue tunnel is one of the sections of the road where there is far more work being done than appears at the surface. Two shafts have been sunk immediately to the south of the portal wall of the old tunnel to a depth of 48 feet below the Thirty-fourth Street level, and from the bottom of each shaft the tunnel is being excavated north and south by as large a force of men as can be worked to advantage against the face of the rock. As the tunnel is completed, it is lined with concrete, the track system being sunk in the floor and the roof turned with an elliptical arch, as shown in our drawing. At Thirty-fourth Street, the roof of the Rapid Transit tunnel is so near to the base of the Fourth Avenue tunnel that the concrete has been carried up to a junction with the footing of the tunnel, as shown in the drawing. Elsewhere on Park Avenue the vertical distance between the tunnels is greater, and solid rock intervenes between the foundation of the old and the roof of the new tunnel. On Thirty-fourth Street there are two lines of track belonging to the Metropolitan Street Railway Company which are operated by means of storage battery cars, and it is an interesting fact that our sectional view presents at this point no less than eight tracks on which are used three different systems of electric propulsion—storage batteries on Thirty-fourth Street, the underground trolley in the old Fourth Avenue tunnel, and the third-rail system of the Rapid Transit tunnel. In our drawing also there are shown some of the electric cabs which are becoming an important element in city transportation, so that this particular drawing may be regarded as a sort of pictorial symposium of up-to-date methods of travel.

The construction of the underground tunnel road offers a great opportunity for solving the difficult problem of properly disposing of the water, gas, electric and other mains, which at present are buried in any sort of fashion beneath the streets, and are the source of untold expense and inconvenience whenever it becomes necessary to renew or repair them. It is a pitiful commentary upon our supposed twentieth century development that these mains should be buried beneath the streets in the altogether haphazard fashion which is shown in the small sketch on our first page, which represents the condition of things at the intersection of Nineteenth Street and Fourth Avenue. It was the intention of the Rapid Transit Engineers to provide special galleries on each side of the subway, and locate the water and gas and other mains within them. Provision was made for these galleries wherever it was possible to use them, and steel was ordered and considerable excavation done in Elm Street, at a cost of about $35,000. The galleries were abandoned, however, because of opposition encountered from the heads of the Sewer, Water and Gas Departments, who raised various objections of a more or less trifling nature. The Rapid Transit Commission, considering that it was its duty to build the tunnel rather than press the question of the pipe galleries to the point of becoming involved in legal complications and delays, decided to leave the question open for future consideration. While we do not dispute the wisdom of the policy pursued by the Commission, there is every argument to be used in favor of the construction of the pipe galleries simultaneously with the building of the tunnel. At present the pipes are merely suspended from falsework during the construction of the subway, and after a section is roofed the soil is filled in around the pipes, leaving them in the unsatisfactory condition which necessitates pulling up the roadway whenever repairs or changes are to be made.

We present a typical section of the tunnel as it was proposed to construct it, with the two galleries adjacent to the tunnel and separated from it by steel and concrete walls. The larger pipes, such as the water and gas mains, would be carried on the floor of the tunnel, while all other pipes, such as those for compressed air, steam, etc., might be suspended from the roof or carried on brackets extending from the side walls. The galleries would be entered by manholes, or other suitable means of communication, and pipes could be repaired, renewed or inspected without any disturbance of the surface of the street.

Electrolytic Sugar.

Some interesting experiments in the electrolytical production of sugar have been tried by M. Dupont. The electrolyzer consists of a wooden trough divided into three compartments by means of porous partitions of porcelain, asbestos, or parchment paper. The electrodes consist of metallic plates that vary according to the object to be obtained. They may be composed of platinum, aluminium, lead, zinc, etc. In order to obtain sugar from cane or beet juice, the saccharine fluid is placed in the central compartments, and the end compartments are filled with water. Under the influence of the current, the albuminoid substances of the juice coagulate and precipitate, and the salts are decomposed. The juice becomes clear, limpid, and colorless, and no longer contains anything but sugar and some traces of organic matter. There seems to be osmosis through the partitions. In the end compartments accumulate the soda, potassa and ammonia. It is not certain that the process can be used commercially. It is probable that it will in time become useful for work on a commercial scale. It is useful now for analysis.

Thirty-six steamers will be run this year between London Bridge and Chelsea.

Engineering Notes.

A meeting of the American Society of Mechanical Engineers will be held at Milwaukee, Wis., May 28 to 31, 1901.

The Krupps are about to discharge 5,000 men from their Buckau, Essen and Kiel works. They have already dismissed 4,000 since October. The industrial depression is very marked.

The Board of Trustees of the Sanitary District of Chicago have decided to have the top of the Washington Street tunnel chiseled off sufficiently to permit of increasing the navigable depth of the river ten inches pending the settlement of the question as to when and by whom the Chicago River tunnels will be permanently lowered.

Larger freight cars are to be used on German railroads. Three-truck freight cars of 25 tons each will be tried in place of two-truck cars of 15 tons each. An experiment was tried formerly with four-truck cars, but they were too heavy and could not be used on all roads. The wear and tear on the truck is also less with the large three-truck car.

Emperor William is investigating the problem of equipping the street car lines of Berlin with fenders and safety attachments. The Emperor found that none of the devices presented met his requirements. He considered that what was wanted was a self-acting life-saving device, so that the motorman could give his undivided attention to the operation of the car.

French naval authorities are preparing for experiments to test the efficiency of rapid-fire guns against submarine boats, at a depth at which the latter are supposed to be invulnerable; a hulk to be submerged is now being constructed. It will be moored at varying depths and subjected to a plunging fire. The results will furnish a basis for guidance in the tactics of submarine boats.

There will be a very complete acetylene exhibit at the Pan-American Exposition. A special building has been constructed for the purpose, measuring 41 x 101 feet and the wing 59½ x 65 feet. Its height is 40 feet. Both the exterior and the interior of the building will be brilliantly illuminated by acetylene gas. The Ohio State Building will also be illuminated by acetylene. It will have a total of 650 jets, of which 160 will be within the structure and the balance will serve to set forth the exterior.

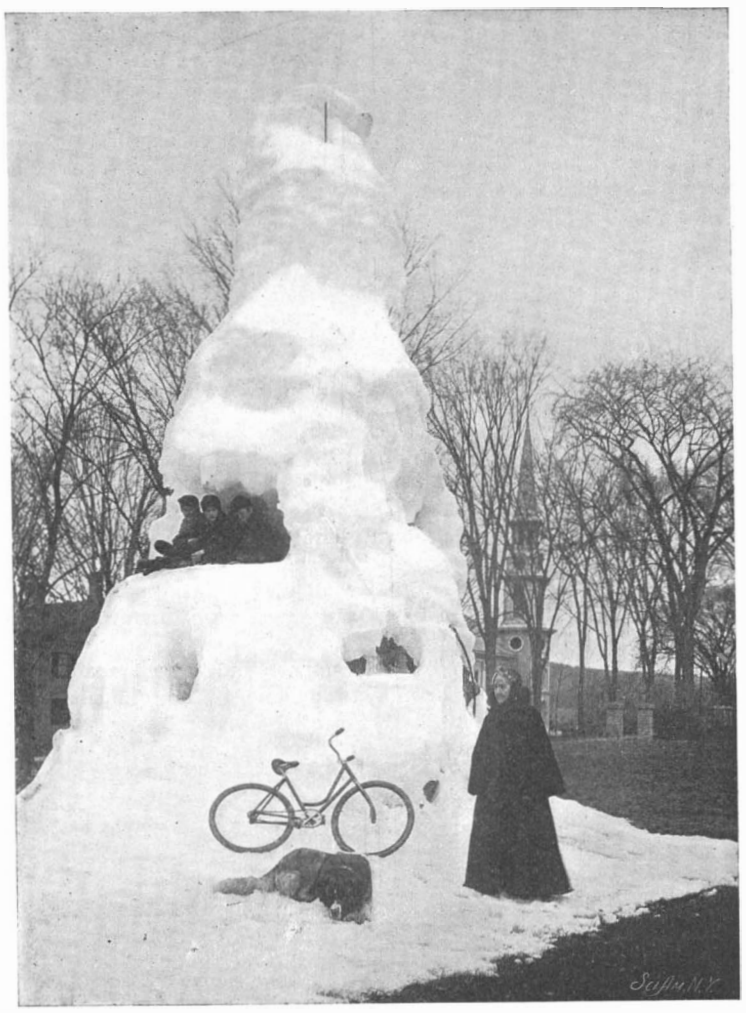
The New Zealand government is anxious to develop the manufacture of iron in that colony. The ore is very rich and abundant in the Taranaki and Middle Island districts. The government proposes to pay a bonus of $100,000 upon the first 20,000 tons of iron that is made. The stipulations are that the company which produces this quantity must have a capital of at least $1,000,000, and must spend $500,000 upon the erection of the necessary plant to manufacture the material. The government furthermore guarantees to purchase at least 50,000 tons of the iron or steel thus manufactured, at a price slightly in advance of the market rates, and if the metal is satisfactory will probably buy the whole of the material produced. By this means the colony will be able to obtain sufficient iron for its own needs without going beyond its own confines.

There has been a convention of Swiss, Austrian, Swedish, Norwegian and German manufacturers of calcium carbide, and they have combined in establishing price-scales and a mode of controlling the sale of their products. It is expected that by this convention the acetylene industry will be considerably strengthened. The members have adopted measures to avoid the fluctuating and ruinously low rates which, owing to heretofore sharp competition, have made the manufacture of their products unprofitable. Thirty-two of the smaller towns in Germany are now lighted by acetylene gas, and a number of other plants are in the course of erection. The gas is also extensively used by railroads for lighting passenger cars. The year's production of calcium carbide is estimated at 120,000 metric tons, equivalent to 9,500,000 gallons of petroleum.

During the passage of the steamer "Henri Rieth" from the Tees to Kustendje, she sustained damage to her propeller while at sea. Being only a single-screw steamer, her position was a helpless, if not a critical, one. It was thereupon determined to attempt tipping the craft in order to repair the propeller. A staff of Middlesbrough engineers, under the superintendence of Mr. J. W. Burton, carried out the work. The sea was quiet at the time, which served to facilitate the task considerably. The forward water tanks of the vessel were filled, and she slowly tipped up aft until her stem was lifted above the water. A staging was then erected under the stern by the engineers, and several important repairs effected to the propeller, sufficient to enable her to steam to port. The vessel was then rebalanced, and continued her journey as easily and steadily as if no untoward incident had occurred.

AN ICE FOUNTAIN.

Monson, Mass., is a delightful New England town, seventeen miles from Springfield. Normally it does not, however, offer any novel features which would permit of our illustrating them, but in the present instance the fountain which was allowed to play during very cold weather resulted in producing a very picturesque scene. The fountain was soon buried under an enormous mask of ice which entirely obscured its real shape and also covered a considerable area around it. In a short time boys succeeded in cutting into the mass of ice and formed an embrasure in this miniature and evanescent fort. In Belgium the carving of snow images is a popular pastime during the winter, and it is surprising that more attention is not given to this form of amusement in this country. The fountain is located upon the lawn in front of the residence of Mrs. William N. Flint.



AN ICE FOUNTAIN AT MONSON, MASS.

THE "SHAMROCK" UNDER SAIL.

BY OUR SPECIAL CORRESPONDENT.

Particular interest has attached to the trial spins of "Shamrock II." on account of the somewhat radical changes which Mr. Watson is supposed to have introduced in modeling the new boat, changes suggested by his lengthy experiments in the Denny towing tank. On the first of the two spins which she has taken in the Solent there was, during most of the time, smooth water, and breezes generally so light that the cup racer carried her big press of canvas at a very slight angle of heel. On the second day there was heart in the wind, and although there was no sea which could be counted as likely to retard the yacht the surface was pleasantly ruffled and there was a fleck of foam showing here and there on top of the short little seas.

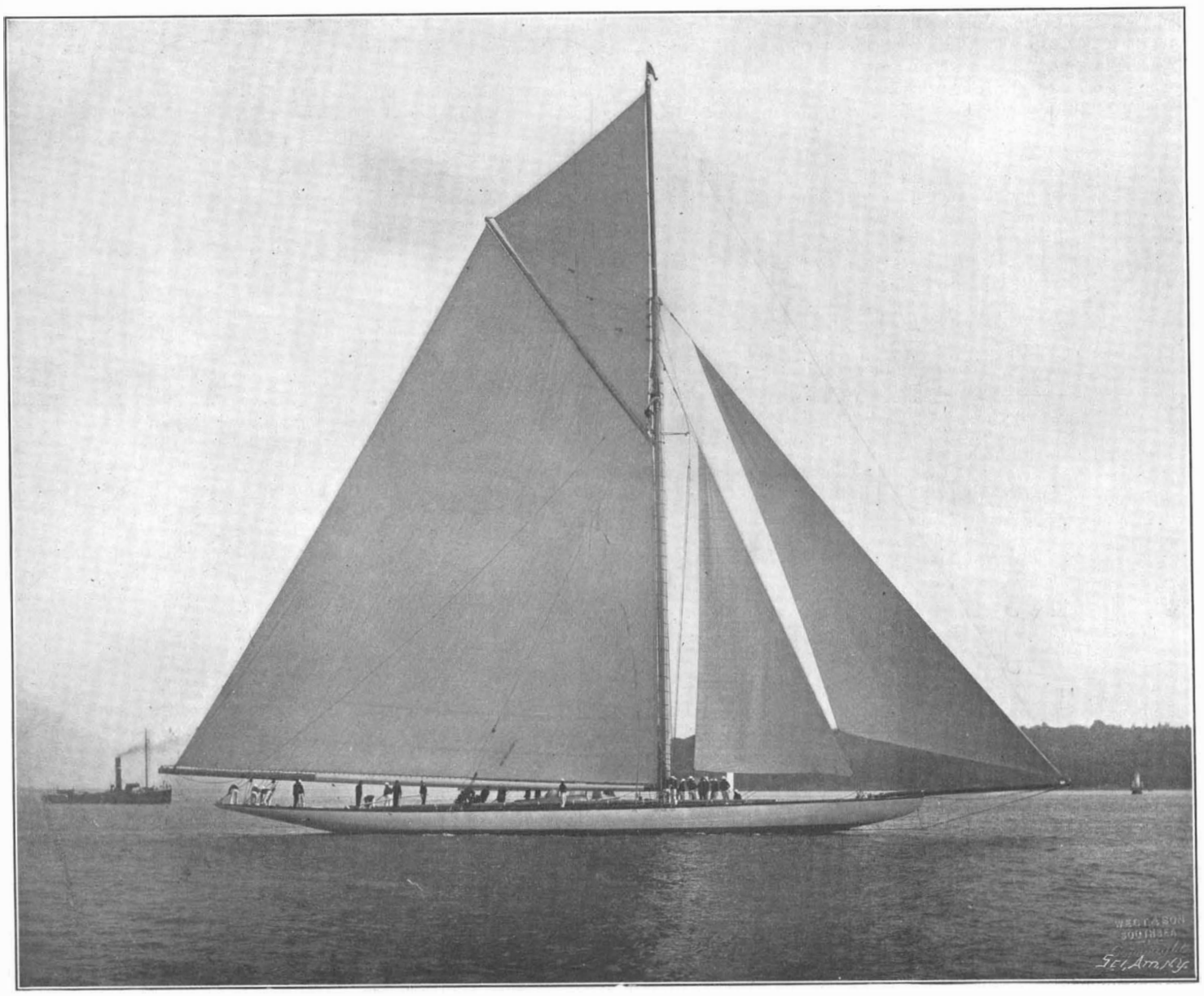
Under these conditions it might have been expected that the watchers would have been able to settle offhand the question of whether the new challenger went along with greater or less disturbance of the water, and therefore resistance, than other sailing cutters of similar size. As it is, however, there is some difference of opinion. When under tow the yacht went along carrying a deal of foam under the bow, and this impression is intensified when she is seen under sail. To the older school of yachting men, trained to appreciation of the sharp-stemmed craft which could cleave its way through the water with least disturbance of the surface, this peculiarity condemns her at once, and heads have been shaken ominously when her chances have been discussed among the men who built and sailed the challengers of bygone days.

On the other hand it is argued by others who have less suspicion of novelty, that the length to which the designer of "Shamrock II." has pushed the principle of skimming over the water involves this disturbance of the surface as a matter of necessity, and it is further contended that the displacement of the water goes no depth, and there is much fuss with very little actual drag. This contention is supported by the fact that the wave from the lee bow, big as it is, has practically disappeared before it reaches as far aft as the chain-plates.

One of the outstanding characteristics of the Watson racer is the exaggerated fashion in which the quarters are run off to the narrowest counter ever put upon a yacht of this size. The object in view in doing this was to give a fine run and a clean delivery, and this, at least, has been accomplished beyond the possibility of dispute. When sailing fast she sheds a sharp little quarter wash, but this, like the curl under the bow, is principally on the surface, and quickly disappears. Under the counter the wake left by the yacht is almost imperceptible, and a careful study of her going in a fresh breeze and comparative calm leads to the conviction that the hull is one which can be driven with remarkable ease.

By all the calculations it appeared likely that the new craft would be excessively tender, and the fact that the scanty rail with which she is provided is put eighteen inches inside the point at which the deck and topsides meet, suggests that the designer himself expected that she would heel far and easily in anything of a breeze. The fine-drawn quarters were opposed only on the ground that the want of beam there robbed the yacht of much of her power to carry sail, and this danger of having a boat which might prove unable to stand up to her work in a moderate breeze was intensified by the shallower draught, less beam, steeper floor and greater height of sail plan given to "Shamrock II." as compared with previous challengers. These calculations looked sound, but they are contradicted in practice, for a careful observation extending through the whole of the first two days' trials shows the new challenger to be able to stand up to a breeze better than "Shamrock I.," and that she inclines to stiffness rather than to tenderness.

[Since the above was written the challenger has been beaten by "Shamrock I." in a strong breeze and rough sea by over five minutes, the older boat showing superiority on every point of sailing. It is offered in explanation that the sails of "Shamrock II." were ill-fitting, particularly the mainsail, and that she was not in her proper trim. Although this is probably true, it cannot be denied that the race has been somewhat of a disappointment in England, and also in America, where the interest is always greatly heightened if the challenger is believed to be a dangerous boat. The last race was over a 20-mile course, and sailing under the same conditions over a 30-mile course the difference would have been about 8 minutes. "Columbia" beat "Shamrock I." in a very similar wind and sea by 6 minutes and 31 seconds, and "Constitution" will probably be 4 or 5 minutes better than "Columbia." This shows the challenger to be many minutes slower than she should be, if the cup is to be carried back to the Solent. It is stated that "Shamrock I." is in better form and better sailed than when she was on this side of the water—which is quite possible—and "Shamrock II." will no doubt beat her in the later trials. We are indebted to Mr. David Barrie, Sir Thomas Lipton's representative in this country, for an excellent photograph of the new yacht. —ED.]



THE "SHAMROCK UNDER SAIL.

The Wind Cave in the Black Hills of Dakota is to be opened by order of Commissioner Hermann, of the General Land Office. The cave is the property of the Federal government, and includes about a thousand acres. Permission to visit it was withdrawn January 16, 1900, owing to vandalism, which was responsible for much injury to the beauties of the place. No depredations or trespasses of any kind will be permitted, and no specimens will be allowed to be taken away by tourists, and there will be no fees or gratuities in connection with the visit.

THE AMATEUR IN PHOTOMICROGRAPHY.

BY PROF. W. F. WATSON.

Those who use a microscope, whether for amusement or scientific investigation, frequently meet with objects which are worthy of permanent preservation and subsequent study. This is especially true in the examination of stagnant water, which teems with organisms varying in size from bacteria to water-fleas and hydra. The observer not infrequently meets with forms exhibiting marvelous structure and exquisite beauty. Those organisms are often too delicate for mounting in permanent slides, or, if they can be so mounted, the technical skill required is too great for the amateur. But it is possible for the amateur with quite a slender outfit to make respectable photomicrographs, provided he has some natural skill and possesses the virtues of patience and perseverance.

For a wide range of work the microscope accessories should include quite a number of objectives and oculars of different powers, a sub-stage condenser and a mechanical stage. Yet these are not essentials, and the amateur can get along without them if he does not care to photograph very minute objects.

The essentials for photomicrography are a microscope and camera with some means of making a light-tight connection and focusing. Any kind of camera will do, as the only lenses used are those of the microscope. Great care must be taken that no extraneous light enters the camera, as the slightest leakage will have its effects intensified during the long exposures which are sometimes necessary.

In Fig. 1 is shown the apparatus with which the accompanying illustrations were made. In the lumber room of the laboratory a small box was selected for a base. To this were nailed two uprights having half-inch grooves on the sides facing each other. A half-inch board is prepared to fit the grooves and slide freely up and down. This board may be clamped in any position, and to it the camera is attached by its

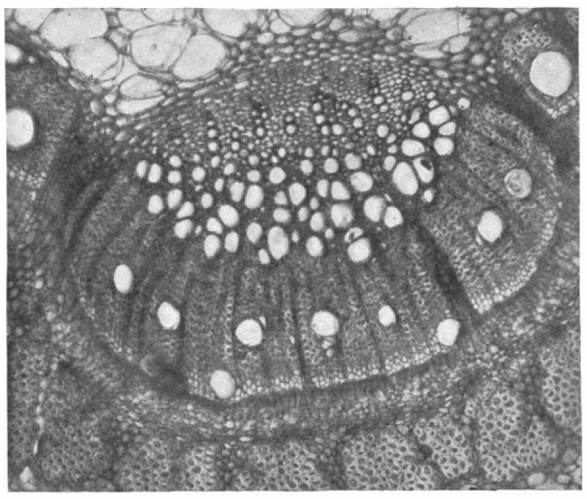


Fig. 2.—TRANSVERSE SECTION OF BLACKBERRY WOOD.

screw. The lens of the camera is removed and a square of wood is substituted, which has a hole in its center for the reception of the microscope tube. A small strip of black cloth wound around the tube makes the connection light tight. A gas jet which is adjustable in any direction is supported in front of the sub-stage mirror. The whole apparatus rests upon three projections as indicated in the picture, and a weight is placed inside the base to make it more stable.

For such apparatus the vertical position seems much better than the horizontal. In this case the effects of vibrations are reduced and the focusing adjustments are within easy reach. In the horizontal position focusing is generally much more difficult.

Figs. 2 and 3 of the accompanying illustrations were taken by transmitted light; Figs. 4 and 5 (being opaque) were made by reflected light. Fig. 2 represents a very small portion of a transverse section of blackberry wood (Rubus villosus). Such a section of wood, cut very thin with the microtome and presenting an even surface with good contrasts, is an excellent specimen for photomicrography, and from it good results can easily be obtained. The next object, a bee's sting, represented in Fig. 3, is far more difficult. The delicate striations on the sting were very hard to bring out clearly. This picture was made by using oblique light with the sub-stage condenser and developing for contrast.

In photographing opaque objects more difficulties arise. Most prominent among these is the matter of suitable illumination. The picture of the needle point, Fig. 4, was made by placing the apparatus about four feet from a north window and turning the apparatus until the light fell slightly to one side of the object, which was an ordinary smooth sewing needle. The picture was taken on a non-halation plate.

The bee's sting and needle point pictures were made for comparative study, and for this purpose the sting was taken straight and in sheath. It was considerably magnified, which would render conspicuous any

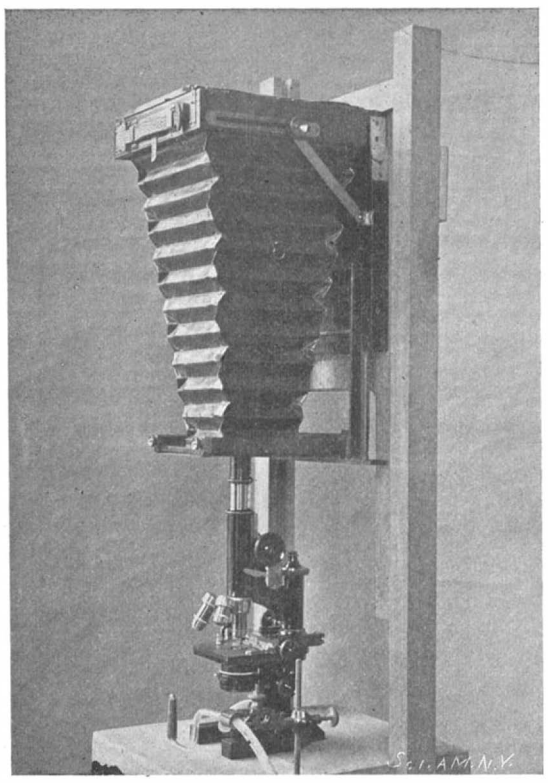


Fig. 1.—APPARATUS FOR PHOTO-MICROPHOTOGRAPHY.

imperfections if they were present. But the microscopic smoothness and perfection of detail in the natural object present a striking contrast to the clumsy workmanship exhibited in the magnified needle, though its magnification is very much less than that of the sting.

An extremely difficult object for photographing is the keen edge of a polished razor blade, which is shown quite highly magnified in Fig. 5. It appears next to impossible to secure good magnifications with delicacy of detail from a brightly polished and glimmering surface, and the amateur who attempts it without much experience must count on a long series of experiments and many spoiled plates before he is likely to succeed.

In photographing the razor edge the blade may be attached to the mechanical stage of the microscope by means of fine copper wires twisted around the shank. A better way, however, is to prepare a little block of wood, as shown in the diagram, about 3 by 1 by ½ inch, cutting a groove along one of the longer edges for the reception of the back of the razor blade and leaving the edge exposed. If the groove be properly cut (which can be done with a fine saw and an awl), the blade can be pushed in from the end and should fit it well or be tightened in place by little wooden wedges. Of course the upper surface of the razor's edge must be level. When once fitted in this way, the block of wood carrying the razor can be

Fig. 6.—BLOCK FOR HOLDING RAZOR BLADE.

moved into any desired place on the stage. These manipulations have to be done with deliberation and care to prevent injury to the keen razor edge and to prevent the fingers of the operator from being gashed.

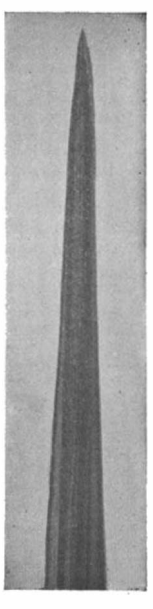


Fig. 3.—BEE'S STING.

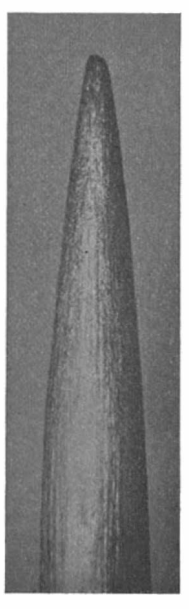


Fig. 4.—NEEDLE POINT.

The light used in making this picture (Fig. 5) was supplied by a large gas burner placed at a distance of one foot from the blade and elevated so that the light fell upon the object at an angle of about 30 degrees. A large plate of ground glass was interposed between the source of light and the razor to prevent the glimmering effect from the polished steel, which would have resulted in a fogged appearance in the negative. The actinic action upon the dry plate was very slow, owing to the loss of light, both in its passage through the ground glass and in its reflection from the razor's surface. There was, of course, the additional weakening effect caused by magnification, the light from a minute area on the razor edge being spread over a comparatively large area on the dry plate. This picture was made by an exposure of one hour on a 26 Seed plate.

On account of the weakness of the light, the focusing, which had to be done with great precision, was difficult. The image in the camera was very faint. When focusing such a dim image the focusing-cloth must be opaque and must shut out every ray of outside light. In addition to this, a hand lens must be used to make the image still more distinct.

Perhaps it is possible to get good pictures of the razor's edge with a stronger light and correspondingly short exposure, but so far the results obtained by using a stronger light with this object have proved unsatisfactory, though the lime light, acetylene and daylight were tried. As an all-around good light, daylight is probably the most convenient and satisfactory of all lights for the amateur.

In photographing transparent objects it is important that reflected light should not enter the lens. A useful attachment is a small cylinder made by rolling up a piece of black photographer's paper and gumming the edge. This cylinder should fit over the end of the objective lens and reach nearly down to the stage. By using this cylinder the brilliancy of the negative is sometimes greatly increased.

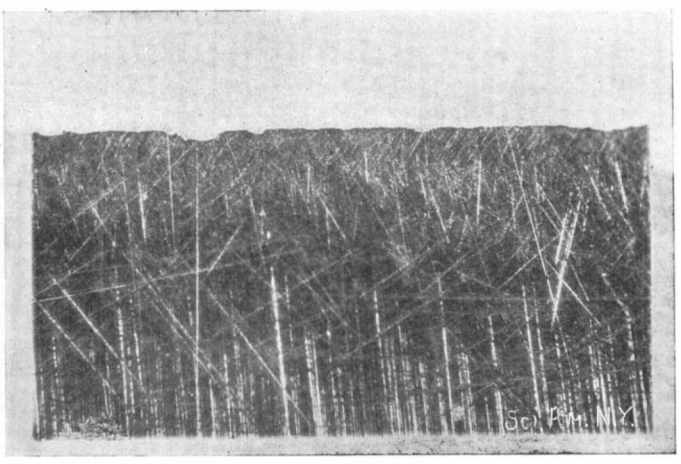


Fig. 5.—RAZOR BLADE HIGHLY MAGNIFIED.

The amateur is sometimes advised to use only the objective lens in photomicrography. The propriety of this is questionable. The pictures made with one lens are generally very small, or the apparatus is inconveniently long. In addition to this it is almost impossible to prevent some light being reflected from the sides of the microscope tube when only the objective is used. It seems better, therefore, to use a low-power eyepiece with the objective.

The time of exposure is an extremely variable element. It varies with every change of objective or of ocular and with every change in the character of the object and nature of the illumination. The time of exposure in the case of the accompanying pictures differed from a few seconds to one hour. No rules of much value can be given, but the beginner will gradually learn by experience to observe the strength of the image when it is focused in the camera, and estimate the time of exposure accordingly.

Acetylene Search Lights in Sweden.

Sweden is one of the countries in which the application of acetylene as an illuminant has already acquired considerable importance. Its use on board ship is perhaps most open to objection since any access of water may cause an explosion. Yet acetylene searchlights are being employed on the fleet of small steamers which ply between the numerous small islands with which the Swedish coast of the Baltic is dotted. During trial runs it resulted that objects could easily be examined at a distance of 500 to 600 meters (1,640 to 1,802 feet) when the acetylene beam was thrown on them, and the manipulation of the lanterns caused no difficulties. The saloons and cabins of some of these steamers are also lighted with acetylene.

Japanese cotton mills are now running 22 hours a day with double shifts, and while wages have been increased they are still ridiculously low. Watches are made in Japan as low as $2, bicycles at $12, and pianos for $100.

AN INTERESTING INSECT—THYRIDOPTERYX EPHEMERÆFORMIS.

BY N. HUDSON MOORE.

The farmer regards an insect as "interesting" if it succeeds in destroying other insects that prey upon his crops.

With the students of natural history it is different. The fact that an insect is beneficent is a point in its favor, but an insect whose life history is not satisfactorily cleared up, or whose family history may be still amended, is one that gives him keen delight.

The bag-worm, basket-worm or drop-worm, as it is variously called, is one of several species of the family *Psychidae*, whose exact place in the insect world is still open to discussion.

These particular ones we have before us are commonly called the Evergreen Bag-worms, but they are quite catholic in their tastes and are equally well satisfied with the leaves of deciduous trees, apple, pear, cherry, plum, locust or poplar, and when none of these are easily come by, shrubs will do as well.

These insects are found most plentifully in the South and Southwest, though they are not unknown in some of the New England States, in New York and on parts of Long Island. When it once gets a hold it is very tenacious, and if left alone will increase rapidly in a few years.

The bag-worms are not masons like the wasps, nor carpenters like some bees, nor cave-dwellers like some ants; for, better than this, they are travelers, carrying their homes with them.

The cases here shown are some of a number that were procured at Atlantic City, N. J., and two of them are prettily thatched with twigs and evergreen needles. But the third one has utilized some young leaves of the privet, and provided for itself a case more than usually ornamental. It is the female that is by far the most interesting member of the family. Forever hampered by her bag, which she never leaves except to die, she yet may take quite a journey, climb a tree, selecting a suitable one, and there lay her bag full of eggs, warmly protected, before her mission is accomplished.

The eggs hatch out generally during the last two weeks in May, and if you have a specimen in a box there is much amusement in store for you. The little wriggling worms, even before they will eat, commence to make some sort of a bag for themselves. They will take any material you will offer, worsted, cotton, paper, straw, leather, and, standing on their anterior legs, with tail in air, weave about themselves the bag to which they attach bits of foreign material.

As they grow they add to the bag from the bottom, always pushing it up, till at last they and it become so heavy that it is allowed to drag behind them. They eat young leaves and grow rapidly. Four times during their growth they withdraw into their bags for from fourteen to twenty-four hours, during which time they stop up the mouth of their bags, and change their skin. The neatness of these insects keeps pace with their cleverness. Although the upper opening is closed, there is a smaller one at the bottom of the bag which is always left open. Through this, in some remarkable manner, they push the old skin and all excrement, so that the interior of the bag is quite clean.

While the larva is completing its growth, if the food supply remains sufficient, it seldom leaves the tree where it was born. But with maturity an instinct for travel seems developed, and they crawl about as much as they can. Even this mode of locomotion is not speedy enough, and they spin silken threads by which they dangle until some person or animal comes beneath their tree, when they drop down, and are thus carried to new localities. This habit has given them one of their names, drop-worm.

After a time, however, nature urges them that the time has arrived for settling down, and they now moor their bags to some twig, with a stout silken band, and prepare to settle down for the winter. Not only do they have sufficient instinct to select some tree, the leafage of which will provide agreeable food for the young, but they never make the mistake of fastening the bag to a leaf, so that the first fierce wind could blow it away.

The exterior of the bag having been looked after, the interior is now attended to, and softly and warmly lined with silk. This accomplished, the insect begins to pupate, having first turned around in the bag so that its head comes near the lower opening.

During the larval state the worms of both sexes have been alike in appearance, and each has alike dragged about its bag. In the chrysalis form a marked change takes place, the male chrysalid being smaller than the female, and the wings, antennæ, etc., showing through the case as is usual in chrysalids.

But *she* has lost form; shows no possibilities of ever becoming a moth; in fact, is nothing better than a bag of eggs, even the few legs she had as a larva being denied her as perfect insect.

The male chrysalid, after about twenty-one days of repose, squeezes himself, still in the pupa case, partly out of the lower opening, the case splits and away he flies, a perfect moth—not a very pretty one, but still complete.

Once in the air his mission is to find a mate—and this accomplished he dies. His life is a short and a merry one—but a few hours, or a day at most. His mate, such as she is, is busy with her mission, too. Never able to wholly leave the pupa shell, she wriggles partly out of it, but after a time wriggles back. In the upper part of the pupa shell she lays her eggs, protecting them with some down which has grown on the lower part of her body. When this work is done she dies, but whether she dries up in the pupa shell, or whether she forces her way out from the bottom of the bag and dies on the ground, is a point open to discussion.

When in the larval state the insect is most peculiar. That part of its body which is protected by the bag is soft and of a brownish color. The mere rudiments of legs which occur on this portion are only of use in assisting the insect to cling to the bag. So much

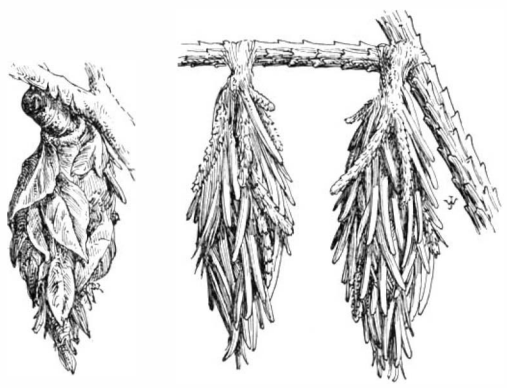
MALE BAG-WORM MOTH.

for the concealed part. The exposed or working segments are wholly different; indeed, they might seem to belong to another class of insect. Hard, horny, black, with a few white speckles upon it, you see at once that the foreparts are strengthened to enable the constant pulling about of the rear quarters and bag.

The bags themselves are interesting to study, much variety being displayed. I have one bag heavily thatched with arbor vitæ, which I cut from a privet bush. There was not any evergreen tree anywhere in the neighborhood, so the larva must have come from a considerable distance. It is not the rule, by any means, that the bags will be thatched with material from the tree they are found on.

The silk which composes the foundation is very soft and fine, and the bag itself, when once its occupant has left it, seems as delicate as a spider's web, save for the rough material woven in with it. However amusing it is to watch these young insects in the study, to applaud their vigor and activity, and their insatiate desire to build, they do not make admirable neighbors, nor are they desirable in the garden. The only effectual means of getting rid of them is to destroy the bags.

Like so many other insects which build comfortable



FEMALE BAG-WORM. BAG WORM CASES.

coverings to protect the eggs in winter, the bag-worm is a victim to at least two species of Ichneumon flies.

There may be anywhere from ten to two hundred eggs in a case, and to see scores of these small brown worms all beginning as quickly as possible, in exactly the same manner, is a revelation. First a perfect arch is built. Then, grasping it with its fore feet, the insect turns a complete somersault, raises the arch above its head, builds the other half, joins the ends, and has swiftly and beautifully formed its circle.

What name shall we bestow on the faculty which gives to a mere worm the power of building to perfection the most difficult feat in masonry, and that without the benefit of working by imitation?

The Cunard Steamship Company will equip its passenger steamers with wireless telegraphic instruments. It is also proposed to install a wireless telegraph station at Fastnet, which would be a better signaling station than Brow Head. This would enable the steamers to be reported with greater celerity, and there is not so much chance of running on the rocks.

Large Hydraulic Plant in the Jura.

Among the new hydraulic plants of Europe is that of Saint-Mortier, in the Jura region. It has been installed by the Union Electric Company and develops about 3,000 horse power. The motive force of the Ain is utilized for this plant. This river has in this part of its course a very swift flow; this varies considerably between high and low water. In the former case it sometimes reaches 24,000 cubic feet per second, and in the latter may fall as low as 135 cubic feet. In the latter case only 600 horse power would be obtained, so in order to keep a constant output of 3,000 horse power a canal has been constructed which during the dry season brings to the river the waters of Lake Chalain, situated 27 miles above Saint-Mortier, on the left bank of the Ain, from which it is separated by only 4,000 feet of alluvial deposits. An underground canal leading from the bottom of the lake gives a supply of over 400 cubic feet per second, so as to bring the total up to 540 cubic feet at low water. The level of the lake is 104 feet above that of the river at the nearest point, and its surface is about 500 acres, so that a considerable water reserve is provided; if the lowering of the water of the lake is limited to 33 feet a supply of 680 million cubic feet is obtained. The engineering work upon the river Ain includes a dam 33 feet high and 140 feet long, a lock of 800 feet, and a derivation canal 4,600 feet long; of the latter, 400 feet are underground. The generating station contains at present four groups composed each of a 700 horse power Picard & Pictet turbine and a triphase Oerlikon alternator working at 700 volts; a fifth group will be installed later. This plant has been in successful operation for several months, and supplies current for lighting and power to a number of towns within a radius of 12 miles.

The Kammatograph.

A London inventor, Mr. Leo Kamm, has devised a new camera in which a circular glass plate takes the place of the celluloid film for moving the pictures. The plate can be made to rotate rapidly by means of a multiplying gear, and at the same time to traverse laterally. A small lens forms an image upon the plate, and when the plate is put in motion these images are multiplied into a series of pictures arranged in a spiral. The plate is developed in the same way as an ordinary negative, and a positive is then taken from it. To display the pictures it is only necessary to place the positive in the camera and to arrange it so that the beam from the lantern close to it can pass through the lens. The plate is then rotated as before, the succession of pictures projected upon the screen reproducing the original movement. About 600 pictures can be photographed during the motion of a single plate at the rate of twelve or fourteen a second.

The Antiseptic Barber Shop in Paris.

Several barbers in Paris have been induced by medical students to introduce aseptic hair dressing. In front of each chair there is a gas burner, metal combs are used and they are passed through the flames several times. Scissors and razors are likewise purified by fire. The brush cannot, of course, be treated in this manner, but it is given a frequent wash in an antiseptic solution, in which thymol is the principal ingredient. The principles of the operating room of the hospital are thus extended to the barber shop, and as the barbers used formerly to be surgeons as well they should be flattered if they are required to observe the practices of surgeons of to-day.

The Current Supplement.

The current SUPPLEMENT, No. 1325, is admirably illustrated. The first page is devoted to "Observation of the Solar Eclipse Carried on by the Astrophysical Observatory, Smithsonian Institution." The article is accompanied by several interesting engravings, showing the prominences, and two views of the corona, and well as two illustrations showing the instruments in position. "Machinery and the Man" is by Alexander E. Outerbridge, Jr. "Mechanical Traction in Paris" is concluded. "The Social Service of Science" is a most valuable address by Prof. William Harmon Norton. "Women as Inventors" is a subject of great interest, and is well treated. "Electrically Operated Punching Presses" deals with the latest types of heavy punches operated by electricity. The usual Trade Suggestions from United States Consuls and Trade Notes and Receipts are published.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Mechanical Devices.

CRANE.—LEONARD S. FLECKENSTEIN, Easton, Md. The inventor has devised an improvement in cranes which rotate around a central axis and are provided with means for throwing the constantly-running power mechanism into and out of action by means of a hand-lever. The upper crane-post is provided with a bearing which is also a bearing for the drive-shaft. By reason of this arrangement the driven shaft, ordinarly arranged in the center of the post, can be more easily set and kept vertical. The inventor has further combined in one simple mechanism, means for governing the hoisting when the power is applied, and means for utilizing the ordinary hand-chain whenever desired.

SEPARATOR. — JENS ANDERSON, Walla Walla, Wash. The separator is a grain-separator in which a shaking-screen and a blast of air are conjointly used. The grain, fed upon top sieves, is sifted through. The chaff and other impurities are blown off into caps and out through fan-boxes, the grain undergoing a continual sifting as it gravitates from one sieve to the other. The grain finally passes into troughs, and then, if desired, onto chute-boards, according to the adjustments of the parts of the apparatus. These adjustments depend upon the character of the material which is treated, and the kind of separation desired.

VENDING-MACHINE.—UBALDO DI MARCO, Bronx, New York city. The vending-machine is designed to sell two kinds of goods. In the machine but a single handle is employed, by the rotation of which to the left or to the right the machine is made to deliver one or the other kind of goods.

Vehicles and Their Accessories.

HAND-TRUCK.—SAMUEL C. B. HEISS and GEORGE RICARDO, Hackensack, N. J. The inventor provides a new hand-truck having roller-bearings to insure light draft and to give long life to the parts. The wheels and the roller-bearings can be very cheaply constructed and the several parts readily assembled, so that the cost of the truck is not materially increased over that of the ordinary hand-truck now in use.

PNEUMATIC SPRING FOR VEHICLES.—WILLIAM W. HUMPHREYS, Sheffield, Ill. The simple and effective pneumatic springs devised by the inventor are of cushion form and are supported on the running-gears of a vehicle and in turn support the vehicle body, such springs being designed to absorb the shocks sustained by the vehicle. The elastic cushions are of elongated form, and are inflatable.

TRUCK.—ROBERT S. SCHOELCH, Shelbyville, Ind. The hand-truck has two sections pivotally connected together. The sections are arranged one above the other. The lower section carries an axle provided with wheels. The axle itself is located at the front part of the truck; and a strut is attached to the upper section in position to engage the axle so as to limit the forward movement of the upper section. Heavy objects can be more easily handled with this truck than has hitherto been possible.

Railway Appliances.

TELLTALE FOR RAIL-BONDS.—JAMES A. EMERY, Atlanta, Ga. The invention relates to telltales for bonds or electrical connections between rails of electric railways. It is the practice to place the bonds of joints between the fish-plates and the rails, so that they are often entirely hidden, and so that it is therefore necessary to remove a fish-plate or a number of fish-plates before the bond can be located. By means of this telltale, the presence of every bond in a new track can be absolutely ascertained.

Miscellaneous.

ATTACHMENT FOR MITER-BOXES.—WILLIAM POTTER, Manhattan, New York city. This simple attachment is adapted to guide and fix the angle of a saw when miters are to be cut. A perfect miter-box can be obtained by attaching the tool to the upright sections of two boards secured at right angles to each other, the tool spanning a cut in the upright section of the box. A simple means is provided whereby the guides for the saw can be locked at any angle to a perpendicular line, thus permitting the tool to be used for the accurate cutting of miters of different degrees of inclination.

BELT-STRAP.—ARTHUR D. THOMAS and IRVING R. PIERSON, Manhattan, New York city. The purpose of this invention is to provide a belt-strap which can be readily attached to or detached from the trousers. The end portions of the strap are turned inwardly under the main or middle portion of the strap and parallel therewith. Removable fastening devices secure the ends of the strap to the trousers, these fastening devices being covered and hidden by the middle portion of the strap.

BOWLING-BALL.—ARTHUR B. PICKETT, Union City, Ohio. Bowling-balls are ordinarily made of wood, composition, or other material or covered with rubber and have their finger-holes lined with a bushing or sleeve of hard or elastic material. Such balls are liable to chip at the bushing, thus rendering the ball useless. The present invention provides a ball having a bushing of a non-elastic material and an interposed bushing of elastic material between the walls of the socket and the outer wall of the inner lining. The elastic bushing thus provided protects the edge of the finger-hole so that breaking or splitting of the ball is, to a large extent, avoided.

CABINET-CASE FOR MERCHANDISE.—ALBERT R. BROWN, Erwin, Tenn. The cabinet-case holds bolts, screws, and other small articles. The case has as great a capacity as possible, considering the space occupied. Drawers of varying sizes are provided for the different goods, or the different sizes of the same kind of goods. When removed the drawers can be returned only in their proper places. Longer drawers can be used than is possible with other cases.

COMPOUND FOR POULTICES, ETC.—CHARLES M. FORD, Box 152, Denver, Col. Most pathogenic processes depend to a great extent upon the presence of water, the removal of which, in many cases, promotes the cure of the diseased parts. This compound is designed to absorb the watery secretions, and has, moreover, valuable anodyne and antiseptic qualities.

PENCIL-SHARPENER.—MICHAEL S. FORTUNATI, Brooklyn, New York city. The device is so constructed that the blade is located over a reservoir and that the shavings from the pencil are received therein. A file or rough surface is provided independent of the sharpener, by which the lead is pointed.

DUMB-WAITER.—EMMIT W. VAN FLEET, Galena, Ohio. The dumb-waiter is to be used in private houses as well as in hotels, restaurants, etc. To a floor having a hatch a guide-frame is secured. In the frame the dumb-waiter runs. A box-like inclosure is provided for the dumb-waiter, which inclosure completely surrounds the dumb-waiter and thus normally excludes the outer air. The inclosure is suspended over the frame but is fixed in position and provided with doors for access to the dumb-waiter. A refrigerating-chamber is also provided.

AUXILIARY VALVE FOR HYDRANTS.—WILLIAM H. BAKER, Trenton, N. J. It has been customary in fire-plugs to run the feed-pipe from the supply main in the street directly to the plug without any stop-valve in the feed-pipe. In order to repair the fire-plug or hydrant it was necessary to turn off the water at the intersection of adjacent streets, thus shutting off the water for a block around. The defect has been partially overcome by the insertion of a key-valve in the street between the supply main and the plug, which key-valve is contained in a valve-box built up to the surface of the street. This valve-box is an eyesore and must be frequently repaired. By the auxiliary valve forming the subject of this invention all these defects are obviated.

NOZZLE. — THOMAS F. BURKE, Riverdale, Bronx, New York city. This nozzle can be applied to any hose and is especially adapted to be carried by a fireman as he enters a burning building. When the hose to which the nozzle is attached, is connected with the force-pump of an engine, and air is supplied through the nozzle by the pump, the nozzle will distribute the air in the compartment entered by the fireman and will force the smoke away so as to permit him to breathe.

DENTISTRY.—DANIEL P. TANCO, Kingston, Jamaica. This invention relates to a system of dentistry in which the false teeth are fastened in place by purely mechanical means. A bridge-piece is employed having openings through which are projected the headed pins attached to the teeth, and these headed pins are held in place by locking-pins, which are engaged with the pins and fastened to the bridge, thus preventing the displacement of the teeth.

LOOSE-LEAF BINDER.—ROBERT G. WOODWARD, Manhattan, New York city. The binder comprises a hollow back open at the front. Posts within the back are adapted to be engaged by slots in the leaves to be inserted. A clamping device within the back, clamps the leaves, the clamping device being mounted to slide on the posts. An actuating mechanism opens and closes the clamping device, which mechanism comprises screw-rods journaled in the hollow back, a shaft under the control of the operator, and a gearing connecting the shaft with the screw-rods in order simultaneously to rotate the screw-rods upon turning the shaft. The clamping device can be very quickly opened and closed to receive the loose leaves.

Designs.

SADDLETREE-HORN.—HENRY C. STEEL, Nashville, Tenn. The saddletree-horn is of the type used by ranchmen in the West for carrying lariats, and is provided with special means for securing the horn to the saddle proper.

PEN AND PENCIL-HOLDER.—EUGENE S. DEVLIN, Port Richmond, Richmond, New York city. The leading feature of the design is an open-ring body, the terminals of which cross each other and are bowed in opposite directions to form an oval space.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send your name and address to the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 666.—For manufacturers of stereotyping outfits and novelties.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 667.—For manufacturers of dog powers.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 668.—For manufacturers of aluminium articles.

Yankee Notions. Waterbury Button Co.. Waterb'y, Ct.

Inquiry No. 669.—For manufacturers of pipe wrenches.

Turbines.—James Leffel & Co. Springfield, Ohio, U.S.A.

Inquiry No. 670.—For manufacturers of carriages.

Dies & Special Machinery. Amer. Hdw. Mfg. Co., Ottawa, Ill.

Inquiry No. 671.—For manufacturers of brick presses.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 672.—For manufacturers of chair bottoms.

Sheet Metal Stamping: difficult forms a specialty. The Crosby Company, Buffalo, N. Y.

Inquiry No. 673.—For parties to manufacture an iron batter mixer.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 674.—For machines for cutting green corn for canneries.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 675.—For parties to manufacture a backband buckle.

Our Specialties:—Steel rims, steel tubes, steel boilers. The Standard Welding Co., Cleveland, Ohio.

Inquiry No. 676.—For machines for making toothpicks.

Ten days' trial given on Daus' Tip Top Duplicator. Felix Daus Duplicator Co., 5 Hanover St., N. Y. city.

Inquiry No. 677.—For manufacturers of special bevel gears.

SAWMILLS.—With variable friction feed. Send for Catalogue B. Geo. S. Comstock, Mechanicsburg, Pa.

Inquiry No. 678.—For manufacturers of one-leaf single piece tapered carriage springs.

Kester Electric Mf'g Co's, Self-fluxing solder saves labor, strong non-corrosive joints, without acid, Chicago, Ill.

Inquiry No. 679.—For manufacturers of machines for making wood pins for telegraph and telephone purposes.

For Machine Tools of every description and for Experimental Work call upon Garvin's, 149 Varick, cor. Spring Streets, N. Y.

Inquiry No. 680.—For nozzles for feeding steam boilers with crude petroleum as fuel.

FOR SALE.—A. Winton motor for 1900; run less than one thousand miles. A. Ward Chamberlin, 57 West 66th Street, New York.

Inquiry No. 681.—For manufacturers of armature disks.

For Sale. Foundry and Machine Shop, doing a good buisness, in a fine locality, at a great sacrifice. Address Foundry, Box 773, New York.

Inquiry No. 682.—For speed indicators for automobiles.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 683.—For manufacturers of expansion bolts.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

Inquiry No. 684.—For manufacturers of small motors.

Sheet Metal Novelties, Articles and Stampings of all sizes. Tools and dies manufactured on contract. Address Standard Stamping Co. Cor. 7th & Hudson Sts., Buffalo, N. Y. U. S. A.

Inquiry No. 685.—For manufacturers of oil well boring outfits.

WANTED.—A young energetic man, who is familiar with the construction and making of Gas Engines. State experience, salary expected and references. C. J. W., Box 773, N. Y.

Inquiry No. 686.—For machinery for finishing and polishing "Mrs. Pott's" sad irons.

WANTED.—Competent foreman for draughting room. State full particulars as to present employment, experience, etc. Address J. M. Birmingham, Supt. Columbia Bicycle Factory, Hartford, Conn.

Inquiry No. 687.—Wanted at once about 250 feet second-hand wire rope or cable for guy rods ½ to ¾ inch.

FOR SALE.—United States Patent No. 563,627. Envelope printing or addressing press. This valuable patent can be secured at a very low figure. Address E. J. Decker Co., 200 South Clinton St., Chicago, Ill.

Inquiry No. 688.—For wholesale dealers in photo jewelry supplies.

WANTED.—Shop Manager. An experienced, thoroughly competent and trustworthy man as office manager, cashier, etc. Moderate salary with opportunity for advancement. Address with full particulars, experience, age, salary now received, etc., Cashier, Box 773, N. Y.

Inquiry No. 689.—For lathes for making match splits and toothpicks.

WANTED.—Assistant to Superintendent. Bright young man, technical graduate, as assistant to superintendent in manufacturing plant. Light machinery. Must be agreeable, thorough, painstaking and moderate in expectations. Address in full detail, Assistant, Box 773, N. Y.

Inquiry No. 690.—For the present address of the manufacturer of the "Baltimore jobber."

WANTED.—Assistant Superintendent. An assistant superintendent or chief foreman in the manufacture of light machinery. Good shop and agreeable surroundings. Must be young, experienced and progressive. Give full particulars, age, present compensation, etc. Address Progressive, Box 773, N. Y.

Inquiry No. 691.—For manufacturers of water meters.

WANTED.—Shop Superintendent. A thoroughly capable man in good shop manufacturing a regular line of light machinery. Must possess all-around qualifications and be a business superintendent rather than a technical one. Moderate compensation and permanency. Address with full detail, salary expected, etc., Superintendent, Box 773, N. Y.

Inquiry No. 692.—For parties to make sprocket wheels to order.

WANTED.—Assistant Superintendent. An assistant superintendent or chief foreman in a model new plant. Must be experienced in light engine work and preferably electrical and pumping machinery as well. Must be well informed, progressive and capable of handling men successfully. Address fully, stating age, compensation expected, etc., Machinery, Box 773, N. Y.

Inquiry No. 693.—For manufacturers of hay baling presses.

WANTED.—Sales Manager. Engines, power plants, etc. An educated, agreeable, progressive man, familiar with power trade and conditions, steam and electrical, capable of catalogue composition and fulfilling general sales requirements, desiring to ally himself with a new concern where demonstrated worth will count to his future advantage. A good opportunity for the right man. Address in confidence, giving full qualifications, salary received and expected, Sales, Box 773, N. Y.

Inquiry No. 694.—For manufacturers of burners for acetylene gas.

WANTED—To purchase articles adapted to the mail-order business. Must have merit; must be cheap. Give full particulars. Room 556, No. 11 Broadway, New York.

Inquiry No. 695.—For welding furnaces adapted for dropping shears.

Inquiry No. 696.—For japanning ovens adapted for japanning shears.

Inquiry No. 697.—For manufacturers of toilet articles for the silverware trade, such as nail files, button hooks, curling irons, etc.

Inquiry No. 698.—For manufacturers of wooden butter dishes and wood and paper pie plates.

Inquiry No. 699.—Wanted to purchase from some plant that has gone out of business cabinet workers' benches and factory trucks.

Inquiry No. 700.—For manufacturers of thermostats.

Inquiry No. 701.—For parties willing to manufacture small electrical device composed entirely of fiber and brass.

Inquiry No. 702.—For steel punches for making embossed plates of medals, such as are used on cigar box labels.

Inquiry No. 703.—For device for placing over the nose to prevent dust.

Inquiry No. 704.—For striping wheels for use in carriage painting.

Inquiry No. 705.—For competent engineers and designers to make a set of drawings from which to build a fore and aft compound engine.

Inquiry No. 706.—For an automobile for carrying about eight passengers.

Inquiry No. 707.—For parties to make a bottle towel holder.

Inquiry No. 708.—For manufacturers outside of the trust who can lithograph tin plates.

Inquiry No. 709.—For manufacturers who can furnish full equipment for making small boxes and tin cans.

Inquiry No. 710.—For dealers in steel 16 and 17 gage of different lengths and widths.

Inquiry No. 711.—For manufacturers of novelties for the mail order business.

Inquiry No. 712.—For dealers in second-hand gasoline engines of 2 to 4 h. p.

Inquiry No. 713.—For manufacturers of carpet cleaning machinery.

Inquiry No. 714.—For parties in compressing coal dust into brick form for fuel purposes.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8187) W. B. Y. asks: How is the horse power of an electric engine found? A. The power of an electric motor is calculated for the watts in its output of current. A watt is the unit of electrical power, and is produced by one ampere working at a pressure of one volt. Of these 746 are equal to one horse power, or 33,000 foot-pounds per minute. If you would measure the electrical horse power of any motor, measure the voltage and the number of amperes flowing. Multiply these together and divide the product by 746. This gives the horse power at the brushes.

(8188) B. M. asks: Up to what distance can the induction coil described in "Experimental Science" be used as a transmitter for wireless telegraphy? What size should the balls of the oscillator be? A. We cannot say definitely to what distance the induction coil to which you refer can transmit signals, but suppose that it should work at a distance of several miles. The balls used are about four inches in diameter.

(8189) C. R. H. asks: 1. What would be the best for the brushes on a Wimshurst machine with two glasses, sixteen inches in diameter? A. Tinsel such as is used for gilt embroidery, only be careful to get that which

is made of metal and not of paper. 2. How long a spark should such a machine give when pint-size Leyden jars are connected to the electrode? A. About six inches. 3. How many pounds pressure to the square inch should you have in a three horse power gasoline engine to be able to get it to start? A. The gasoline engine should turn over with from 10 to 15 pounds pressure. If you start it with an explosion, you may have from 100 to 200 pounds pressure per square inch.

(8190) S. A. S. asks: 1. When magnetic storms on the earth cause electric currents to flow over telegraph wires, in what direction do the currents flow, from north to south, south to north, east to west, or west to east, and do the currents always flow in the same direction? A. The idea of direction in an electric current is wholly conventional. We say it flows from positive to negative as a convenience. No one knows in which direction it does flow. It is just as likely that it flows the other way, from negative to positive. The same is true of lightning. It may descend from the clouds to the earth or ascend, for all that we can see or know. When magnetic storms prevail it is not possible to ascribe direction to the force which works a telegraph instrument. 2. What is the average potential, and strength of current, or do such currents vary greatly in strength? A. In a magnetic storm the effect of the change of magnetic intensity is to produce an electric current in the wires of a telegraph or telephone circuit, which may be strong enough to enable messages to be sent without a battery. We have no figures of their potential at hand. The potential of the air fluctuates several hundred volts either way, and when a thunderstorm is approaching, it changes rapidly and capriciously, even reversing its sign in a few minutes. Current from such potential is a very minute quantity. 3. What is the duration of such currents? A. These phenomena may last for hours, or for a few minutes only. 4. About what is the electrical resistance of the human body? A. Anything up to perhaps 5,000 ohms, varying with the person and his condition. Under any moderate voltage the current strength which can flow through a person is very little. 5. About what strength of current is necessary to give a person a moderate shock? A. It is the voltage which determines the shock. A pressure of 100 volts will give a slight pricking sensation; 200 will be disagreeable; 500 may be dangerous; while anything above is very likely to be fatal.

(8191) E. M. J. asks: I have some hard rubber slides to photographic plate holders. I want to etch a part of the surface so as to be able to write upon it with a lead pencil and to erase the same. Can you tell me how to do it in your column? A. Rubbing the surface with fine emery paper will form a matt surface which will take a pencil mark.

(8192) D. E. G. asks: I have a 500-volt current, with which I wish to run one strong arc light. Could you advise me, in the next issue of your valuable paper, how to do this? A. Your 500 volts will suffice for 10 arc lights, and if you use it for one the remaining 450 volts above what one lamp can use must be disposed of in a rheostat. You will require about 2,200 feet of No. 12 B. & S. German silver wire for such a rheostat.

(8193) F. C. H. writes: Near here two telephone lines cross, and what is said over one can be heard on the other line. Please tell me whether the speech is transmitted through the air or through the ground. A. The electric waves act from one line across the other through the air, in the same manner as the waves are transmitted in wireless telegraphy. It is called "cross talk," and is remedied by a metallic return wire, twisted around the other wire of its own circuit.

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