SCIENTIFIC AMERICAN

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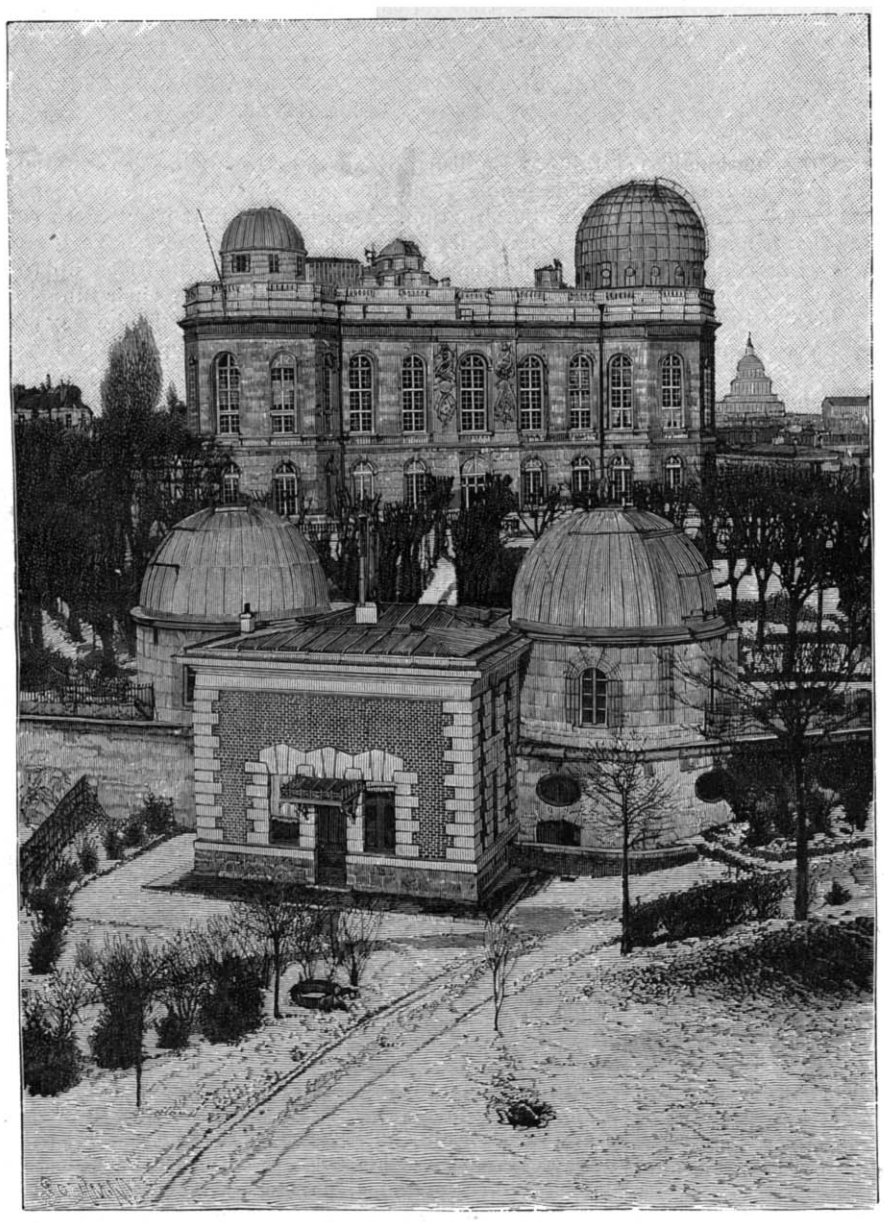
THE OBSERVATORY OF PARIS.

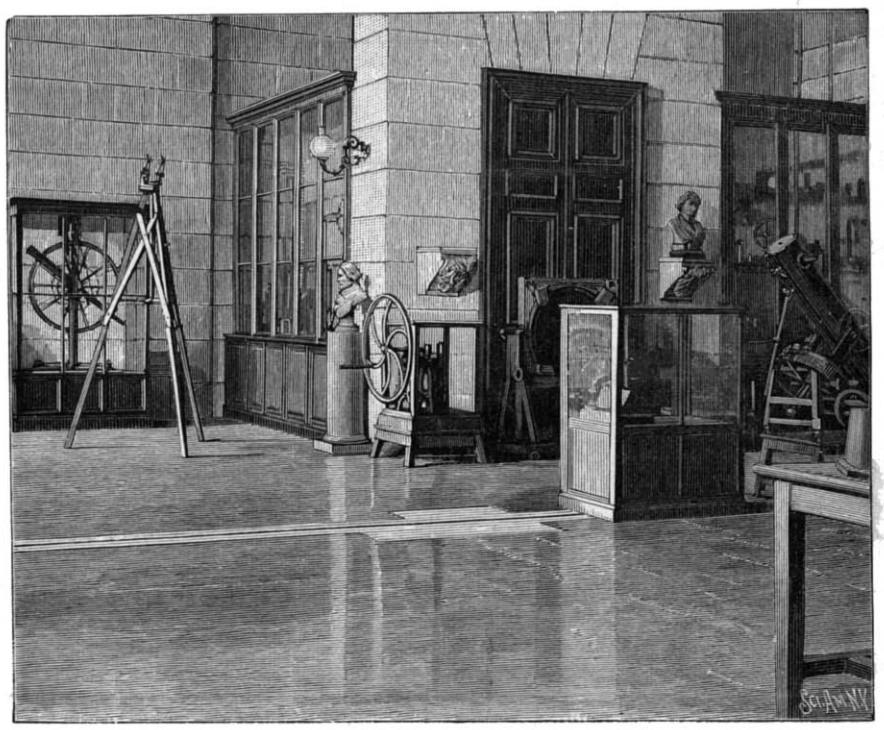
The city of Paris may well claim a position as one of the great scientific centers, its university and kindred institutions having witnessed many of the developments of the sciences and the discoveries of modern times; and particularly so in the science of astronomy, the Observatory of Paris being recognized as one of the centers of astronomical work, its astronomers having from the commencement been associated with the history of the science; the Observatory has, in fact, seen the science of astronomy emerge from its primitive stage of two centuries ago into the remarkable condition of development which we find at the present day.

The foundation of the Observatory dates from the middle of the seventeenth century, at which period the Académie Royale des Sciences decided to create an establishment devoted to physical research and astronomical work. The observatory lies on the southern side of the Seine, being inclosed by the Rue d'Enfer, the Rue du Faubourg Saint-Jacques, and the Boulevard Arago. The condition of the science at the time of its foundation may be imagined when we remember that many of the astronomers of the period had not yet adopted the ideas of Copernicus as to the movement of the planets around the sun, but considered, with the Danish scientist Tycho Brahe, that the sun and moon revolved around the earth, while the other planets revolved around the sun. Colbert took the work in hand, Claude Perrault designed it, and the eminent

(Continued on page 327.)



The Observatory of Paris.



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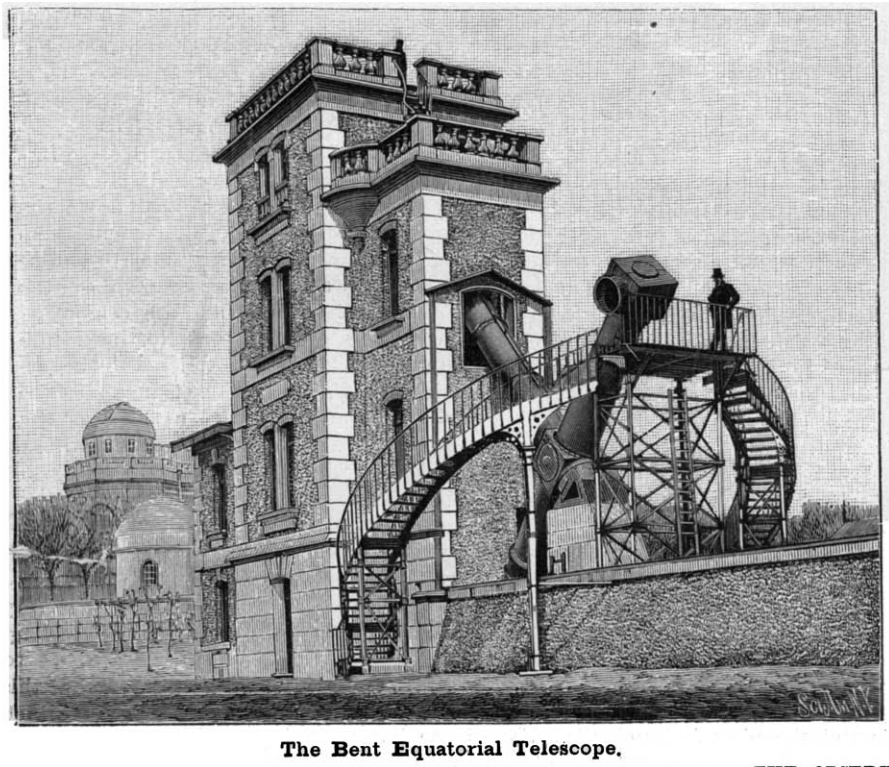

The Bent Equatorial Telescope.

The Great Reflector.

THE OBSERVATORY OF PARIS.

Scientific American.

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NEW YORK, SATURDAY, NOVEMBER 19, 1898.

FACT AND FANCY.

Mr. Nikola Tesla, of New York, has invented what is known in naval science as a dirigible torpedo, that is to say, a torpedo which, instead of being self-driven and self-steering, like the Whitehead and the Howell, now in use in our navy, is driven and steered by an operator on shore, who controls the torpedo through electrical connections. Of the latter kind are the Sims-Edison, the Brennan, and the Victoria.

The Sims-Edison torpedo is driven by an electric motor carried within the shell of the torpedo, and it is steered by exciting certain magnets which control the steering gear. Current for operating the motor and magnets is supplied through a flexible cable which is wound upon a reel carried within the shell of the torpedo, and has one end connected to the shore. As the torpedo travels through the water, the cable unwinds. The torpedo is maintained at the proper depth by attaching it to a canoe-shaped float. To enable the operator to follow the course of the torpedo, two small flagstaffs are carried at each end of the float, and by keeping his eye on these, the operator is supposed to be able to steer the deadly weapon unerringly on its course. By night two colored lights are carried at the ends of the flagstaffs, and are hooded in such a way that, while they are visible to the operator, they are invisible to the enemy.

The Victoria, an Australian invention, differs from the last-mentioned in being entirely submergible below the water and in using compressed air as its motive power. When first started, it hauls a cable after it, unwinding it off a reel on shore, and the first part of its course is covered at moderate speed. When the operator has guided it to within striking distance of the enemy, a current is sent through the cable, which releases the reel on the torpedo and allows its cable to unwind. At the same time the current starts the air engines at full speed, and the final dash for the ship is made. The Brennan is another torpedo of the dirigible type, which received considerable attention as the result of its being taken up by the British Admiralty and subjected to exhaustive experiments. Like all the torpedoes of the dirigible type, however, it has proved to be only moderately successful, and, in common with them, is not regarded with much favor by naval authorities, the Whitehead automobile being par excellence the torpedo of the present day.

The most characteristic feature in Mr. Tesla's torpedo as distinguished from the others of the dirigible class is that, whereas they use a connecting cable for transmitting the controlling power to the torpedo, he makes use of the Hertzian waves, dispensing with the cable. This method of transmission is more popularly known under the name of "wireless telegraphy," and as such attracted considerable public attention during the recent experiments by the British Post Office with the apparatus designed by the young Italian, Marconi. On another page we reproduce some of the drawings accompanying the patent which has recently been granted to Mr. Tesla, and these, together with the descriptive matter, will render this interesting device clear to our readers.

Regarding the merits of the invention and its practical value, it is altogether too early to make any predictions. The abolition of the connecting cables is, of course, greatly to be desired, and the Tesla torpedo will, presumably, be rid of the liability to accident due to several thousand yards of cable trailing in the water. On the other hand, since the propelling current can no longer be transmitted from the shore, it becomes necessary to provide batteries within the torpedo itself, thereby adding again the weight that was saved by abolishing the cable.

It is true the range of the torpedo is enlarged (according to the inventor, indefinitely); but as the Sims-Edison has an extreme range of two miles, at which distance it would be extremely difficult to follow the motion of the two small flagstaffs above referred to, we fail to see what advantages would ensue from being able to drive and control the torpedo at any greater distance.

Except so far as it dispenses with the cables, it is not evident what advantages the Tesla torpedo possesses over others of the dirigible type, and unless it proves far more effective in actual test than they have done, it cannot be considered as even a formidable weapon.

Unfortunately for its reception by the thinking public, Mr. Tesla's improvement has been introduced to the world with some of the most extravagant rhapsodies that ever threw discredit upon an untried invention. Under the "scare head" title "Tesla declares he will abolish war," one of the leading New York journals quotes Mr. Tesla as saying in an interview: "War will cease to be possible when all the world knows to-morrow that the most feeble of the nations can supply itself immediately with a weapon which will render its coast secure and its ports impregnable to the assaults of the united armadas of the world. Battleships will cease to be built, and the mightiest armorclads and the most tremendous artillery afloat will be of no more use than so much scrap iron. And this irresistible power can be exerted at any distance by an agency of so delicate, so impalpable, a quality that I feel that I am justified in predicting that the time will come, incredible as it may seem, when it can be called into action by the mere exercise of the human will."

Having thus oratorically blotted out the navies of the world, the interviewed descends to particulars, and the reader, whose faith in battleships and cruisers is thus so rudely assailed, is relieved to learn that the mighty agent of this naval cataclysm is no more nor less than our time-honored friend the torpedo (that ever verdant topic of the universal destructionalist); in new war paint and snorting strange and new defiance, it is true, but still—"a torpedo." Unlike its prosaic forbears, however, this prodigy is not content with smiting anything in the way of a warship that may be in sight; for so keen is it on the scent that it could strike, we are told, a vessel that lay at Southampton, England, while the operator was snugly ensconced in the forts at Sandy Hook.

"Mr. Tesla told me," says the reporter, "that some months had elapsed since he had fully developed his device, for which he has applied for a patent. When it was learned that Admiral Cervera was bottled up at Santiago, it was his intention to apply his mechanism to several launches and similar small craft loaded with high explosives and annihilate the fleet at anchor. Admiral Cervera, however, came out and met his fate under the guns of the American fleet before the necessary arrangements could be made. Then Mr. Tesla planned a raid on the Spanish vessels in Havana Harbor, only to be thwarted by the proclamation of the suspension of hostilities."

In view of these facts we can well believe the inventor when, according to the journal in question, he says of his dirigible torpedo:

"My imagination fairly reels when I attempt to contemplate its countless possibilities. Already I hear the knell of the battleship and the monster gun! . . . England is now no stronger than the weakest of the maritime nations. . . . She will be utterly confounded, . . . and France will rejoice."

Now all this extravaganza may or may not express the true state of the "reeling imagination" above referred to. We prefer, charitably, to hope it does not; but the question to be asked in all seriousness is, What possible good can be done either to the inventor himself or to the great cause of science, which he is presumably desirous to promote, by confusing the minds of the public by such unscientific exaggerations as we have quoted above?

The facts of Mr. Tesla's invention are creditable enough in themselves. Their practical value will be demonstrated, we presume, in due course under the fierce searchlight of a test by naval experts. Until that time it would be better to allow the navies of the world to enjoy to the full that short spell of life which yet remains to them.

GIANT STEAMSHIPS FOR THE ATLANTIC SERVICE.

The modern tendency toward centralization is very manifest in the ever increasing size of the steamships, both freight and passenger, built for the Atlantic service. It seems but a few months since we were recording the truly enormous dimensions of the "Pennsylvania," of the Hamburg-American line, yet in the brief interim she has been succeeded by a sister ship, while others rivaling her in size are upon the stocks or projected. The same company is building for the New York service a vessel that will exceed the "Pennsylvania" (which, by the way, is credited with having carried over 14,000 tons of freight in her hold on a single trip) in every point of comparison. A special feature of her construction will be the fact that the cellular construction known as the double bottom will in this ship be carried up into the sides, giving her practically two complete hulls. This will greatly increase her chances of surviving a collision by providing her with a more elaborate watertight subdivision. Two other large freight steamers are under construction for the New York service of this company and several for the Baltimore and Philadelphia and the West Indian and East African service.

The most interesting of the new vessels, however, is the passenger steamer "Deutschland," which is under construction by the Vulcan Company, of Stettin, the builders of the "Kaiser Wilhelm der Grosse." She is to exceed the latter vessel in size and speed, and with the exception of the "Oceanic," which is shortly to be launched at Belfast, she will be the largest steamship in the world. Her dimensions are: Length, 685 feet; beam, 66½ feet; depth of hold, 45 feet; tonnage, 16,000; horse power, 33,000; and sea speed, 23 knots. Including the "Oceanic" and "Deutschland," the four largest steamships will be the "Oceanic," "Deutschland," "Kaiser Wilhelm," and "Campania." Below we give a comparison of these with the "Great Eastern":

	Tonnage.	Length.	Beam.	Horse Power.
"Great Eastern"	22,500	680	83½	7,650
"Oceanic"	17,000	704	?	?
"Deutschland"	16,000	685	66½	33,000
"Kaiser Wilhelm"	14,000	649	66	30,000
"Campania"	12,950	620	65	30,000

The "Deutschland" is to be completed in the spring of 1900, in time for the heavy travel in connection with the Paris Exposition.

BOILER CAPACITY IN AMERICAN AND ENGLISH LOCOMOTIVES.

The constantly increasing weight of the express trains on English railroads of late years has necessitated the designing of much more powerful engines to cope with the situation. During the past two or three years, particularly, the English designers have been enlarging the dimensions of their locomotives up to the full limit allowed by the small size of their tunnels and by the other constructional features in the way of bridges and station platforms which impose a serious limit upon the dimensions of locomotives and cars in that country. Anyone who follows with interest locomotive development in this country and England must have been struck with the great disparity in size and power between the locomotives in use in the two countries. There is nothing in England to compare with our heaviest ten-wheel express locomotives or with such gigantic freight locomotives as those which have recently been built for the Great Northern Railroad, the Philadelphia Railroad, and the huge 115-ton engine turned out by the Pittsburg Locomotive Works.

It must be admitted, however that even after making allowance for the cramped condition of tunnels, bridges, etc., English engineers have been slow to avail themselves of such opportunities as they had. It has been a common occurrence, and is, indeed, a common occurrence on some lines to-day, for the heavy trains to be hauled by two comparatively light engines under circumstances where a single engine of greater power could have been designed to do the same work with a considerable saving in the expenses of operation. There are many express engines in constant service in England to-day whose heating surface is barely one thousand square feet. In America, trains such as these engines are hauling would be handled by a locomotive of between fifteen hundred and two thousand square feet of heating surface and having cylinder capacity in proportion.

For some reason or other, the English have been slow to increase the size and power of their boilers. The diameter of the cylinders and the stroke have been increased without any corresponding provision being made for a larger supply of steam, with the result that to American eyes many of the English express locomotives look to be very much over-cylindered. Of course, this disparity is somewhat corrected by the fact that the coal burnt on English locomotives is, as a rule, of better quality than ours, and there is, moreover, a certain amount of benefit derived from the copper fireboxes, which are universal over there, and the brass tubes, which, we believe, are still very widely in use.

Another cause which has operated to keep down the size of the boiler is the partiality of English engineers for large driving wheels, coupled with their prejudice against placing the boiler at any great height above the rails. On engines, for instance, like the celebrated eight-foot single drivers of the Great Northern Railway, the diameter of the boilers is restricted to the distance between the drivers, and hence it is impossible to largely increase the heating surface as long as the boiler is kept well down upon the frames without extending it to a length which is not desirable.

In America the tendency to increase the size of the boiler in express locomotives showed itself at about the time when we were also greatly increasing the size of the driving wheels. The difficulty was met by boldly placing the center line of the boiler well up above the wheels, allowing the boiler, if need be, to overlap them considerably. A notable instance of this was the New York Central engine, No. 999, in which the center of the boiler is 8 feet 11½ inches above the rails. Experience has proved that this arrangement presents no objectionable features, and, indeed, it is found that a locomotive with a high center of gravity

is easier in its motion and less destructive to the track and roadbed than one in which the center of gravity lies several feet nearer the rail. No. 999 was provided with a heating surface of nearly 2,000 square feet, or about double that of the average English express locomotive at the time when she was constructed.

The obvious advantages of the large boiler capacity of American locomotives were not lost upon English engineers, and two or three years ago Mr. Drummond designed for the Caledonian Railway a powerful engine, the boiler high above the wheels, whose total heating surface was about 1,500 square feet. Following the lead of this design, other roads, such as the Great Western, the Southwestern, and the Great Northern, brought out some very handsome engines, in which the heating surface has been raised as high as 1,600 square feet, the cylinder capacity in every case being increased in proportion. One of the latest and most successful of these designs is illustrated on another page. We think it is questionable whether such engines as the one in question and the powerful four-cylinder engine recently built for the Southwestern Railway by Mr. Drummond have not about reached the limit of size obtainable on English roads. Hence the rapid increase in size and weight of English rolling stock makes it evident in the course of time the problem of providing sufficiently powerful locomotives will be a difficult one to solve.

ANNUAL MEETING OF THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

The annual meeting of the Society of Naval Architects and Marine Engineers took place on Thursday and Friday, November 10 and 11, in the building of the American Society of Mechanical Engineers, 12 West Thirty-first Street, New York city. In view of the excellent list of papers to be read before the society, many of them bearing directly upon the operation and lessons of the recent war, there was an unusually large attendance of members. On the first day the meeting was called to order by President Clement A. Griscom, who delivered an address in which he paid tribute to the designers and builders of the American ships in common with the officers and men who had fought with such brilliant results. He expressed the opinion that our acquisition of distant territory would have a stimulating effect upon our shipbuilding industry, and that it was possible that it would prove the turning point from which we should rise to our former proud position as one of the leading shipbuilding countries of the world.

Assistant Naval Constructor Lawrence Spear read a paper on "Bilge Keels and Rolling Experiments, U. S. S. 'Oregon,'" in which he gave some interesting information as to the effect of placing bilge keels on this vessel. Naval Constructor Bowles read a paper by G. W. Dickie, manager of the Union Iron Works, of San Francisco, on "Torpedo Boat Destroyers for Sea Service, with Special Reference to the Conditions that Prevail on the Pacific Coast." Questions raised by this paper were taken up in connection with the topical discussion on "The Utility of Torpedo Boats, and Has the Submarine Boat a Place?" Communications were read by Secretary Bowles, from officers who had commanded some of the torpedo boats during the war, who claimed that the boats were of great utility, but were handicapped by an insufficient complement of officers and men accustomed to this form of service. An interesting and valuable paper was that read by F. M. Wheeler on the "Steam Economy Test of a Unique Form of Feed Pump."

On the second day of the session the following papers were read: "The Steam Yacht as a Naval Auxiliary," by William P. Stephens; "Designs of the New Vessels for the United States Navy," by Chief Constructor Philip Hichborn; "Methods of Testing Water-tight Bulkheads in United States Navy," by Assistant Naval Constructor H. E. Smith, U. S. N.; "Tests of the Strength of a Longitudinal Bulkhead Separating Two Engine Rooms," by Naval Constructor J. J. Woodward, U. S. N.; "An Electrically Operated 150 Ton Revolving Derrick," by Walter A. Post; and the "Stability of a Battleship under Damaged Conditions."

Commencing with the next issue of the SCIENTIFIC AMERICAN SUPPLEMENT, we hope to publish a series of the above papers.

COMMISSION TO REVISE THE PATENT AND TRADEMARK LAWS OF THE UNITED STATES.

A commission has been appointed by the President, under an act of Congress, to revise and amend the laws of the United States concerning patents, trademarks, and commercial names, to the limited extent of their interference with the Convention for the Protection of Industrial Property, and the agreements under such convention for the prevention of false indication of origin, and for the international registration of trademarks.

The active duties of the commission, in respect of amending the patent laws, are therefore very limited; but the provision as to the report of the commission is very broad, and enables them to accompany their report by references to such treaties and foreign laws relating to patents, trade and other marks, as may affect the citizens of the United States. The commission, therefore, have the widest latitude for instruction and information to the inventors of the United States.

They have issued a letter addressed "to citizens of the United States interested in inventions and trade marks as related to foreign commerce," which raises a multitude of questions of interest to our people, and which, if properly answered, will enable the commission to make a report of the greatest interest and value.

The letter does not show any bias on the part of the commissioners for or against any particular side in the discussion of the desirability of patent laws by the people of this country, but on the contrary would seem to indicate the bringing together of all the questions which may be raised for the amelioration of our present patent system.

We think that the plan of action adopted by the commission is highly commendable, seeing that it will place them in close touch with the needs and wishes of the great body of inventors and manufacturers who are immediately concerned in the questions at issue. If the commission had drawn up, on its own initiative, a series of amendments that might or might not have commended themselves to the interested public, they would not have worked with such a comprehensive grasp of the problem as they will after the various meetings have been held and the inventors and manufacturers have had an opportunity to discuss the matter in the form of a series of questions or suggestions, as written down in the letter "to citizens of the United States" above referred to.

In pursuance of their policy the commission are holding a series of meetings in the principal industrial centers, to which they are inviting the attendance of inventors, merchants, and manufacturers. The first meetings, held in Chicago on Thursday, Friday, and Saturday, October 6, 7 and 8, were largely attended, chiefly by the members of the Patent Bar Association. Addresses were delivered by Lysander Hill, Judge L. L. Bond, James H. Raymond, Robert H. Parkinson, President of the Patent Bar Association, Lewis K. Gillson, Arthur Steuart, of Baltimore, Paul Synnestvedt, Ephraim Banning and Mr. Pierce.

Mr. Francis Forbes, one of the commissioners, attended a meeting of the Association which was held in St. Louis on October 10, 1898, at the invitation of the Association, and explained the operation of the International Convention, and received suggestions in regard to alterations in the patent laws which would remove existing disabilities under which the various branches of business represented at the meeting were laboring.

The open letter or invitation before referred to has been sent out to the extent of 5,000 copies by one manufacturing association alone in this city, and it is to be hoped that there will be a large attendance by those whose interests are affected. The forthcoming New York meetings will be held at the United States Court rooms in the Post Office building in New York at 10 A. M. on November 19 and 21. These will be followed by a meeting at the Patent Office in Washington on November 22.

The Convention for the Protection of Industrial Property requires in general terms (art. 2) that the citizens of one member of the union created by it shall enjoy in another all the rights which the citizens of the latter enjoy in regard to patents for inventions, trademarks, and commercial names. The open letter of the commission submits a series of questions from which we select the following:

What advantages do the laws of the United States accord to its citizens which the citizens of other members of such union do not "enjoy"? It is pointed out that our patent laws grant the right to file caveats to citizens of the United States only, and the question is asked: "Is this a right which citizens of other members of the Union for the Protection of Industrial Property are entitled to enjoy under the convention?"

We think that as long as the filing of caveats is practiced in this country, there can be no question of the advisability of granting to foreign inventors the same right, should they wish to exercise it. It should be borne in mind, however, that the advantage of filing a caveat is open to some question, and that some practitioners advise against this step, except in certain limited and special cases.

Regarding the "date of invention," the circular calls attention to the fact that in interference proceedings before the Patent Office, the foreign applicant is allowed to carry back the date of his invention to the date of publication of his foreign patent, or of his disclosure in this country, and not to the date of filing his application abroad. It is asked whether this rule should be changed by statute?

It is evident that the foreign applicant is here placed at a great disadvantage as compared with an applicant in this country.

Regarding the application for and obtaining of a patent by a foreign executor, the circular asks, "Should it be provided by statute, that in case of the death of a foreign inventor the executor or administrator authorized to act by a foreign court having jurisdiction of the estate of the deceased inventor, should be permitted to apply for and obtain the patent for the invention of such foreign inventor?" As matters now stand, the foreign inventor is at a disadvantage owing to the fact that a foreign administrator has no standing in our courts. Should an applicant die during the prosecution of his application, his estate is put to the trouble and expense (the latter amounting to about the usual cost of obtaining the patent) of having to take out ancillary letters of administration.

Regarding trademarks, the circular states that each member of the union agrees that "every trade or commercial mark regularly deposited in the country of origin shall be admitted to deposit, and so protected in all other countries of the union;" and the following questions are asked: "Is a national law, which shall be enforceable irrespective of the State laws of the several States of the United States, required by the convention? Must such a law, if granted, allow of the registration of every foreign mark, duly registered abroad, except such as are contrary to morals and to public order? Should the Tariff Act of 1897 be amended so as to afford to manufacturers of other states of the union the same protection that it affords to domestic manufacturers?"

Under the head of "Consideration of Special National Features of Patent Laws" the most important question brought up for consideration is as to whether a provision should be inserted in the law forbidding the grant of a patent in the United States in the case of the prior application for and grant of a foreign patent for any other invention than that for which said foreign patent was granted? The case of Germany (Germany is not a member of the union) is a familiar illustration of the inequality that exists in this particular. If a citizen of the United States or a German subject applies for a patent in Germany for a new chemical combination, the German government allows the grant of a patent for the process only. "Should a German citizen, therefore," the circular asks, "be granted a patent in the United States for both the process and the new chemical combination produced by the process?"

The broad principle of equality which underlies the whole movement of the Protective Union commends it to the people of the United States, and we sincerely hope that the effort on the part of the Revision Committee will be met by a prompt response on the part of the industrial interests in New York city and vicinity.

DEATH OF D. A. WELLS.

David A. Wells, who was widely known as a writer on economics, died at his home, Norwich, Conn., November 5, 1898. He was born in Springfield, Mass., 1828, and was a lineal descendant of Thomas Welles, Governor of the Colony of Connecticut from 1655-58. Mr. Wells graduated from Williams College in 1847 and became assistant editor of the Springfield Republican. He invented the first successful machine for folding newspapers and books. Journalism did not appear to be to the liking of Mr. Wells, and, as he realized a sufficient sum from the sale of his invention to render him independent, he abandoned newspaper work and took a special course at the Lawrence Scientific School of Harvard. He graduated from this school in 1852, and received an appointment as professor in the school. At the close of the civil war Mr. Wells was brought prominently into public life by his writings on economical subjects. His essay, "Our Burden and Strength," was received with enthusiasm in the Northern States. President Lincoln sent for Mr. Wells in 1865 to confer with him as to the best methods of dealing with the enormous debt which the war had accumulated. In March of that year Congress created a commission of three persons to inquire into the subject of raising by taxation such revenue as was necessary to supply the wants of the government. Mr. Wells' work so impressed Congress that, in 1866, an act was passed making him "Special Commissioner of Revenue." Most of the laws passed between 1865-70 dealing with the whole system of revenue laws were passed at Mr. Wells' suggestion. In 1865 Mr. Wells made a trip abroad to investigate forms of competitive industry with a view of drafting a new tariff. The result of this visit was to change Mr. Wells' views from strong protection to free trade, and on his return he began an aggressive campaign against what he termed "existing evils in the system of revenue taxation." Since that time Mr. Wells devoted his attention largely to writing on economic subjects, and has held positions as a State commissioner for investigating laws relating to legal taxation.

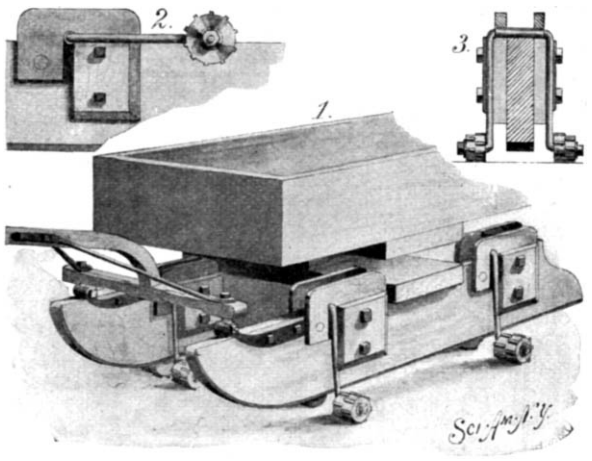
THE best locomotives on steam lines weigh 154 pounds per h. p., but on an electric traction line at Baltimore, which was opened in 1895, the electric traction locomotive weighed 126 pounds per h. p. These locomotives weigh 90 tons, and develop 1,600 h. p., distributed on six independent driving axles.

A WHEELED ATTACHMENT FOR SLEDS.

In order to provide a device by means of which a sled can be readily mounted on wheels, when running over cleared portions of roads, John D. Wilson, of Heron Lake, Minn., has devised a novel attachment by means of which the desired end is attained.

Of the annexed illustrations, Fig. 1 is a perspective view of a sled with the attachment in operative position; Fig. 2 is a side elevation showing the attachment in inactive position; and Fig. 3 is a transverse section of a runner with the attachment applied.

The attachment consists of a U-shaped axle mounted in a bearing on each end of a runner, and bent down



WILSON'S ATTACHMENT FOR SLEDS.

over the sides of the runner, the ends of the axle being formed with outwardly extending spindles on which ribbed wheels are journaled. In order to hold each axle in proper position, the inventor employs cleats bolted to the sides of the runners. The top edges of these cleats are arranged in alinement with the bottom portion of the axle bearings. When swung into the inoperative position shown in Fig. 2, the side portions of each axle will rest upon the top edge of a cleat. At their forward ends the cleats are provided with ledges, by means of which the side portions of the axles, when in operative position, may be held vertically, as shown in Fig. 1.

When the sled is running over snow or ice and a cleared portion of the road is reached, the driver throws the axles forward so as to bring the wheels on the ground. The sled upon being pulled onward will rise upon the wheels and swing the axles against the forward ledges of the cleats. The sled is now mounted upon wheels and can be readily moved over the cleared portion of the road. When snow or ice is again reached, the sled is backed, thus causing the wheels to move forward and enabling the driver to swing them into the inoperative position shown in Fig. 2.

FOUR-COUPLED EXPRESS ENGINE FOR THE GREAT NORTHERN RAILWAY, ENGLAND.

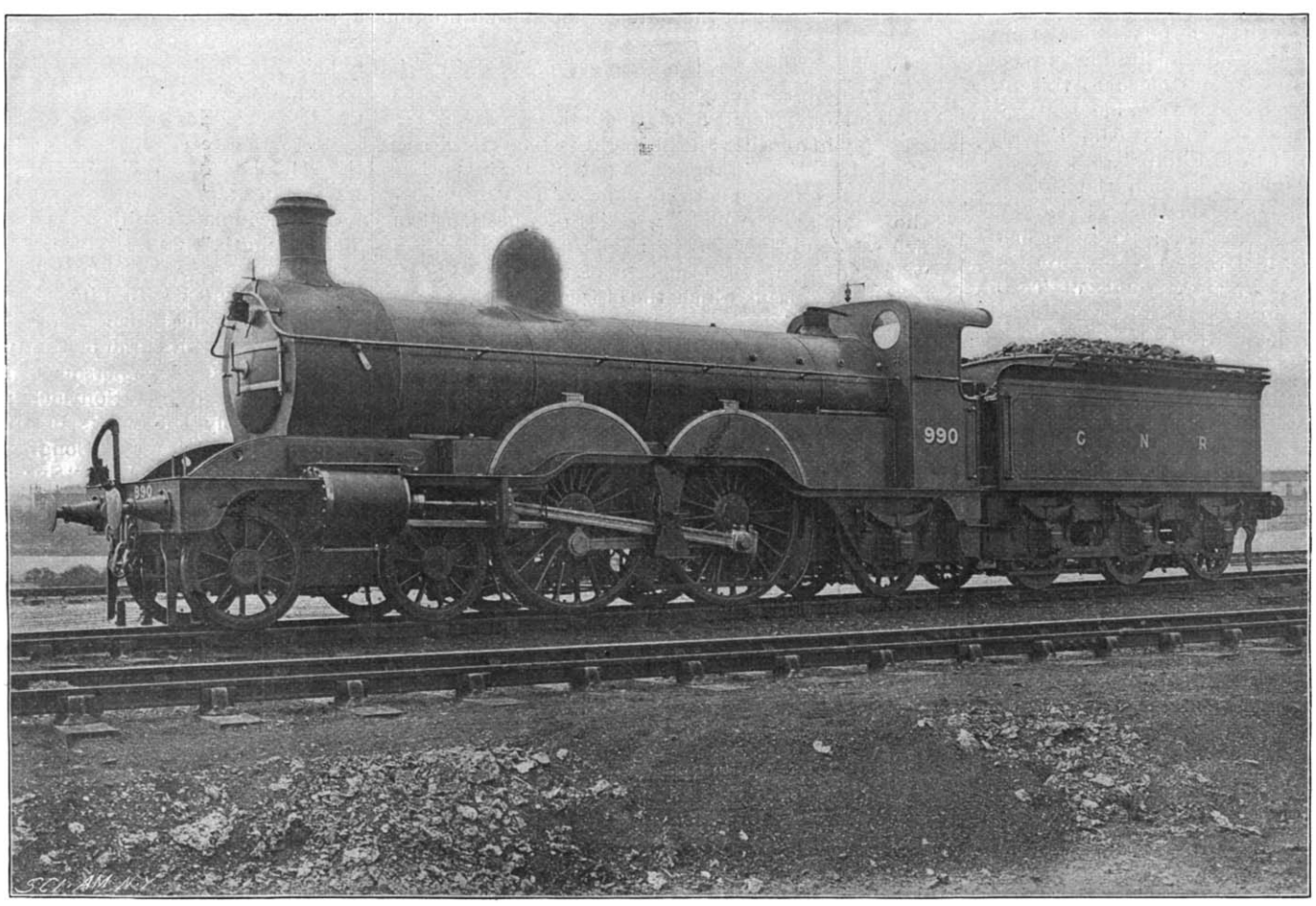
In another column we have referred to causes which have led the English locomotive engineers to design engines of much greater weight and power and larger boiler capacity than those which were standard practice less than a decade ago. We have been favored by Mr. H. A. Ivatt, locomotive superintendent of the Great Northern Railway, England, with a photograph of a powerful express engine which he has lately designed for that road. At first glance our American readers will notice that the arrangement of the driving wheels is similar to that of a class of Baldwin engines which are just now doing excellent work on the fast express trains running from Philadelphia to Atlantic City, the likeness consisting in the fact that the cylinders are connected to the rear pair of drivers, to which the forward pair are coupled up with the customary side rods. The likeness does not extend beyond this feature, however, the Baldwin engines being four-cylinder compounds of the Vauclain type and possessing other distinctive features peculiar to the type.

The engine illustrated has been built for the fast and heavy express service from London to the North, and it is of exceptional weight and power to enable it to cope with the necessities of a very trying service. Hitherto the express trains have been hauled chiefly by Mr. Sterling's well-known single-driver engines, with 19 × 28 inch cylinders and 8-foot driving wheels, and a heating surface of from 1,000 to 1,200 square feet.

The new engine is the largest and heaviest express engine in Great Britain, its weight being 65 tons, and the weight of the tender 45¾ tons, the total weight of the engine and tender in working order being therefore 110¾ tons. The drivers, four in number, are 6 feet 6 inches in diameter, and they are placed about the middle of the boiler. The cylinders are 19 inches in diameter by 2-foot stroke, and are outside connected after the American fashion. The boiler is 4 feet 8 inches in diameter and 14 feet 8 inches long in the barrel. By placing the driving wheels well forward, it is possible to provide an unusually large firebox between the rear driver and the pair of trailing wheels, with the result that there is a total heating surface of 140 square feet in the firebox and a grate area of 26·75 square feet, both of which figures are unusually large for an English locomotive.

The firebox is of copper and the tubes are of iron, the total heating surface of the latter being 1,302 square feet, making a total heating surface of the whole boiler of 1,442 square feet. The working pressure is 175 pounds per square inch. The weight on the drivers is 34¾ tons, giving a total tractive power of 14,303 pounds for every pound of effective pressure in the cylinders. The truck wheels and the pair of trailing wheels are 3 feet 7½ inches in diameter. The tender, whose capacity is 3,670 gallons of water and 5 tons of coal, is carried on six wheels 4 feet in diameter, and its total wheel base is 13 feet. Empty, the tender weighs 22¼ tons.

We are informed by Mr. Ivatt that the new engine has proved fully equal to the heavy demands of the express traffic. With a load of 295½ tons, it has easily maintained a speed of from 55 to 60 miles an hour over the more level stretches of the Great Northern Railway.



NEW TEN-WHEEL EXPRESS ENGINE FOR THE GREAT NORTHERN RAILWAY, ENGLAND.

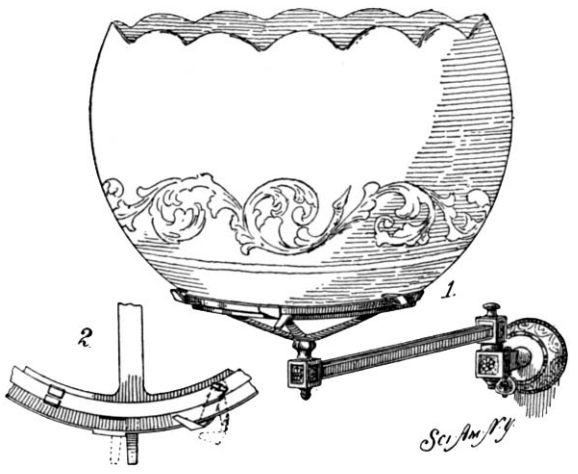
Cylinders, 19×24 inches; diameter of driving wheels, 6 feet 6 inches; heating surface, 1,442 square feet; steam pressure, 175 pounds; weight of engine and tender, 110¾ tons.

THE seeds of the Datura stramonium recently claimed their annual victim in Newark, N. J., in the person of a five-year old child. It is said that there has been in that city at least one death from this cause every year for the past twenty-five years. The practice prevailing in many of our large cities, as well as in the smaller ones, of allowing vacant lots to produce year after year crops of noxious and poisonous weeds cannot be too strongly condemned. It was by seeds procured from such sources that the recorded fatality was effected.

A CONVENIENT GLOBE-HOLDER.

In the globe-holder of which we give an illustration, the inventor, Charles Ayres, 165 West Ninety-eighth Street, New York city, provides a series of retainers for engaging the globe, and connects all the retainers to operate simultaneously.

On the usual base, a ring is mounted to have a limited rotatable movement. The movable ring may be held in place and guided by stamping up ears or tongues from the base, and bending them over the movable ring as shown at the left of Fig. 2. The globe retainers, of which one is shown clearly at the right of Fig. 2, are pivoted to the ring; they extend outward through the usual vertical flange on the base and their outer ends are bent upward to clear the base flange, and then diagonally inward to an engagement with the bottom of the globe. An operating arm seen at the center of Fig. 2, and also in Fig. 1, projects from the movable ring outward to a position to be grasped by the fingers. Adjacent to the operating arm, a catch device is secured for holding the arm against movement, and thus locking the globe-retainers in engagement with the globe. The dotted lines in Fig. 2 show the two



AYRES' IMPROVED GLOBE-HOLDER.

positions of the globe-retainers and operating arm when the arm is moved partly to rotate the ring and shift the fasteners in securing and releasing the globe.

FEW of us are aware of the virulence with which certain poisons act through the olfactory nerves, and it is important that those who have to do with chemicals should know the toxic effect of inhaling certain noxious odors. A few of the more dangerous smells are stated by The Boston Transcript. We are told that a single whiff of highly concentrated prussic acid will kill a man as quickly as a shot through the heart. The odor of a bad egg is due to the presence of sulphureted hydrogen, and the objectionable smells of sewers and bone factories are attributable chiefly to the same gas. Chemical laboratories are famous for bad smells. Berzelius, who discovered the element called selenium, once tried the experiment of permitting a bubble of pure hydrogen selenide gas to enter his nostrils. For days afterward he was not able to smell strong ammonia, the olfactory nerves being temporarily paralyzed. Selenium gas has the odor of putrid horseradish. Tellurium is even worse.

ON October 31, 50,000 bushels were loaded into the hold of the British steamship "Ormesby." The task was completed within a few hours of midnight, when the charter under which she was being loaded expired. The work of loading the grain began early in the morning of the 31st, and, with the aid of two elevators, steady streams of grain were sent into the vessel's hold until late in the evening.

HANDSOME MODEL LOCOMOTIVE.

In his letter accompanying the photograph which we herewith reproduce Mr. Richard H. Kiddle, of Kinsman, Ohio, informs us that this beautiful working model of a locomotive was made by him last winter in his leisure hours. Behind the locomotive is the locomotive builder himself and his four-year-old boy, who "can tell the names of nine-tenths of the different parts of the engine and can tell what most of them are for."

In building the model the construction of a full sized locomotive was followed with considerable attention to detail. It is provided with air pump and main reservoir (not shown in cut) under the cab and between the frames. The engineer's brake-valve reservoir is placed under the cab windows, and if we could look within the cab we should find a steam gage, three gage cocks and drip pipe to carry off the water, a reversing lever and sector, a complete little injector, with its feed pipe and check valves, a whistle lever, bell rope, rod to open cylinder cocks, a rod to open draught in ash pan, and, indeed, every item that goes to make up the complete fittings found in a modern locomotive cab.

The boiler is lagged with Russia iron, except the extension front, which is enameled jet black. The tender is also black enameled, with the letters in gold. The cab roof is made of Russia iron and the cylinders are lagged with the same material. The saddles, which are black enameled to match the extension front, are of cast iron, and the drivers are made of the same material. The engine has a steam brake between the drivers, and there is also a hand brake on the tender. The brake beams are of oak. The pilot is cast and is firmly bolted to a neat walnut cross piece, in each end of which are seen pockets for flags. The pilot is provided with the regulation push-bar.

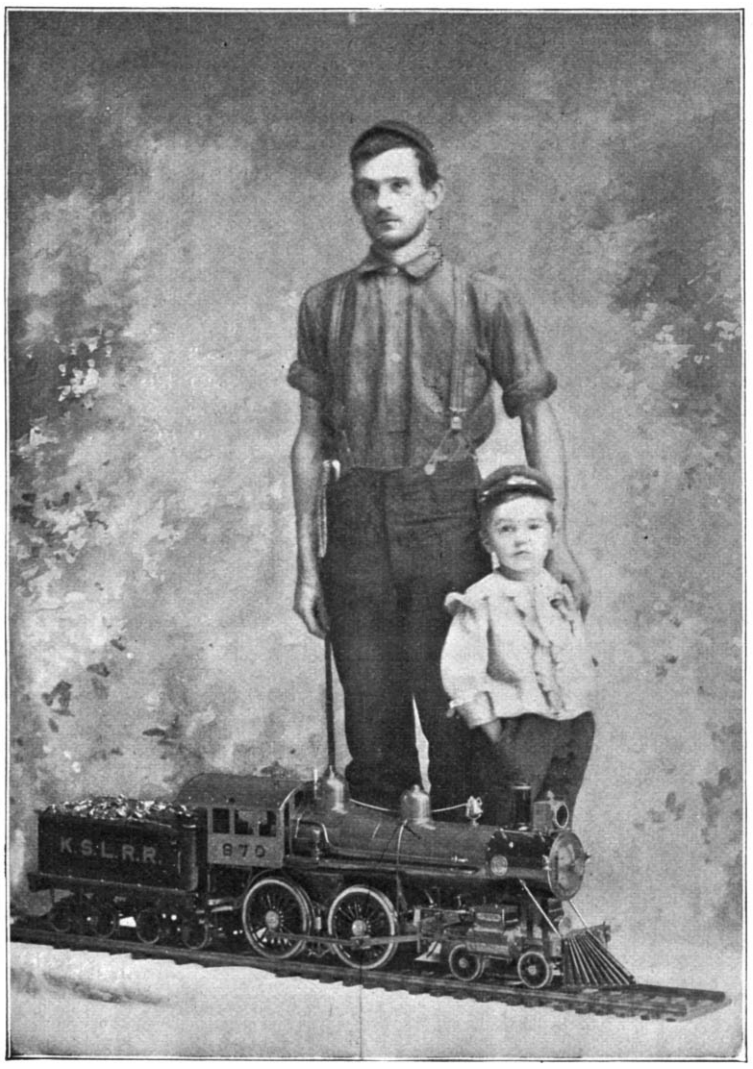
The headlight, which burns wood alcohol, is complete with glass and reflector. The boiler, it should be said, is fired with gasoline or wood alcohol. Note should also be made of the small lamps, or markers, carried on the extension front, and also of the flag pockets on each side of the headlight. The extension front carries a small brass plate with the builder's name and the date.

The boiler is of the wagon-top type. The cylindrical portion was made from a 5-inch boiler flue, and the fire box is built of $\frac{5}{32}$ steel plate and strengthened in the regular way with stay bolts. The flues are of bicycle tubing $1\frac{1}{16}$ inch diameter and No. 20 gage. The front head of the boiler, ¼ inch in thickness, is riveted and brazed. The tender is as carefully finished as the engine and carries a drawhead and couplings. On the tender are the usual tool boxes with a complete set of tools, and in their proper place are found a coal pick, shovel, poker, etc.

Throughout the engine provision has been made for taking up wear. The side rods are of the solid end type. All wheels are turned with a taper to facilitate rounding the curves. The rails are ¾ inch high and are laid on ½ by ⅞ inch ties. The engine, when blocked up from the track, has been run at a speed of over 1,000 revolutions a minute.

This beautiful little model follows closely the lines of the well known express engines of the New York Central Railroad, of which No. 999 of Empire State Express fame is the best known example. It carries the number 870, by which the engine which is at present hauling that train on the run between New York and Albany is known. The letters on the tender stand for the Kinsman Shortline Railroad, a projected road in which the citizens of Kinsman and the neighboring town of Farndale are interested.

The fact that the builder of the model is not a railroad man and has never worked in a railroad shop is another evidence of the fact that the locomotive is an ever attractive subject for a machinist when he is tempted to put in his spare hours at model building.



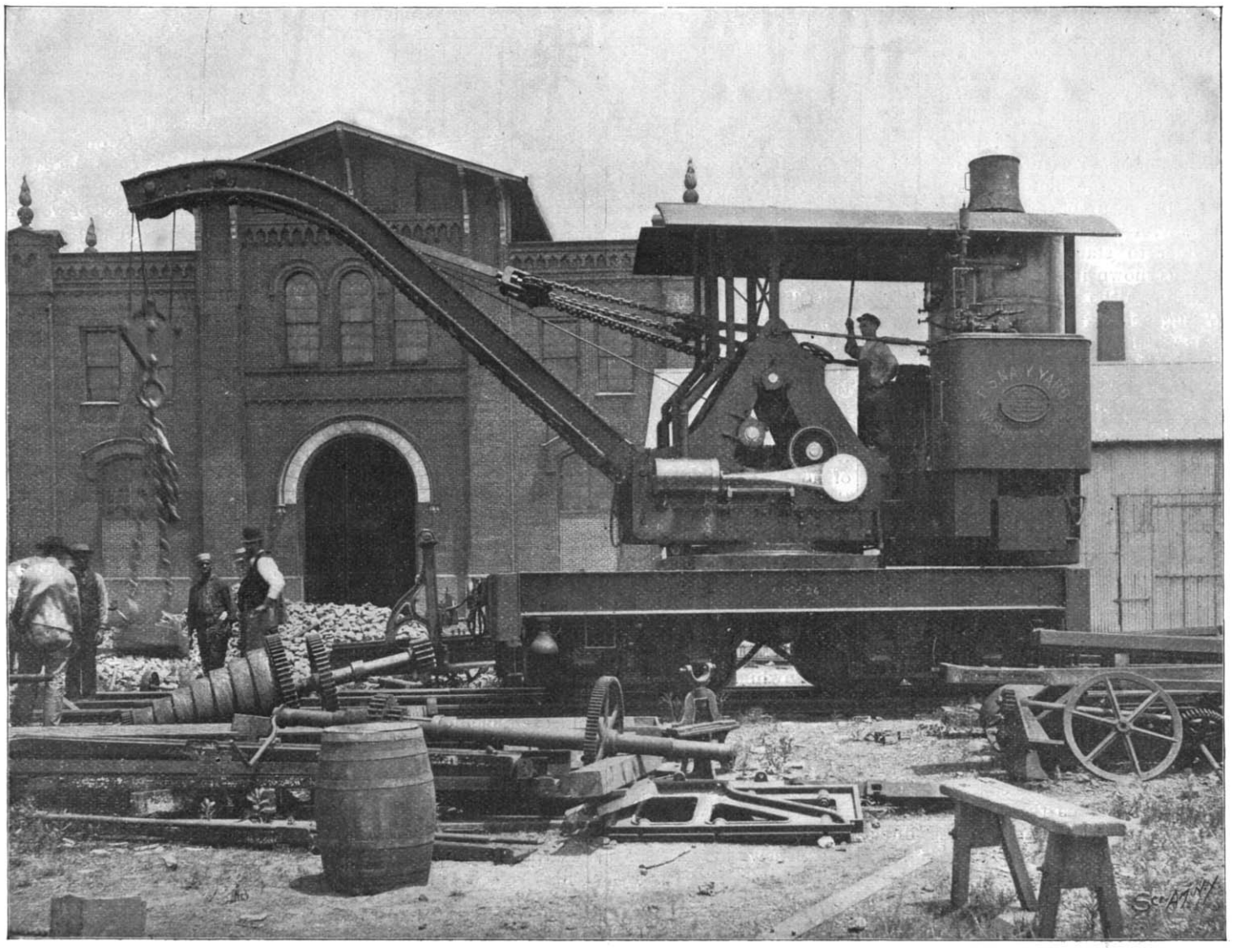
MODEL OF EMPIRE STATE EXPRESS LOCOMOTIVE No. 870.

Gage of road, 5¼ inches; total weight engine and tender, 126½ pounds; cylinders, 1⅛×2⅛ inches; boiler diameter, 5 inches; steam pressure, 110 pounds.

A STEAM LOCOMOTIVE CRANE AT THE WASHINGTON NAVY YARD.

Our engraving represents a 15-ton locomotive crane, mounted on an eight wheel car, at the Washington Navy Yard. This crane can handle its load at a radius of 15 feet, and it will lift and carry loads of the above weight in any position of the jib, whether ahead or at right angles to the car. The self-propelling feature which it has, makes it a specially useful adjunct in the work to be done about any large plant where heavy castings or materials are to be handled, loaded and unloaded from cars. The crane is specially useful in the Washington Navy Yard to handle materials of all kinds, such as gun forgings, gun carriages, and all the miscellaneous material used in the manufacture of ordnance. At the Washington Navy Yard there is a system of tracks extending to all the buildings of importance, so that the crane can take material from the cars and transfer it through a system of tracks to the shops where the work is to be done upon it, and when this work is completed the finished material may be removed and loaded onto cars for shipment. The power is obtained from a pair of engines with 8 by 10 inch cylinders, and the combined horse power is about 40. From the engine shaft the motion is communicated through powerful clutches to the countershaft operating the motions of traveling, slewing the crane, hoisting the load, and varying the radius of the jib. All of the motions mentioned are performed by the engine shaft through a spur or bevel gearing.

Inasmuch as it is necessary for the machine to go around curves in the navy yard, the two pairs of central wheels supporting the car have blank treads and the operation of self-propelling is performed by connecting the countershaft by an endless chain belt with the axles of the two pairs of the supporting wheels. The machine is thus able to propel itself, and if necessary one or two loaded cars may be pulled along by it. The levers operating the different motions mentioned above are within easy control of one operator, who stands in the position shown in our engraving. He also fires and controls the boiler, which is 52 inches in diameter and 9 feet high. Through the radius varying mechanism this crane may extend its jib to a radius of 20 feet if desired; the jib may be pulled in so that its radius is contracted to 12 feet. This locomotive crane has been in use for about three years in the Washington Navy Yard. It was manufactured by the Industrial Works, of Bay City, Michigan, to whom we are indebted for the particulars given.



A FIFTEEN TON STEAM LOCOMOTIVE CRANE AT THE WASHINGTON NAVY YARD.

M. ROGER is of the opinion that the artichoke possesses several advantageous qualities as a medium for bacterial cultures. After having stripped off the scales the thick part of the artichoke is cut up into little cubes, care being taken to preserve the fibers (foin). The pieces are then placed in tubes plugged with damp wadding, the fibers being uppermost, so that the culture medium is represented by a fleshy mass surmounted by a sort of tuft. When the wadding is inserted, the whole is heated in an oven to 115 Centigrade for a quarter of an hour. In making an inoculation the germs must be deposited at the point of insertion of the flowers.—Lancet.

NIKOLA TESLA'S LATEST INVENTION.

We have recently been informed by the public press in flamboyant rhetoric that Nikola Tesla has devised a boat which is destined to revolutionize the art of warfare. Apart from its value as an excellent subject for sensational newspaper articles, Mr. Tesla's invention presents certain aspects which are, perhaps, not uninteresting from a scientific point of view. We have therefore produced herewith diagrams of this vessel, from which it will be seen that, ingenious as the mechanism employed may be, no very decided advantage is presented over the dirigible torpedo.

Of the annexed diagrams, Fig. 1 is a plan view of Tesla's boat, presenting a general view of the apparatus employed, Fig. 2 is a sectional view of the Tesla system, and Fig. 3 is a longitudinal section of the boat showing the mechanism in side elevation.

Tesla claims that, in a broad sense, his invention differs from all other systems of controlling boats, in so far as he uses no intermediate wires, cables, or other form of electrical or mechanical connection with the object, save the natural media in space.

The boat itself is provided with a propelling mechanism comprising a screw propeller, *C*, secured to the shaft of an electric motor, *D*, driven by the storage battery, *E*. The vessel is steered by a rudder controlled by a steering motor, *F*. The apparatus by means of which the operation of both the propelling and steering is controlled, involves the use of a receiving circuit adjusted and rendered sensitive to the influence of the electrical waves or impulses emanating from a distant source, the adjustment being such that the oscillations of the circuit and of the source of disturbance shall occur in electromagnetic synchronism.

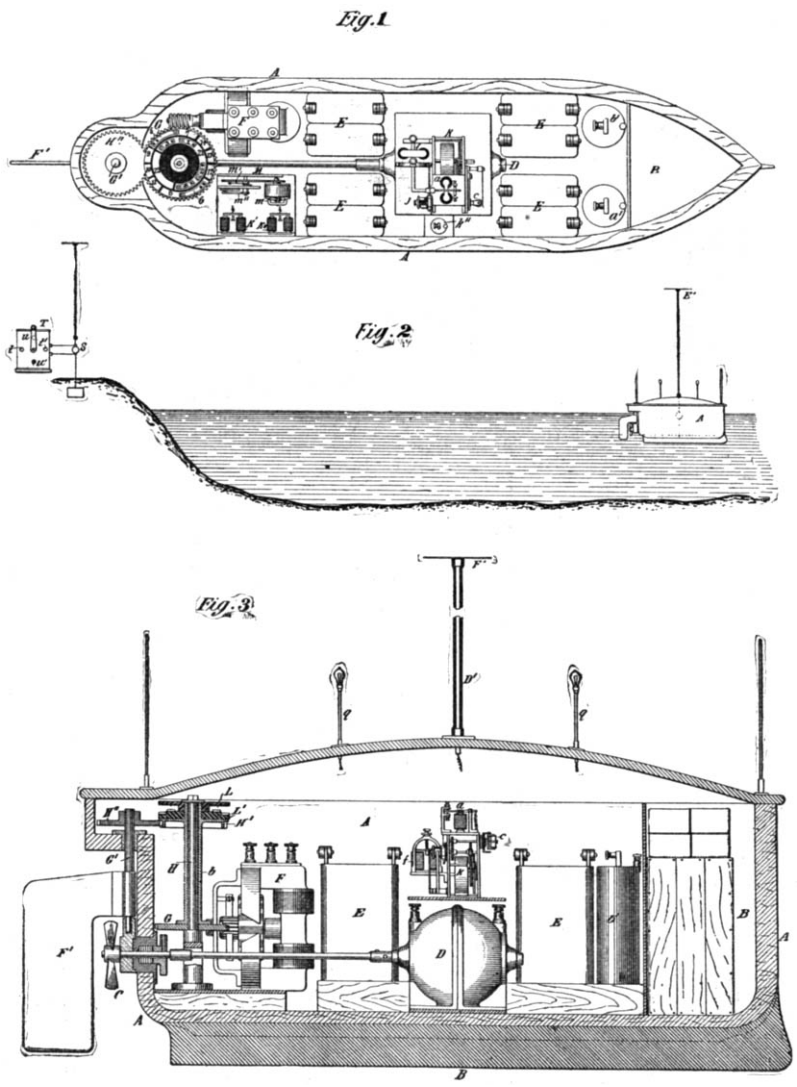
The receiving circuit consists of a terminal, *E'*, a conductor, an electric controller similar to that used in "wireless" telegraphy, and means by which the current may be led to the ground through the medium of the vessel's keel. The circuit in question forms part of a local circuit, in which are included a relay magnet, *a*, and a battery, *a'*, the electromotive force of which is so determined that although the dielectric layers in the electric controller are subjected to great tension, yet normally they withstand the strain, and no appreciable current flows through the circuit. When, however, an electric impulse reaches the dielectric layers, they are broken down, thus suddenly diminishing the resistance and permitting a current to pass through the relay magnet. The particular controller employed need not be described here, but is shown in side elevation over the motor, *D*, in Fig. 3. The relay magnet, *a*, is used to control the operation of the propelling engine and of the steering apparatus.

Placed in the circuit of the electric controller is a commutator, by means of which the direction of the current may be changed in order to influence one of the two relay-magnets, *K'* or *K''*, placed in the circuit of the battery, *k''*. While one relay, *K'*, for example, is in operation, its armature closes a circuit passing through the motor, *F*, in order to cause the rudder to be swung to port. The other relay, *K''*, causes the motor to throw the rudder to starboard. The steering apparatus, as shown in Figs. 1 and 3, consists, in addition to the steering motor, *F*, of a toothed wheel, *G*, engaged by a worm on the shaft of the motor, *F*. The wheel, *G*, controls the rudder, *F'*, through the medium of a sleeve, *b*, a toothed wheel, *H''*, and rod, *G'*. A fixed vertical rod, *H*, is mounted within the sleeve, *b*, and carries an insulating disk, *L*, to the under surface of which brushes are secured. The sleeve, *b*, surrounding the rod, *H*, and turned by the motor, *F*, carries a disk, *L'*, upon the upper face of which are secured two concentric circles of conducting contact plates interspersed with insulated plates. In certain positions of the disk, *L'*, the brushes are in electric connection with the contact plates. Conductors connect the contact plates with the terminals of the propelling motor, *D*; and the poles of the battery, *E*, are so connected with two of the brushes that when the rudder is in straight position or turned to either side, the current is conveyed through these two brushes and through the contact plates to the propelling motor, *D*. The steering motor is similarly driven by current taken from the battery, *E*, and conducted to two brushes of the plate, *L*. The motor, *F*, according to Mr. Tesla, may always be caused to rotate in one direction whatever may be the position of the rudder; and may be caused to rotate in either direction whenever the rudder is inclined less than 45° from the center position.

In addition to this mechanism the vessel carries a small auxiliary motor, *m* (Fig. 1), connected in series with the armature of the steering motor. By means of this auxiliary motor, lights on the ends of the standards, *q*, may be flashed in order to indicate the course of the vessel to the operator at night.

In Fig. 2, illustrating diagrammatically the operation of the system, *S* indicates any source of electrical wave energy controlled by a switch located in a box, *T*. The handle of the switch is movable in one direction only, and stops on four points, *t*, *t'*, *u*, *u'*, so that as the handle passes from stop to stop, oscillations are produced during a very short interval. Tesla places the handle of the switch so that when arrested on the points, *t t'*, the boat is deflected respectively to the left or to the right from its course. The normal positions of the handle are *u u'*. The impulses sent forth from *S* are, according to Tesla, received by the terminal, *E'*, transmitted to the commutator, *j*, to influence one of the relays, *K' K''*, and to cause the motor, *F*, to act on the brushes to turn the rudder in whichever direction it may please the operator. The motor of the rudder causes the second set of brushes to act on the propelling motor to drive the vessel.

Whether, as Mr. Tesla claims, his apparatus, by reason of its certain and unlimited destructiveness, will tend to bring about and maintain permanent peace, is a question discussed elsewhere.



TESLA'S DIRIGIBLE BOAT.

Cost of Living in the Yukon.

The last report of the United States consul at Dawson City, speaking of conditions in this most remarkable of all "mushroom cities," states that the large amount of supplies which have lately been brought in has had a tendency to reduce prices on a few commodities. What the higher prices must have been we may judge from the fact that a 50-pound sack of flour at the reduced rate cost, at the date of the consul's letter—August 31—$50. A hope is expressed that the price of hotel accommodations will be reduced, as none but the wealthy is able to command the luxuries of hotel accommodations, $6.50 per night being the price for a room containing a bed of straw and husks, with a candle for a light, and board costing the moderate sum of $12 per day. If the citizens of this metropolis of the frozen North prefer suburban to city life, they can rent a log cabin for $50 per month and upward, according to location and distance from the center of the town.

Meanwhile it is evident that the percentage of successful gold seekers in the Yukon is probably smaller than that in any previous gold excitement of magnitude, and the perils and privations are incomparably greater. The future of Dawson City is said to depend greatly upon new discoveries of gold being made during the coming winter. The cost of taking food up to the mining camps and the high price of labor render it so expensive to work the claims that they have to be rich in order to return any profit.

CHARCOAL absorbs the gases and relieves the distended stomach pressing against the nerves which extend from the stomach to the head.

Government Aid for Air Ship Experimenters.

The Board of Ordnance and Fortification has decided to institute an investigation of the possibilities of flying machines for reconnoitering purposes and as engines of destruction in time of war, and at the meeting of the Board, November 9, $25,000 of the fund at the disposal of the Board was appropriated for the purpose of experimenting. The subject of the use of airships in time of war has been a most attractive field for speculation during the past few years, and eminent men have expressed the opinion that, once the dreams of the believers in practical flying machines were realized, the whole scheme of war would be revolutionized.

But, whether the dream of the believers in the ultimate successful operation of an airship of weight-carrying power and under complete control is ever realized, the progress already made in that direction has induced England, France and Germany to test the possibilities of existing inventions and contrivances for war purposes.

So impressed were the authorities here with the advantages which might result from the employment of air machines during the operations of the late war, that Secretaries Long and Alger last summer selected a committee to report upon the subject. This fact is not generally known. The commission made a favorable report upon the desirability of experimenting, and that report was submitted to the Ordnance and Fortification Board, under whose general direction all such matters are investigated. Prof. Langley, of the Smithsonian Institution, the inventor of the aeroplane, appeared before the Board recently and gave his expert opinion in favor of experimentation.

The Board decided, after hearing Prof. Langley and reviewing the report of the commission, to expend $25,000, with a view, at present, to the perfection and use of some aerial contrivance for reconnoissance. The experiments will be conducted under the direction of Gen. Greely, of the Signal Corps, and Prof. Langley has agreed to give Gen. Greely the benefit of his devisings and advice, but with the distinct understanding that he does so without compensation.

The fact that the government is now in a position to encourage inventors by conducting experiments on this important subject is most gratifying. We do not doubt that many meritorious schemes have been allowed to lie dormant on account of the inventors not being in a position to carry on costly experiments, and doubtless many have not even secured proper protection under our patent laws, as they knew that they would be unable to carry on experiments.

Color Photography at Chicago University.

The McDonough process of color photography has been adopted by the University of Chicago as a part of its course of study. This has been after a careful investigation by the President and Faculty. A large factory is being erected in Chicago, in which color photography and the letterpress work following are to be carried out, and in this factory the students of the University will have their place of work and rooms for experimenting on the process. No attempt has been made as yet to put the process into commercial use.

Mr. Tripp has decided that the process should be carefully studied by the public until everyone had been satisfied that a secret has been discovered which will prove of almost incalculable value to the world. He is especially desirous that it should be used for experimental purposes in photographing the spectrum of the stars, X-ray work, geological work, archæological work, etc. He has also taken steps by which the best works of the old masters shall be reproduced, thus making them accessible to all. This will prove of great value in the furnishing of school rooms. A special press will be completed within the coming month, and an exhibition of the work will then be made. The patent, which has now been sustained, covers a transparent screen, for use in taking and viewing a photograph. A screen is provided with differently colored substances arranged according to regularly recurring patterns, the screen having on its surface red. blue, and green colored particles; a prepared paper is necessary in the process, which consists of making colored pictures, which are made by covering or obscuring, by means of a positive picture. the color upon a material prepared to correspond in color and to register in form and dimensions with the patterns of red, green, and blue colored glass acting upon a negative, whereby the colors corresponding to these do not act upon the negative, but will be obscured or covered, while such properties of colored patterns as correspond to the action of the colored lights upon a negative sensitive plate will be left visible.

THE OBSERVATORY OF PARIS.

(Continued from first page.)

Italian astronomer Cassini was appointed by Louis XIV. to the presidency of the new Observatory, and during this period he discovered several of the satellites of Jupiter and made observations upon the rotation of the planets. It was under his direction that the "meridian of Paris" was determined, the position of which is shown by a line drawn upon the stone floor shown in our engraving. This meridian divides the edifice into two parts by a line which, prolonged north and south, would reach in one direction Dunkerque on the North Sea, in the other Callioure on the Mediterranean. These two lines, which intersect one another at the central point of the façade, served as a base for the numerous triangles upon which were drawn up in the last century the map of France, known as the map of Cassini, and in the middle of the present century the map known as the "Staff map." According to the observations made at the time of the founding of the Observatory, the meridian is represented by a line of copper bars inserted between marble plates, upon which are figured the twelve signs of the zodiac, according to the custom of the time. At a period somewhat later in the history of the Observatory the eminent mathematician Laplace contributed largely to the progress of the science by his famous work "Le Mécanique Celeste." In the present century the celebrated astronomer and physicist Arago assumed the direction of the Observatory, and by his public lectures awakened an interest in the science, which has ever since continued to increase. It was his successor Leverrier who immortalized himself by his discovery of the planet Neptune, of which, it is well known, he determined the position in the heavens by calculation before the planet had been found by the telescope. This succession of celebrated names shows the important place which the Observatory has occupied during the last two centuries. At the present time a series of important investigations is being carried on; among others may be mentioned the completion of the map of the heavens, for which the photographic plates, obtained by means of a large telescope, are carefully measured and recorded.

In the foreground of our first engraving will be seen the buildings adapted for this purpose, and in the background the main building of the Observatory, begun in 1667 and finished in 1672, each of whose towers, surmounted by a movable dome, contains a large telescope of the form known as "equatorial." The west wing contains a great amphitheater in which the illustrious Arago delivered his lectures. The building also contains the laboratories for meridian observation and other astronomical and astro-physical work; here are found the instruments which have been used by celebrated astronomers and, among others, instruments for determining the speed of light, instruments for making experiments in magnetism, observation of earthquakes, etc. The museum contains the instruments and apparatus used by Arago and Fresnel for the measurement of the velocity of light. Our engraving gives an idea of a few of the historical instruments. The museum was founded in 1879 by Admiral Mouchez, director of the Observatory. Here is the quarter circle used by Lalande in the observation of the 50,000 stars of his catalogue, a collection of German instruments of the sixteenth century, the standards of the metric system, etc. Our engraving shows at the left a cabinet containing apparatus constructed by Breguet for the measurement of the velocity of light; the machine with the fly wheel and crank, and his air pump used to produce a vacuum in the apparatus for determining the standard kilogramme. Next to it will be seen the glass lens cast by Chance, which was to be used in the construction of a large telescope of the focal length of sixteen meters. In front of the case to the right is a telescope of wood used by Foucault, and on the table the apparatus used by M. Wolf for determining the personal equation in the observation of the passages of the stars.

The largest telescopes are placed outside of the main building in the grounds of the Observatory. The great instrument with the staircase shown in our right hand engraving was installed in 1875; the mechanical part was made by the celebrated constructor Eichens, the optical part by Adolphe Martin. It is completely inclosed by a metallic cupola (not shown in the engraving) which slides upon a system of rails, which, together with the staircase necessary for the observer, was constructed in the shops of the Compagnie de Chemin de Fer de Lyon; the movable part weighs 9,000 kilogrammes (20,000 pounds); the instrument is provided with a clock movement having a Foucault regulator. The mirror deserves special mention; the casting of this mirror was intrusted to the works of St. Gobain; the mass of glass as delivered by the works weighed 500 kilogrammes (1000 pounds), which weight was reduced to nearly half by the optical work. The diameter of the mirror is 1·20 m. and the focal distance 7·20 m. The mirror is generally resilvered every year; in 1880 MM. Wolf and H. Guénaire modified the old process of silvering in order to avoid turning the mirror, which in the case of so large a mass is a difficult proceeding; the mirror itself, being concave, is used as a reservoir for the silvering liquid during the process. This instrument was used at first for observations of nebulæ and for stars of inferior luminosity, and afterward in connection with the spectroscope; in 1879 photographs of the stars and also of the moon were made by placing the photographic plates at the focus; these latter were given an exposure of one and two seconds; during the last few years, the instrument has been used by M. Deslandes for spectroscopic research.

Our left hand engraving shows the bent equatorial refracting telescope and its brick tower.

Since 1855 it had been decided to install at the Observatory a large telescope of 16 meters focal distance; the project was taken up in 1880, at the time of the purchase of the large grounds, which served to isolate the observatory from the rest of the city; the optical part was ordered from the constructor Adolphe Martin, who made for the purpose an objective of 0·74 m. diameter; the cupola was to have a diameter of 20 meters, that is, as large as the dome of the Pantheon; the house of Eiffel submitted a project in which the cupola was to be upheld by an arrangement of floats in liquid reservoirs, thus replacing the system of rails generally used; however, at the time of construction it was found the ground was unsuited for this purpose, and the project was abandoned. In its place the present telescope was installed, in 1889; the mechanical part has been executed by M. Gautier, successor of Eichens, and the optical part by MM. Henry. The objective has 0·62 m. diameter and 18 meters focal distance; the upper end may be turned toward the heavens in any direction, while the observer, stationed in the tower, receives the image reflected from a mirror in the bend of the instrument. This instrument is employed for the photography of the moon by MM. Loewy and Puiseaux with remarkable results.

A great telescope is being made by the house of Gauthier et Cie., of Paris, for the exposition of 1900, which will be the largest yet constructed, its objective lens having a diameter of 48 inches. The telescope remains stationary, while the movement of the stars is followed by a large mirror of silvered glass, 7 feet in diameter and 20 inches thick, which is mounted in connection with a mechanism permitting it to follow the movement of the heavens.

The Observatory is a state establishment under the control of the Minister of Public Instruction. It is governed by a director, who oversees the work of astronomers, adjunct astronomers, and assistant astronomers. The administration is in the hands of the director, aided by a council, who, moreover, superintends the scientific surveys, and is charged with the correspondence and the publication of reports.

The work of the Observatory is divided into several different services quite distinct, besides the work already mentioned; the meridian service has at its disposition four telescopes; observations are made upon the sun, moon, Mercury, Venus, and the fixed stars necessary for the measurement of their relative distances and the determination of the time (hour). The lunette and circle of Gambey are used specially for the determination of the co-ordinates of the stars in connection with observations upon the moon. The smaller equatorial is used in research on comets and observation of smaller planets.

The equatorial of the west tower is used principally for observation of nebulæ, comets, and double stars, the occultation of stars by the moon, and the eclipses of the satellites of Jupiter. At the equatorial of the east tower are observed more particularly the smaller planets and comets.

An important service is that of astronomical photography. At the international congress of astronomy held ten years ago it was decided to make a catalogue of stars more complete than that which had been made up to that time. For this purpose the heavens were divided into several zones, each of which was assigned to one of the large observatories, which was to make photographs of the part assigned to it and from these to make the necessary measurements and calculations. At the observatory this work is now in progress and the photographic portion is nearly complete.

Paris. J. GUÉNAIRE.

THE Meteorologische Zeitschrift contains a treatise by Dr. F. Maurer on the regular periodical repetition of cold and warm years. During certain intervals of time, extending as a rule to about fifteen years, there is a recognized change of warm and cold periods. The warm periods, Dr. Maurer says, do not simply include a series of summers of extraordinary warmth, but also a series of mild winters. Similarly, during the cycle of a cold period, not only are the winters more than ordinarily severe, but the summers are far below the average heat. Dr. Maurer affirms that we can predict with tolerable accuracy the time when the next cycle of warm periods will occur. It is due, he calculates, somewhere about the turning point between the two centuries; and he thinks it probable, from the data obtainable, that the early years of the next century will be distinguished by a series of hot, or, rather, extremely hot, summers and a series of exceptionally mild winters.

Science Notes.

The ptomaines of preserved meats are, according to Van Ermenglin (Jour. de Ph.), secretions of a specific bacterium, bacillus bolulinus. The toxin, called by the discoverer "bolulin," is so poisonous that 0·000001 gramme is sufficient to kill a rabbit. Fortunately, the toxin is destroyed by a comparatively low temperature, 60° to 70° C. At 85° the bacillus is also destroyed; cooking is, therefore, a reliable safeguard in the use of salted, smoked, or otherwise preserved meats.

Rainfall in India is variable, says Engineering News. English engineers report as follows concerning the rainfall in the Midnaper and Howrah districts of Lower Bengal: The average annual rainfall in this section is about 70 inches; but observations made at Ban Kura record a rainfall as follows for the four days ending at 8 A. M. on the dates set down:

June 16	0·90 inches.
June 17	6·45 "
June 18	12·48 "
June 19	2·40 "
Total	22·73 "

Magnetic deflection of iron plumb-bobs, in shaft work, is noted by Mr. O. Brathuhn in an article on underground surveying in the Berg und Hüttenmannische Zeitung for 1898. He notes that, in plumbing a shaft 390 feet deep with an iron plumb-bob, he found a considerable error. The explanation lay in a crosscut from the shaft in which a large number of spare rails had been stored with one end of the pile very close to the plumbline. He says that by the induced magnetism of the rails the plumbline was drawn from its perpendicular position to such an extent that the bottoms of two lines were 7·5 mm. further apart than the tops of the same lines, and the line connecting the plumblines at the points of suspension formed an angle of 6′, with that at the bottom of the shaft. The trouble was corrected by using brass plumb-bobs.

O. Noevius has, on purely spectroscopic evidence, given some reasons for suspecting the presence of another undiscovered gas, besides argon and krypton, in the atmosphere. The evidence is not very strong, but appears to deserve further investigation. After eliminating the lines due to electrode matter, the lines due to the spark spectra of nitrogen and argon were catalogued at atmospheric pressure. Some 15 lines, between wave lengths 377 and 486 $\mu\mu$, were found to be common to the blue argon spectrum and the nitrogen spectrum, though rather fainter in the latter. The supposition is that they are due to an unknown gas which remains as an impurity in the preparation of argon, and also, but to a lesser extent, in the preparation of nitrogen. The spectrum shows a single coincidence with that of krypton at 473·6. It is not due to carbon impurities.—Noevius, Wied. Ann.

The Maryland State Geological Survey has just received from France a machine for testing the wearing power of various kinds of rock and stone which has been in use for some time by the French government. It is composed of duplicate revolving cylinders and is worked in a unique manner. The cylinders are hollow, and allow a good sized piece of stone to be placed inside of each. The rod of the machine is attached to the motor, and the cylinders revolve rapidly a number of thousand times. They are opened then, and the fine material that has been ground off is gathered up after the stones have been washed, and is weighed. In this way the experience of years can be gathered in a few hours. Calculations can be made from the result to just what extent the stones experimented with would wear if placed in a roadbed or used to build a highway or public building. The machine is a very valuable one, and Prof. William Bullock Clark, State Geologist, superintended its erection.

In order to render ultra-violet rays visible, we can make use either of photography, which allows us to examine rays down to 100 $\mu\mu$ wave lengths, or of a spectroscope whose lenses are made of quartz or of quartz and fluorspar, provided with a fluorescent eyepiece. These apparatus show rays down to 185 $\mu\mu$ wave lengths, though not so perfectly as the photographic plate; but they are more convenient. A uranium glass plate is placed on the focal plane of the telescope. The parts of the uranium glass which are hit by ultra-violet rays emit visible rays in all directions. To make our eye sensitive to these rays, we must cut off the light coming from the ordinarily visible parts of the spectrum. Soret has done this by turning the Ramsden eyepiece about a horizontal axis through an angle of 45 degrees. In the Zeitschrift für Instrumentenkunde, Dr. F. Martens proposes a simpler method. He introduces a stop with two apertures, the one central, the other eccentric: a little lever releases either opening. When we look through the central aperture, we see the rays which regular refraction has sent down the telescope. When we place the eccentric aperture in position, these rays are stopped by the lever upon which they fall, and we perceive only the diffuse light emitted by the fluorescent uranium glass.

SAN FRANCISCO WATER SUPPLY.

THE GREATEST MUNICIPAL SYSTEM OF ARTIFICIAL STORAGE IN THE WORLD.

In the memory of living men, drinking water has sold in the streets of San Francisco at a dollar a bucket. This was derived from wells situated where now the Palace Hotel stands. Later, individual enterprise erected pumping works in the northern portion of the city, drawing from Point Lobos Creek, a streamlet forming a boundary of the military reservation known as the Presidio. This water was forced into reservoirs with elevations of 140 and 300 feet, and from thence distributed over the city in pipes. The supply was limited.

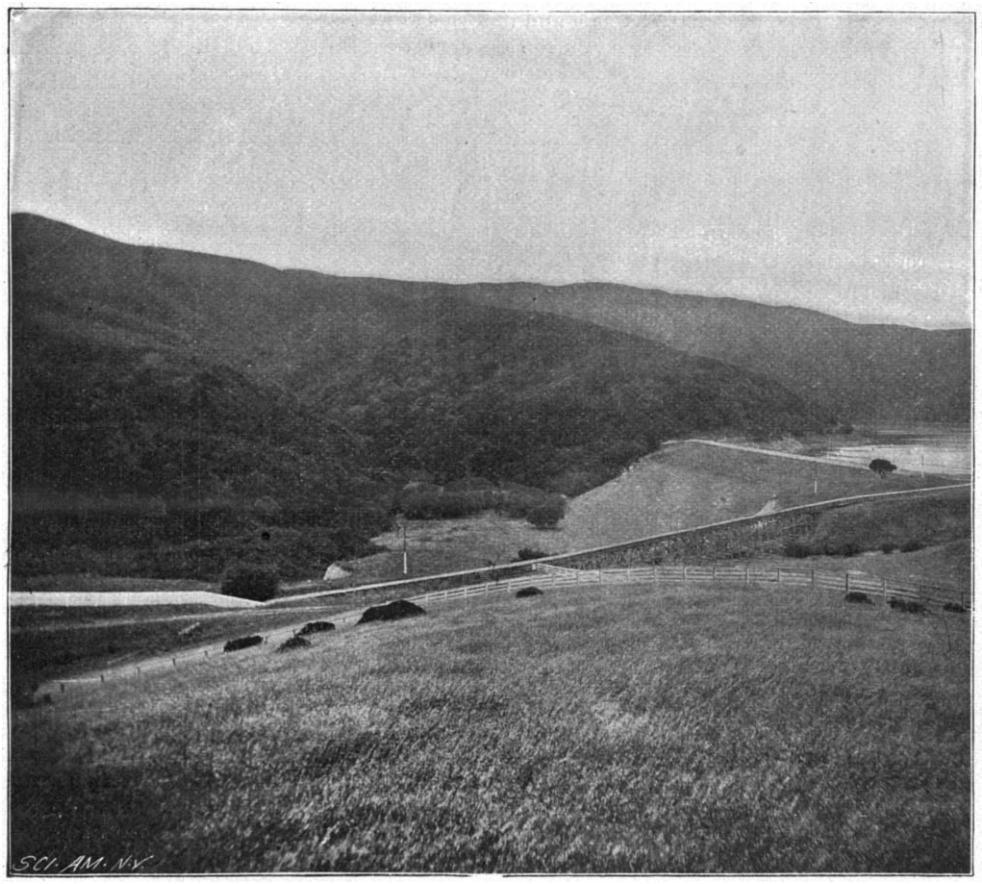
To-day no city in the world surpasses San Francisco in the abundance and purity of its water supply; but this result has not been achieved without an expenditure of nearly $30,000,000 in money. The obstacles met with and successfully overcome were almost insurmountable; for Nature, though granting every other advantage that the site of a great maritime capital required, gave neither natural reservoirs nor living streams whence supplies of water for a populous community might be drawn.

In one respect only were the engineers assisted by the natural features of the country—the ranges of mountains that traverse the peninsula upon which San Francisco is located provided admirable sites for artificial storage lakes. By the erection of massive dams across their outlets vast artificial stores of water were laid up, from which supplies might be drawn in the event of prolonged droughts and during the intervals when no rain falls whatever.

Within the boundaries of San Francisco and the country immediately adjoining, all sources of water supply combined would not naturally furnish a city of 30,000 inhabitants. The problem so successfully solved provides water in ample quantities for a city of, prospectively, 1,000,000 inhabitants, without natural resources of its own, and dependent upon the rainfall of but six months of the year. How this great feat has been accomplished is one of the engineering triumphs of the century. Nothing in municipal supply is to be found to compare with it on the globe. London, Manchester, Liverpool, Glasgow, Philadelphia, Boston, and New York, all cities which have spent vast sums in obtaining an adequate water supply, would suffer severely were a six months' drought to afflict their watersheds. San Francisco, on the contrary, with its system of great artificial lakes, could face a drought of twenty-four or even thirty-six months with entire equanimity without curtailing its normal consumption of 750,000,000 gallons a month. If the great cities named were compelled to provide a two years' supply by artificial storage, assuming it were possible to do so, their investment, on this account, would be multiplied many times and their charges, therefore, would have to be proportionately increased. Geographically, San Francisco occupies the head of a peninsula about fifty miles in extreme length and less than twenty-five in average breadth. The superficial area of the city is about that of Manhattan Island, and it is capable of supporting an equally large population. Unlike Manhattan Island, the contour of San Francisco is extremely irregular, rising from sea level to an elevation of 900 feet. Its surface is covered with hills of various height, divided by valleys, and to secure a practicable grade for its streets an immense amount of leveling has been necessary. As the city increases in population the higher elevations are becoming built up and water has to be afforded. Eventually the highest elevations will be covered with dwellings. Irregular as the surface of the city is, every foot of the area will ultimately become habitable. At present the population is about 325,000.

Within the city limits ten high distributing reservoirs have been constructed. The most elevated is at Clarendon Heights, 600 feet above the tide. The others are Lake Honda, 377 feet; Clay Street Hill, 375 feet; Halliday Hills, 375 feet; Russian Hill, 306 feet; Potnero Heights, 300 feet; College Hill, 210 feet; University Mound, 175 feet; Francisco Street, 139 feet; and Industrial School, 300 feet; with an aggregate capacity of about 200,000,000 gallons, available at all times for any emergency. The city is divided into four water districts, according to elevation. From 0 to 139 feet is the first, and 250 feet, 375 feet, and 600 feet are the limits of the other districts.

It is this high distributing system that affords San Francisco such ample protection from great conflagrations, even though 90 per cent of the buildings are frame, built less solidly than Eastern dwellings on account of the almost frostless climate The water flows from these reservoirs by gravity at a pressure of from 40 to 70 pounds per square inch at the hydrants, and the larger number of incipient fires are extinguished by means of private facilities made possible by this heavy pressure. In San Francisco there are in all 363 miles of pipes laid in the streets, from 3 to 44 inches in diameter, with 3,581 hydrants. At the present time there are 41,022 rate payers, increasing yearly about 1,000. The daily consumption of water is 25,000,000 gallons. The important functions performed by the great reservoirs of the San Francisco water supply system will be better understood if the peculiar conditions, meteorological and climatic, that prevail in the latitude of San Francisco be explained. The seasons are divided into "wet" and "dry," the former extending from October until May, during which all the rains of the year are precipitated. These rains are always moderate, never torrential, a fall of 1·5 inches in twenty-four hours being considered "heavy." During the whole twelve months there is an average of not more than 60 rainy days. In the season of 1897-98 there were only 36 days of rain. From May to October is the "dry" season, in which practically there is no rainfall whatever. From a record of 50 years the average annual fall is 25·54 inches. In 1889-90 the unprecedented amount of 52·27 inches was recorded; in 1897-98, but 10·07 inches. The lowest on record was in 1850-51—7·40 inches.



LAKE SAN ANDREAS; SAN FRANCISCO WATER SUPPLY.

Pilarcitos Lake was the first constructed by the company. It is situated in San Mateo County, 17½ miles from the city. Its elevation is 696 feet and it is inclosed by a stone dam 95 feet in height. Its storage capacity is 1,050 million gallons and it discharges into Lake Honda, within the city limits, through a 30-inch conduit, 32 miles in length, 2,500 feet of which is through a tunnel.

San Andreas Lake is 15 miles from the city at an elevation of 452 feet. Its dam is 95 feet high and built of stone. The storage capacity is 6,200 million gallons.

Crystal Springs Lake is 23 miles from the city and is the largest of the entire group. It is formed by the great stone dam 145 feet in height, which is to be raised an additional 30 feet, which will increase the present storage capacity of 19,000 million gallons to 29,000 million. The elevation is 350 feet.

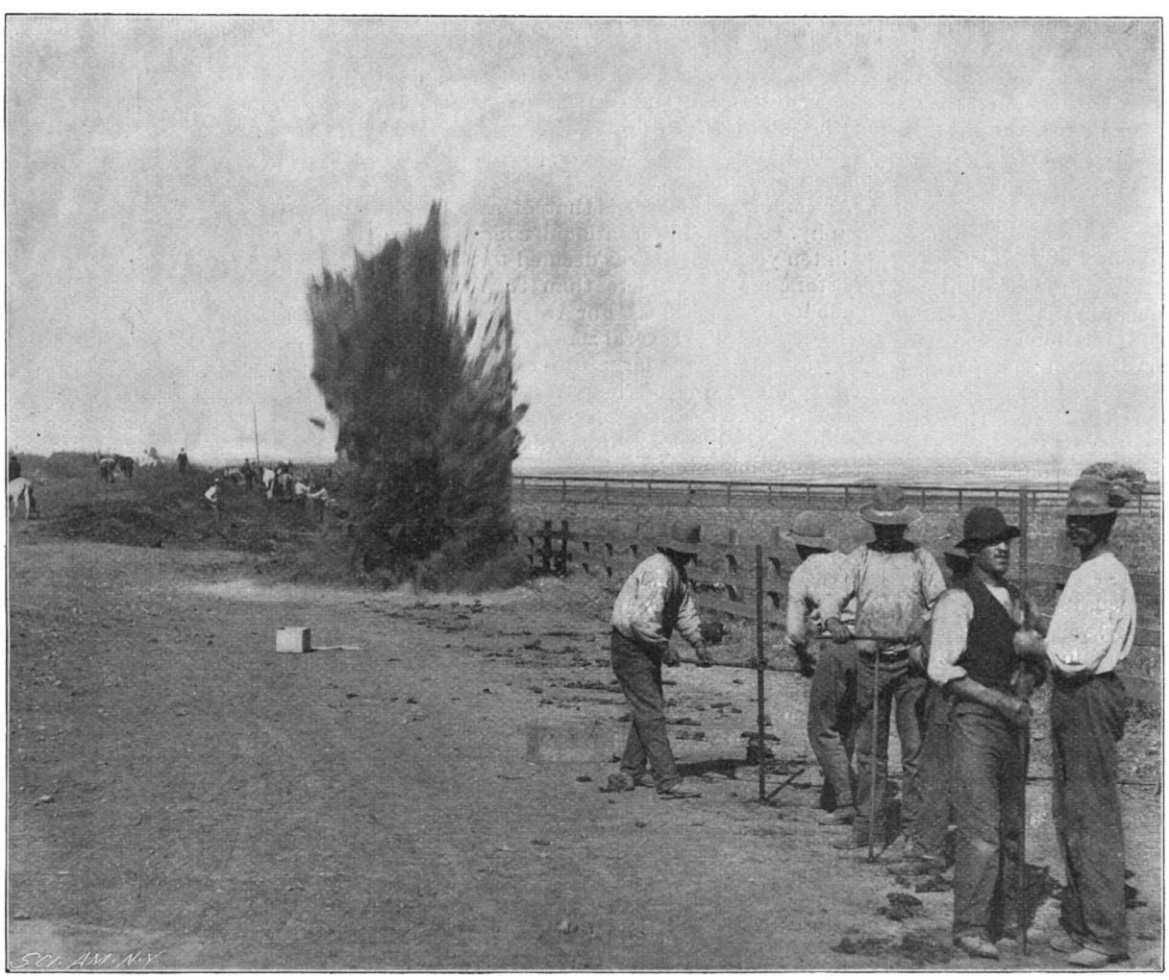
Portula Lake is 26 miles from the city, near Menlo Park. Its stone dam is 120 feet high and stores 3,000 million gallons.

The total storage capacity of these four artificial lakes is 29,250 million gallons. In addition to the sites occupied by these immense bodies of water, and to insure against any pollution of the supplies, the company has acquired by purchase the entire control of their watersheds, from which nearly every habitation has been banished. The land thus acquired amounts to many thousands of acres.

The only natural reservoir on the whole peninsula is Lake Merced, once

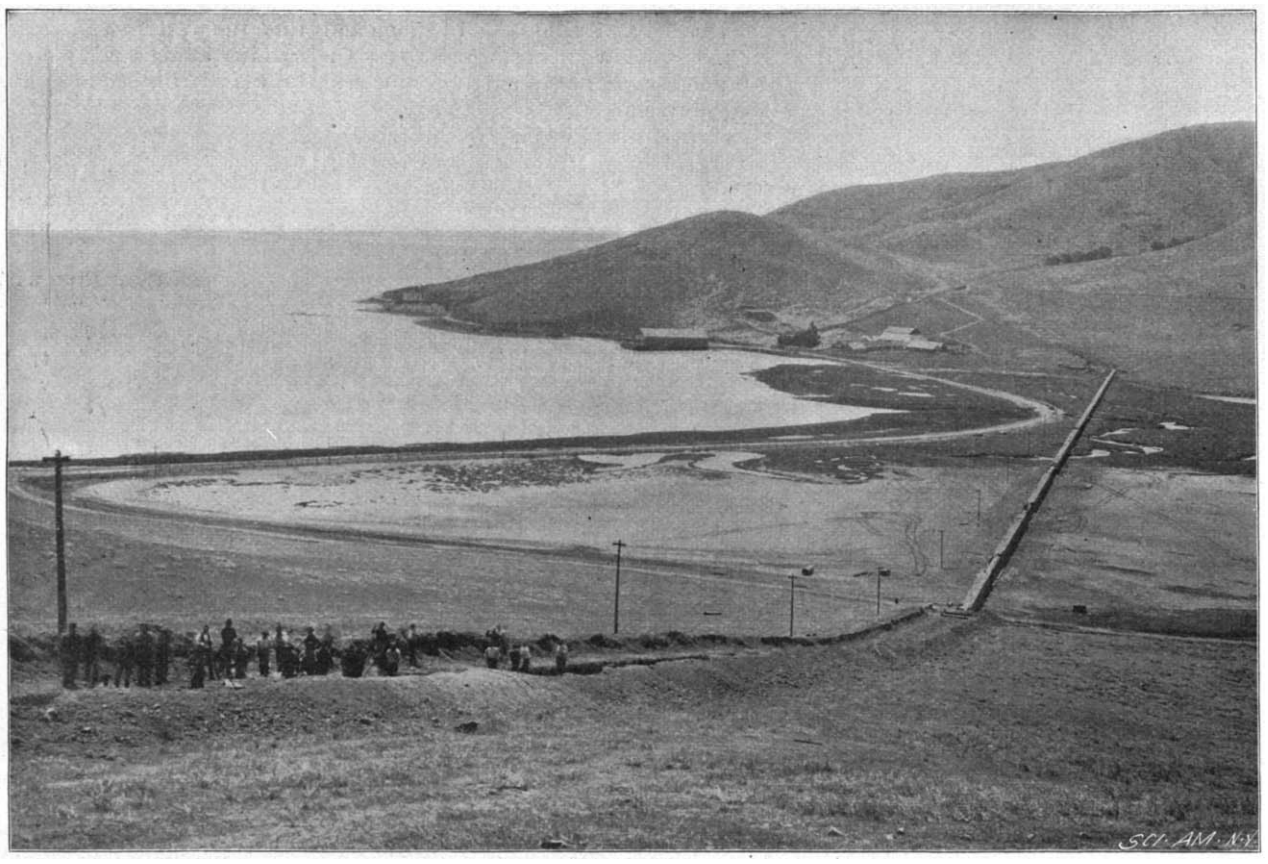
NUMBER OF "RAINY DAYS" IN SAN FRANCISCO DURING PAST TEN YEARS.

	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898
January	6	21	3	7	8	12	13	12	5	7
February	6	9	12	9	9	13	5	3	15	8
March	11	13	10	13	13	8	6	13	13	4
April	7	5	8	7	6	6	3	13	3	1
May	7	4	4	7	2	6	6	5	1	4
June	....	2	1	....	1	4	....	....	1	1
July	....	1	1	....	....	....	1	....	....	....
August	....	....	....	....	....	....	....	2	....	1
September	....	1	3	....	2	1	3	3	....	....
October	13	....	1	5	2	5	2	3	5	....
November	7	....	3	7	11	1	5	8	5	....
December	25	5	10	11	12	22	8	11	6	....
Total	82	61	56	66	66	78	52	73	54	23

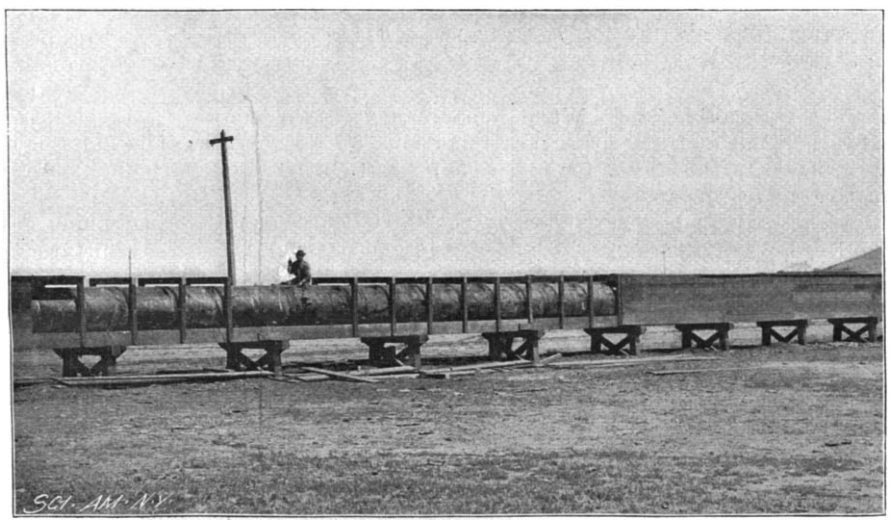


BLASTING IN HARD GROUND; FROM AN INSTANTANEOUS PHOTOGRAPH.

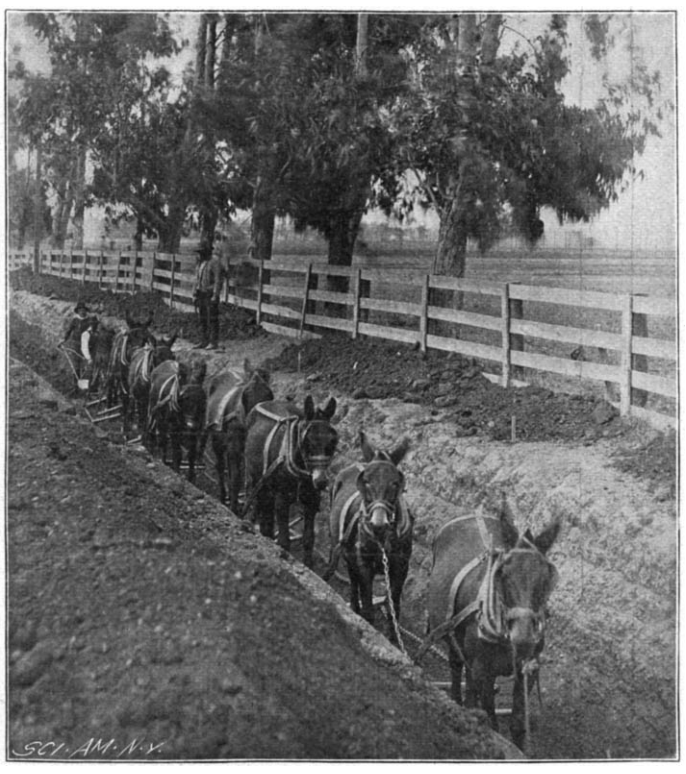
an arm of the sea, situated within the limits of San Francisco, and at its lowest depression. The outlet, through which the tide used to flow, has been closed; the lake water has become fresh and is now a valuable source of supply. It has a superficial area of several hundred acres and affords storage for 2,700 million gallons of water of the best quality. Three million five hundred thousand gallons can be drawn from it daily without diminishing the volume of the lake. A fine pumping plant, with a capacity of 7,000,000 gallons every twenty-four hours, forces the water to an elevation of 430 feet, supplying one of the larger high distributing reservoirs. In order to keep the lake free from surface pollution, the company has acquired 3,000 acres immediately surrounding it, and otherwise controls its entire watershed of 8 square miles. At times, however, when rains are unusually copious, floods of surface waters have poured into the lake down Ocean View and Coloma cañons and temporarily rendered the waters unfit for domestic use; but within the past year a settling reservoir has been constructed at the southerly end, with a brick conduit leading therefrom to and through the ridges oceanward by a brick tunnel, discharging into the ocean and carrying



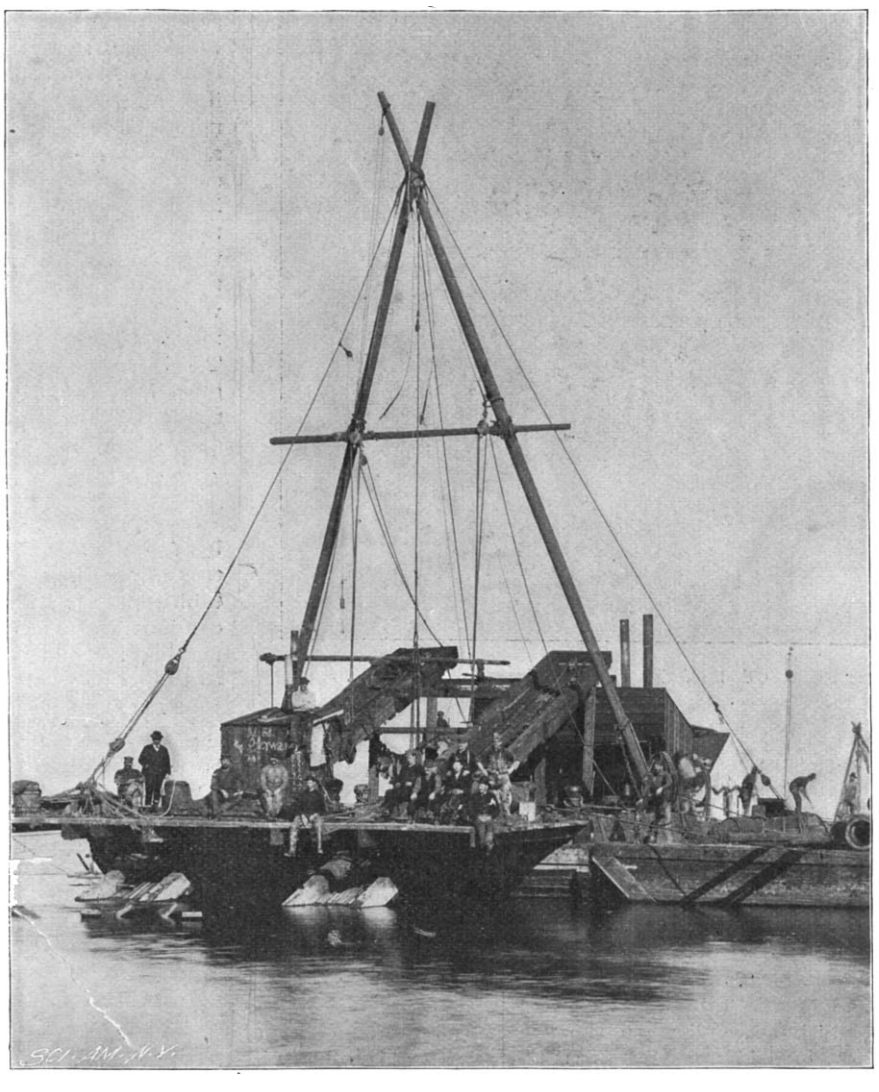
PIPE-LINE ACROSS MARSH, CARRIED ON TRESTLES.



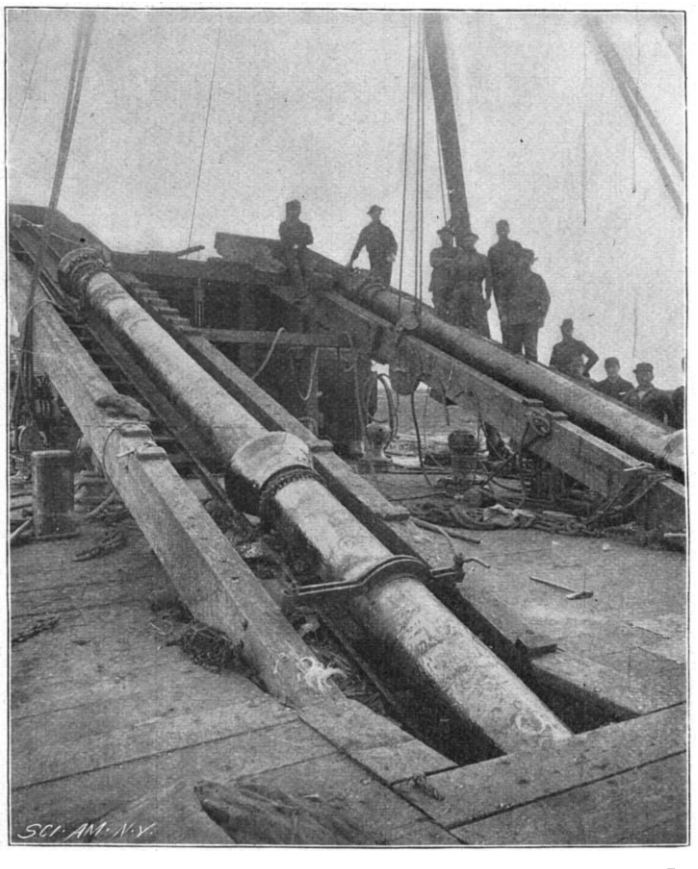
METHOD OF CARRYING PIPE ON TRESTLES.



DIGGING PIPE-DITCH WITH PLOW AND MULES NEAR SAN MATEO.



VIEW OF THE PIPE-LAYING BARGE.



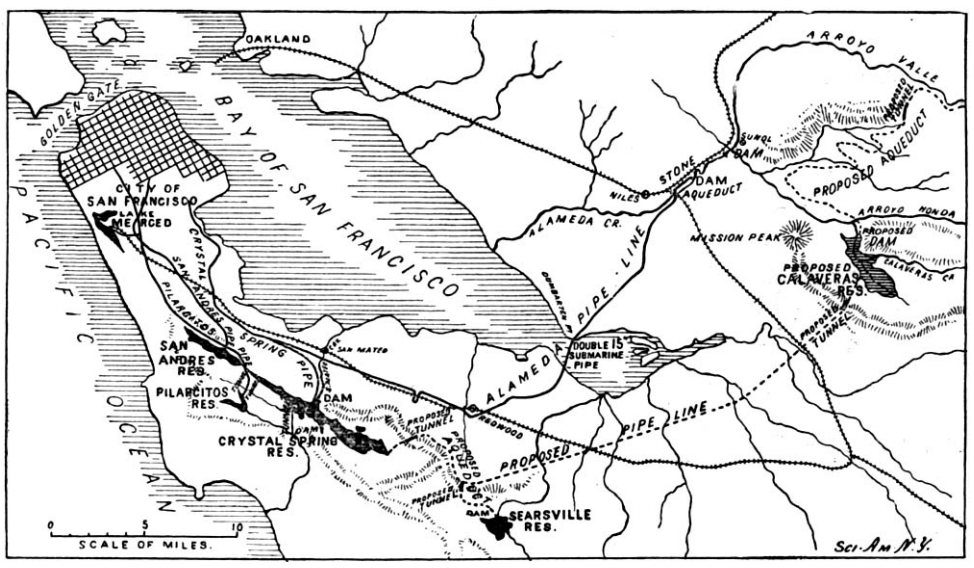
END VIEW OF BARGE, SHOWING LAUNCHING CHUTES FOR LAYING PIPES BELOW THE WATER.

away all polluted waters. From other neighboring cañons a redwood flume conveys the floods to the settling reservoirs. This provision keeps the lake waters pure, no matter how violent the floods may be.

With the store of Lake Merced added to the other reservoirs, an aggregate of 31,950 million gallons is available, or sufficient supply to furnish San Francisco, at its present rate of consumption, for at least three years.

Twenty-five years ago the water company began to realize that no policy of extension ought to be adopted that did not adequately provide for all future eventualities.

To supply a city of the size that San Francisco is destined to assume with water was manifestly beyond the power of the limited watershed of the peninsula to accomplish; consequently, a tract of land, with all the water rights, reservoir sites and adjacent lands, was obtained on the east side of the Bay of San Francisco, and added to the resources of the company. It extends from Mount Diabolo on the north to Mount Hamilton on the south, and embraces an area of 700 square miles in three counties. On Calaveras Creek the site of a gigantic artificial lake has been selected, and a great stone dam, much higher than the one at Crystal Springs, will in the not distant future be erected. This great lake will submerge the entire Calaveras Valley and contain 100,000 million gallons of water. This tract is separated from the peninsula by the Bay of San Francisco.

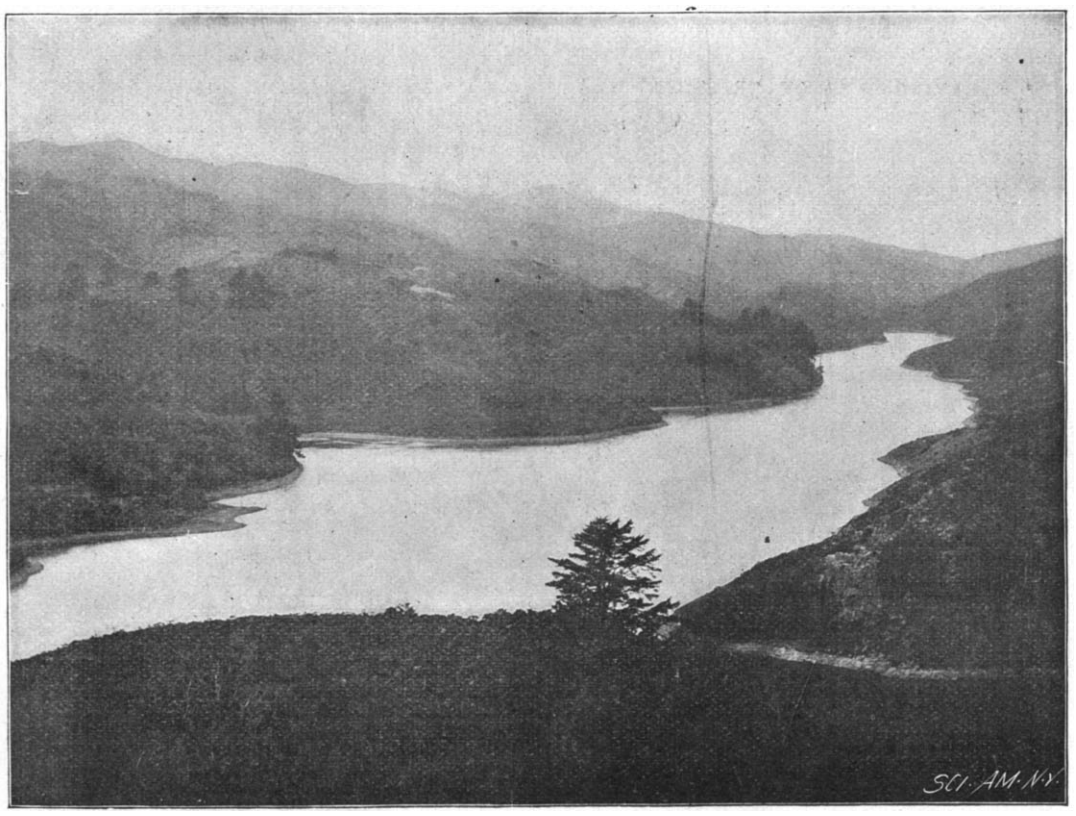


MAP SHOWING THE RESERVOIRS AND PIPE-LINES OF THE SAN FRANCISCO WATER SUPPLY.

It was not until 1887 that water from the Calaveras tract was utilized for supplying San Francisco. In that year a stone dam was erected across Alameda Creek, near the city of Niles. The distance from this dam to the pumping works at Belmont, on the west side of the bay, is about 29 miles, and it cost $1,750,000 to make the connection, which required 146,000 feet of 36-inch and 13,000 feet of 16-inch iron pipe. The larger pipe was laid on land, 19,000 feet being laid on piles. There was, besides, a deep slough, 300 feet wide, and the bay, 6,500 feet wide and 60 feet deep, to span. Below water, double pipes, of 16 inches in diameter, were substituted for the 36-inch. The operation of laying the small pipes across the bay was highly ingenious, and has been but rarely employed in this country. Engineers were greatly interested at the time and anticipated failure, but time has proved it a success.

A working barge 40 × 100 feet was fitted up especially for this work. Two heavy inclined chutes or aprons, fourteen feet from center to center, were built on the stern end, so swung on an axle on the barges as to admit of the angle being quickly changed to suit varying depth of water. Tracks, extending some ten feet under water, were fastened to the chutes for the pipes to slide down.

Erected on the barge, and straddling both chutes, was a large pair of shear legs 100 feet high so arranged that pipes could be taken from the lighters alongside and dropped into either chute. The pipes were connected with ball and socket joints. The entire conduit was constructed and placed in position by the Risdon Iron Works, of San Francisco, from plans prepared by Hermann Schussler, chief engineer of the Spring Valley Water Company. Through this conduit 6,000,000 gallons are received daily.



LAKE PILARCITOS, ONE OF THE SOURCES OF SAN FRANCISCO WATER SUPPLY.

Transmission of Power Through the Air Without Wires.

BY PROF. JOHN TROWBRIDGE.

Mr. Tesla has recently patented a method of transmitting power through the air without the use of wires. This method consists in producing a very great difference of potential between a high point in the atmosphere, reached by a wire connected to a balloon, and a distant point on a balloon, which in turn is connected through a stepdown transformer with the earth. A step-up transformer produces the high potential at the sending station, or at the first balloon, and the difference of potential thus created produces a current of conduction through the rarefied air to the second balloon and thence through the stepdown transformer to earth. Mr. Tesla relies upon the good conductivity of rarefied air to high electromotive force.

Some recent experiments I have made with high electromotive force are interesting in regard to the suggestion of Mr. Tesla, and are in continuation of those I described in the SCIENTIFIC AMERICAN for January 15, 1898. At that time my apparatus was capable of producing one million two hundred thousand volts. It now can produce three million.

Up to the point of one million and a half volts, the length of the electrical discharge in air appears to be closely proportional to the electromotive force. When this voltage is exceeded, the length of the spark no longer increases in proportion to this force, for instance, and electromotive force of approximately three million volts produces a spark of about seven feet in length, when it should excite one at least ten feet long. The reason of this diminution is readily seen when the operation of my apparatus is examined in the dark.

From both terminals and from the conductors to those terminals there is a luminous brush discharge to the walls and floor of the room. The main portion of the discharge is, so to speak, shunted through the air, which breaks down with facility at such high voltages. The high electromotive force exerts a similar action to that of diminished air pressure.

In the case of rarefied air, one sees the luminous area of discharge on the positive terminal extend farther and farther from the point of the terminal, thus indicating that there is an increased flow through the rarefied air. In ordinary atmospheric air the same increase of electrical conductivity takes place under the action of great electromotive force. When discharges produced by one million volts or more are excited between terminals six feet apart, in tubes filled with water, the tubes are speedily burst, and when the phenomenon is carefully examined, it is perceived that the disruptive sparks occur on the surface of the water inside the tubes which vaporize the water and thus lead to an explosion. The layer of air conducts more readily than the water. The same phenomenon can be shown by interposing a conductor made of plumbago and infusorial earth, making a resistance of about 10,000 ohms between the terminals of the apparatus. A spark passes over the surface of such a conductor through the air, if the length of such a conductor does not exceed ten or twelve inches.

I found also that the spark preferred to jump through five centimeters of air to passing through a thousand ohms of a copper sulphate solution. Thus the air evidently breaks down with increasing readiness when the electromotive force is increased beyond a certain limit.

One of the most striking experiments in this connection can be performed by coating a board with a thin layer of plumbago, which is polished upon the surface in such a manner as to make a resistance of about 1,000 ohms between broad terminal bands of copper. When a discharge under a difference of potential of 1,000,000 volts passes between the terminal bands, the entire surface of the conductor becomes luminous.

When my new apparatus was first set up, the coated surfaces of the Leyden jars were not more than a foot from the floor. On account of the great loss due to electrostatic induction, I determined to have the entire apparatus lifted three feet from the floor. A certain portion of the loss was thus obviated, but when discharge takes place, sparks an inch long can be drawn from the neighboring brick walls, and the entire room seems to be filled with brush discharges.

I believe, therefore, that beyond one million volts, the length of the spark is no longer proportional to the voltage, and that this departure from proportionality is due to the initial resistance of the neighboring air becoming less and less. In order to get the full effect of the voltage of my machine, I believe that it should be placed thirty or forty feet above the earth and at a distance from neighboring masses. The apparent length of lightning discharges at low altitudes is therefore no criterion of the voltage which produces these discharges; for there must be great leakage, which necessitates an excess of electromotive force to produce the discharge. On the other hand, the discharges in higher regions of the atmosphere are much lengthened on account of the increased conductivity of the medium.

In view of the experiments which I have described, I am led to believe that ordinary atmospheric air under very high voltage acts like a fairly good conductor, and I can conceive of such a high electromotive force that the initial resistance of air might not be more than the resistance of metals. The loss of electrical energy in producing difference of potential of three million volts at a distance of ten feet from the terminals of my machine is very great, and in employing such high voltages Mr. Tesla could only obviate great loss by lifting his entire generating apparatus far above the surface of the earth.

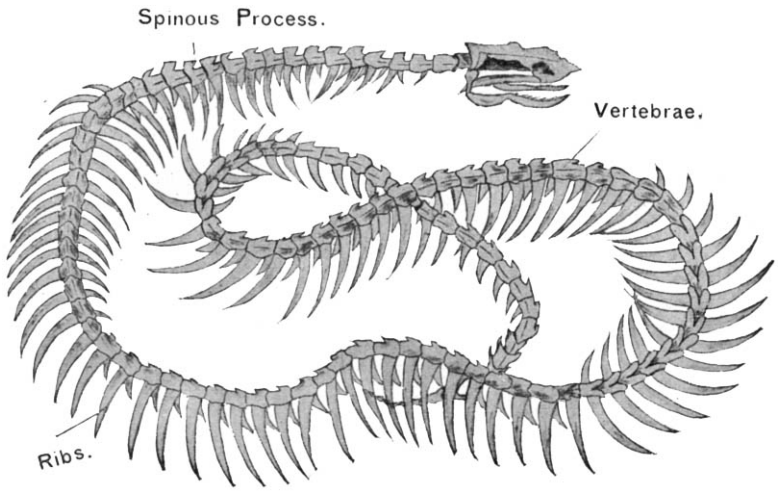
A COMMITTEE appointed by the English government to consider the matter of establishing a national physical laboratory has reported, making recommendations as to the scope of the proposed work. There seems to be now a very good likelihood that the laboratory will be established and that it will, when in operation, be directed by a governing council appointed by the Royal Society. It is thought, further, that it will be located near Kew, where much valuable work has already been done in the way of standardizing thermometers, barometers, watches, nautical instruments, etc. The new laboratory will take up the line of physical work which would naturally come before such a bureau.

IT is announced that a first-class meteorological observatory is to be built on the Zugspitze, the highest mountain in Germany. The altitude is stated to be nearly 3,000 meters.

SOME OF OUR COMMON SNAKES.

M. C. Holmes, of Germantown, recently read before the Philadelphia Natural History Society the following paper:

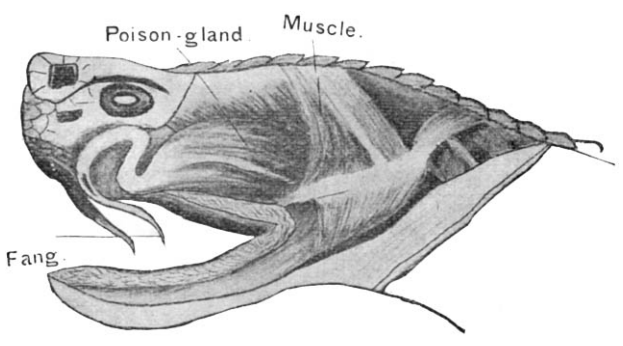
It seems strange that the snake, though one of the most interesting, is the least favored of all members of the animal kingdom; therefore, its peculiar structure, beautiful coloring, and graceful movements are seldom appreciated. This dislike and aversion once overcome, the life and habits of the snake become a most pleasing study. As all know, snakes are scaly reptiles, with long, cylindrical bodies that crawl along the ground without the aid of limbs. Some of these animals, however, still retain vestiges of the hind legs, and an examination of the skeleton reveals remnants of the bony framework of the pelvis and hind limbs—showing clearly the snake's descent from reptiles endowed with four complete limbs. The jaw bones seem to be a combination of elastic springs having no limit to their tension; and the two branches of the lower jaw are united at the chin by a ligament, so as to be capable of wide separation. In order to further enlarge the capacity of the mouth, this same arrangement is sometimes found also in the upper jaw, while the jaw bones and those of the palate are movably joined together, which allows the snake to devour prey much larger than the normal caliber of the mouth and throat. A peculiar feature of the snake is the number of vertebræ making up its long, tapering backbone, numbering 400 in some species. The skeleton is arranged to allow the greatest amount of freedom, the vertebræ being hollow in front, convex behind, and furnished with extra articulations, a rounded projection from one vertebra fitting into a corresponding hollow on the next, literally working on a ball and socket plan.



SKELETON OF RATTLESNAKE.

No less remarkable than the number of vertebræ is the number of ribs; in fact, from the head to a long way down the tail, each joint of the backbone has attached to it a pair of ribs. In ordinary land vertebrates the ribs are largely connected with the function of breathing; but in snakes, as well as supporting the walls of the trunk, and thus keeping open the cavity of the chest, the chief function of these ribs is in progression. The majority of snakes have on the under portion of the body a series of large, transverse, horny plates or shields, which are much wider than long, and which correspond to the terminations of the ribs. By holding on to the rough portions or inequalities of the surface which they are traversing with the free edges of these shields (which free edges extend backward), and then drawing close together the ribs on one side of the body and afterward those of the other side, the snake produces that well known undulating movement we call wriggling; then, by straightening out the front part of the body, and, when a firm hold has been obtained, drawing after it the hinder portion, progression is effected.

Harmless snakes generally have two rows of teeth in the upper jaw and one in the lower, these teeth being slender, sharp, comparatively short, and not set in sockets; as these animals do not tear or mutilate their food. The teeth are simply used as hooks by which the food is drawn into the snake's throat. The bones of the jaw being movably joined together, the teeth are advanced on one side, securing a hold on the prey, and then on the other, in which way the swallowing is



HEAD OF RATTLESNAKE (CROTALUS HORRIDUS), SHOWING POISON GLAND AND FANG.

accomplished. Poisonous snakes have two long, sharp fangs which appear to be flattened out like a knife blade and then bent up, forming a groove, in some cases forming a closed tube, open, however, at both ends, the upper end of which is fastened to a bone in the cheek which moves with ease, so that the fangs when not in use can be folded or packed away. The saliva of all animals, even man, contains poison; though in man it is greatly diluted and of use in assisting digestion. In the poisonous snakes it is collected into sacs or glands placed on each side of the upper jaw. A delicate canal extends from the poison gland forward under the eye to the edge of the jaw and there opens into the fang, and to use the poison the snake has but to strike the prey; as the fangs enter the flesh the muscles of the jaw press upon the poison glands, squeeze the poison through the little canal down through the hollow of the poison fang in the wound. There is a most ingenious arrangement in the fang. The opening is not at the very tip, where it would be liable to get plugged up with skin and flesh, but it is a little way up in front of the groove, so that the sharp point goes in first and makes a little hole into which the poison flows.

Snakes vary greatly in color, some being very beautiful, and in many cases their coloration is highly protective, green snakes occurring among a luxuriant vegetation, while gray snakes generally frequent rocky districts. The skin, which consists of a coat of scales, formed from the epidermis and generally overlapping each other, is shed during the summer months. The eyes have no lids, being covered with a delicate film or membrane, giving to them that stony stare with which we are more or less familiar. The poisonous snake has a large, flat head and a short, thick body, and as a rule possesses a vertical keel along the center of the scales, while the non-poisonous snakes have small heads, long bodies, and no keel on the scales.

Perhaps of our poisonous snakes the best known are the rattlers. The Northern rattlesnake (Crotalus horridus) has the widest geographical range, being found in nearly every State of the Union from the Gulf of Mexico to Northern New England and west to the Rocky Mountains. Its appearance is not very pleasing, it having a large flat head, brilliant eyes, and between the eyes and the nostril a deep pit. The horny appendage to the tail, which is termed the rattle, and gives to the snake its distinctive name, consists of a number of hollow dry rings ending in a rounded button, which rattle together when the tail is vibrated, which vibrating or rattling is done whenever the snake is alarmed. The exact use of this rattle is not known; but it is supposed that the animal is provided with this appendage because it lacks the power of hissing. The idea that a rattle is added every year is not borne out by facts. A specimen owned by one observer, Dr. Holbrook, developed two rattles within a year. Mr. Peale, the naturalist, kept a rattler for fourteen years. When he obtained it, it had eleven rattles, and during the fourteen years it lost several; but new ones took their places, so that at the end of this time the snake still possessed eleven rattles. In disposition the rattlesnake is mild and peaceful when not provoked, and will submit to a great amount of teasing before showing any signs of retaliation. A friend of mine, when a little girl, amused herself for nearly an hour teasing a rattlesnake while it was lying in a clump of blackberry bushes, by throwing stones at it and poking it with sticks. A rattler scarcely ever goes out of its way to attack a human being. It can strike stretched out at full length quite as well as when coiled, despite the prevalent idea to the contrary.

The rattlesnake's alleged powers of fascination—in fact, the powers of fascination of any snake—are simply mythical. It is only that the presence of the animal so inspires the individual or animal with horror that they become fairly paralyzed with fear, just as a person crossing railway tracks will become so horrified at the sight of the near-approaching locomotive or trolley car as to be stupefied with fright and unable to move out of danger; yet no one would say that the person had been charmed or fascinated by locomotive or trolley car. So with snakes. Their presence so inspires the victims with fear that they are unable to move out of their way and are consequently attacked; so that in reality the rattlesnake is not the dreadful creature it is often made out to be, but a perfectly inoffensive, harmless animal when let alone.

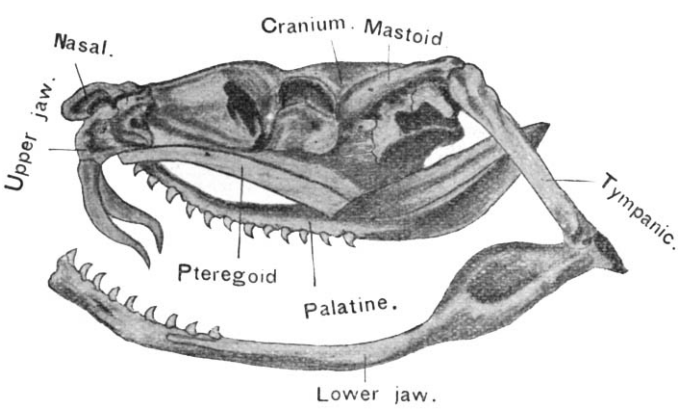
In the secluded parts of Pennsylvania and on the shores of Lake Champlain these snakes are abundant. In Sullivan and Ulster Counties, New York, many men are employed as professional rattlesnake hunters, as the skin is very valuable for making belts, pocketbooks, card cases, etc., and the oil is sold for a large sum, being believed by some to possess great curative powers. Many of these snakes are killed during the summer months, but the grand hunting season is in fall, when the reptiles have returned for the winter to their dens. The hunters well know these places of retreat and choose for the hunt a bright, sunshiny day in October or November. When the snakes have come out of their holes to bask in the sun, lying on the rocks huddled together in great numbers, the hunters arm themselves with old-fashioned flails and attack group after group of the reptiles, but few of them escaping.

There are seventeen species of this snake in the United States. The diamond rattler (Crotalus Adamantus) is strictly a Southern species, found south of the Carolinas; and in the same locality is found the ground rattler. The greatest variety, however, seems to occur in the Western States, Arizona and New Mexico containing several different species, while in California and Oregon is found the Crotalus Lucifer, or black rattler.

Their bite is extremely dangerous but not necessarily fatal. Most animals succumb to it, and man, if proper remedies are not at hand. In most localities there is some one who has a remedy for snake bite, but the most effective, perhaps, is whisky. Onions are also very good, as, when applied to the wound, they will draw out the poison. Prof. Frazer, of Edinburgh, discovered that the serum of the blood of an animal whose whole system was impregnated with snake poison, or the blood serum of the poisonous reptile itself, is an excellent remedy for snake bite. He found out the minimum dose required to kill an animal, and, starting with an amount much smaller than this, gave the dose to the animal, increasing the dose at intervals of ten days until he found that the animal was taking fifty times the minimum dose, or enough snake poison to kill fifty animals of its own weight and size, without developing any bad effects therefrom. He then injected into a healthy animal some snake poison; and soon as it began to produce a bad effect on the animal, he immediately injected into the wound the blood serum of the poisoned animal, which serum immediately counteracted the bad effects of the poison. This, certainly, is a most valuable discovery.

Another snake perhaps more feared by some than the rattler is the copperhead (Ancistrodon contortrix), known as the cotton-mouth moccasin and red eye in the South. It ranges from the Catskills to the Gulf States and west of the Mississippi River: generally attains a length of two feet and inhabits grassy meadows, also mountain regions, where it preys upon small animals, rarely attacking large ones, unless stepped upon. Sometimes cows and horses, not seeing the copperhead in the long grass, accidentally tread on it and are immediately bitten. The bite of the copperhead is poisonous, but not necessarily fatal, when proper remedies are applied.

The water moccasin (Ancistrodon piscivorus) is of a very pugnacious disposition and will with savage ferocity attack both man and brute. It is found from the Pedee River to the Gulf States. In Texas there is a species known as the Texas moccasin, but the great



SKULL OF RATTLESNAKE.

stronghold of this animal is the great swamp of Southern Florida. These reptiles are essentially watersnakes and live principally upon fishes and small reptiles.

The care of the snake for its young is a question which has been very much discussed, a great many instances having been recorded of eye witnesses to the parent snake taking, when alarmed, its young into its mouth; whereas, noted naturalists have asserted they have never been able to discover this trait in the snake. A gentleman living in Georgetown, South Carolina, discovered that the shrubbery on his lawn near a stream was tenanted by a water moccasin; and, locating the snake one day, he placed a rabbit on a log near the stream and removed a short distance to watch the snake, which, when it spied the rabbit, immediately

descended from the bushes and crawled along by the log to the rabbit. When the moccasin had the prey about half way down its throat the gentleman approached, when the snake suddenly disgorged the rabbit, and, making a noise like a shrill whistle, a number of small moccasins quickly ran out from under the log, entered the snake's mouth, and she rapidly crawled away. It would seem, therefore, that the moccasin used this means for protecting her young. The rattler and copperhead are also supposed to resort to this habit when alarmed.

Perhaps one of the most beautiful snakes of the United States is the harlequin (Elaps fulvus). This snake has permanently erect poison fangs, is venomous but not fatal, and of an extremely mild disposition. Its coloring is exceedingly rich and beautiful, being red, with seventeen broad black bands bordered with yellow. The harlequin is found from Virginia to Arkansas, while four other species inhabit Florida and Texas. They spend most of their time underground, often being turned up by field workers, and seem to have a particular fondness for sweet potato patches.

The black snake (Bascanion constrictor) is of a beautiful steel blue color. It is wild and untamable, and particularly bold during the breeding season—very often going out of its way to attack passersby, and will sometimes chase an intruder for quite a distance. The black snake is a powerful foe of the rattler, who, being of a sluggish disposition, is easily overcome and squeezed to death. This snake is a great climber and preys upon birds in their nests, seeming to prefer the cat bird and red wing, often penetrating thickets in search of them. This reptile is an inhabitant of the region east of the Rocky Mountains, where it is a very familiar form, always in districts where there is water.

The coachwhip (Bascanion flagelliformis) is a long, slender form of the Gulf States, which has been vested with remarkable powers by the Indians on account of its rapid movements, and by them has been made the subject of many legends, which are still believed by some, particularly the negroes, who assert that the snake has the power of cutting its antagonist in twain, and can take its tail into its mouth and roll along the ground like a hoop. There is a story current among the negroes that a little boy who was playing in a field one day was attacked by one of these snakes, which lashed his limbs just above the ankles, entirely cutting off both feet. This is, of course, a myth. The species inhabits the Southern States as far west as the Mississippi River.

The Ophibolus triangulus, or milksnake, is found from Canada to Virginia; also bears the name of thunder and lightning snake, chicken snake, and house snake; the latter as it often frequents cellars and outhouses, where it preys upon mice and other small vermin. It also feeds upon snakes and lizards. The milksnake is very graceful in its movements and reaches a length of four feet. Its disposition is exceedingly pugnacious, which trait it exhibits when very young.

A more Southern species and nearly related to the milksnake is Ophibolus getulus, or chainsnake. This, like most of the Southern snakes, is a very beautiful reptile, being of an intense black ornamented by a series of narrow white rings arranged one after another in the form of a chain, whence its name. The negroes hold it in high respect, calling it the king of snakes, from the fact that it is the deadly foe of the rattlesnake. The chainsnake lives on lizards and small birds, as well as weaker members of its own species. The hognose or blowing adder is a large, unsightly snake found in the Eastern United States, but is perfectly harmless, spending most of its time basking in the sun. When one meets it, it does not try to escape, but flattens out its head and body and seems all ready to strike. This it rarely does; but should it strike, it can do no harm, being non-poisonous.

A very active but a very timid snake is the pine or bull snake, deriving its name from its wonderful bellowing note, much like that of a bull, produced by filling its body with air, which it noisily expels. This snake ranges east of the Mississippi River and south of the Ohio. It burrows holes in the ground into which it rapidly retreats when approached and emits a very sickening odor, thought to be a sort of defense. The odor is so sickening that one approaching the snake is very apt to stop for a moment to find out what it is, thus giving the snake time to retreat.

The water snake found in the Eastern United States is a most harmless, inoffensive creature, found almost always in meadows near pools and streams. It is often seen around watercourses, hanging from the branches of trees over the streams, into which they rapidly drop when approached. A water snake, having thus taken to a stream, was observed to swim quite a long distance, keeping its head well out of water, when suddenly it opened its mouth and a number of little water snakes ran into it.

A very beautiful snake is the green Leptophis aestivus, which is very common in the South. It is of a brilliant green color and a perfect mimic of a vine—often surprising one by starting up from among the leaves of a vine and darting away. It has a habit of coiling in birds' nests, but is perfectly harmless and, like our common green snake of the North, is easily tamed.

The Virginia striatula, which is found in the South of Virginia and Texas, is a very pretty little snake, but is very modest and retiring. Its back is a beautiful reddish brown and its under surface salmon colored; but we are not often favored with a view of this pretty reptile, as it is nearly always hidden away under some log or old fallen tree or pile of dead leaves.

The most familiar form of all is the garter-snake, a non-poisonous reptile, of which the United States contains ten species. This snake is the first to crawl out in early spring, and the number found around streams at this time is remarkable. At this season of the year they are always hungry, and one snake has been known to eat three adult toads within an hour. These snakes are perfectly harmless and easily tamed, so that they will even feed from the hand.

Lithium.

Recent researches on metallic lithium have shown that this metal cannot be distilled in either hydrogen or nitrogen gases, vigorous combination occurring in both cases. The metals of the alkaline earths would appear to behave similarly; so that if it should be necessary to heat these substances in an indifferent gas, argon or helium must be employed. In a recent number of the Comptes Rendus M. Moissan shows that if pure calcium be heated in hydrogen the metal takes fire and burns energetically, forming the hydride CaH_2, a transparent crystalline substance which is stable at a high temperature. It behaves as a strong reducing agent and is violently decomposed by cold water, giving off one-seventh of its weight of pure hydrogen gas. It differs from the corresponding lithium hydride in that nitrogen is without action upon it at a red heat.

The Current Supplement.

The current SUPPLEMENT, No. 1194, is commenced with an article entitled "Visit of the German Emperor to the Holy Land," with illustrations and sectional view of the imperial yacht "Hohenzollern," used by the Emperor on his tour, with views of the Holy Sepulcher, the Golden Gate, and views in the sacred city. "The Progress of Electro-Metallurgy in 1897" is an important paper. "The New Prison of Fresnes" describes new prisons which are to take the place of the crowded and unsanitary penal institution in the French metropolis. "Artists' Colors" is a paper giving a quantity of out of the way information. "The Liquefaction of Gases" is a fully illustrated article, describing many interesting experiments. "The Chemical Purification of Potable Water" is an article on the new type of filter. Prof. Brabrook's article on "Anthropology" is continued.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Mechanical Devices.

APPARATUS FOR MIXING TEA.—CHARLES H. BARTLETT, Bristol, England. The device of this inventor belongs to that class of mixing apparatus in which the tea is discharged through an axial aperture in the end of the mixing drum. The discharge-chute is permanently mounted within the front trunnion of the drum. Into the drum the chute projects in order to receive the tea from the mixing and discharging pallets. The chute extends outwardly as far as may be desired, and is carried preferably by a circular plate fitting the aperture of the trunnion, but prevented from turning with the drum. The inwardly-projecting or receiving part of the chute is provided with a sliding cover, by means of which the tea is prevented from being delivered to the chute while the mixing is in progress. The drum is provided with internal helical blades whereby the tea is brought to cups at the front end, which cups deliver the tea to the discharging-chute. So long as the cover remains closed, the tea deposited thereon falls back on one or more helical conveyers of a twist reverse to that of the blades. By this means the tea is returned to the rear end of the drum.

TYPE-WRITING MACHINE.—WILLIAM P. QUIMBY, Gettysburg, Pa. The essential feature of this invention is found in an improved mechanism, by means of which the lines may be spaced any desired distance by the operation of the spacing lever. In carrying out the invention, the spacing lever employed is made to turn the platen. In connecton with the spacing lever and the means whereby its movement is imparted to the platen, devices are used which operate to vary the extent to which the movement of the lever is imparted to the platen. Hence, the distance to which the platen is moved by the spacing lever may be varied without changing the movement of the lever. A uniform movement of the spacing lever is thus secured, and a varying movement of the platen effected, to secure thereby a very narrow or wide spacing, or any intermediate spacing.

COMBINATION-LOCK.—JAMES W. MINER, Johnstown, N. Y. This invention provides an improvement in such combination-locks as are used on safes, vaults, and the like. The lock has two combinations of tumblers, working independently, but operated by a common spindle. By turning the handle of the spindle, either combination can be thrown out of action, or moved by a common cam on the operating spindle into engagement with a locking bar. The peculiar merit of this invention resides in the possibility of employing so many combinations of tumblers that it would be well-nigh impossible, to one not knowing which combination is in engagement with the locking bar, to pick the lock.

Miscellaneous Inventions.

FURNACE-CLEANER.—CHARLES M. MCCAMEY, Denver, Col. The purpose of this invention is to furnish an attachment for fire-boxes, by means of which attachment the ashes may be quickly removed from a grate. The furnace is provided with a rigid dead-plate located forwardly of the grate-bars and provided with an opening through which clinkers may be dropped into the ash-pit. A cover commands the opening, is mounted to slide back and forth on the dead-plate in a plane parallel with that of the plate, and is supported by continuous engagement with the top of the dead-plate.

EXTENSION SHADE AND CURTAIN-POLE HOLDER.—FRANK T. RICE, Tower City, N. D. This curtain-shade and pole-holder comprises a frame formed in two sections sliding longitudinally on each other. Each section has its outer end bent inwardly in the form of a U. A shade-holding fixture is mounted to swing on each inwardly-bent end of the sections. Each fixture has a flange which serves to limit the outward movement thereof, and each is capable of swinging into a plane with the frame-sections. Pins are carried by the frame-sections at points outwardly from the adjacent shade-holding fixtures. Pole-supporting brackets are carried on the pins. For each frame-section a hanger is provided. Each hanger has a loop with which the blocks are engaged, by this means connecting the hangers with the frame-sections.

FOLDING CHAIR AND ROCKER.—RUDOLPH LUND, Cincinnati, Ohio. In this folding-chair, two inverted U-shaped leg-frames are pivoted together in order to enable one to fold within the other. An inverted-U-shaped back-frame has its side members pivoted a short distance from their ends to the upper portions of the side members of one of the leg-frames. The lower ends of the side members of the back are formed with inwardly-projecting lugs. A seat and back of flexible material are secured to the cross-bar of one leg-frame, passed under the cross-bar of the other leg-frame and secured to the cross-bar of the back-frame.

WAGON-BODY.—LYSANDER J. LISHNESS, Bad Axe, Mich. This invention provides a wagon-body having a superstructure at its sides, which structure may be arranged perpendicularly to form a stock-rack, and which may be thrown outwardly to form a hay-rack. The device constitutes a desirable form of wagon-body for use on farms or places where produce of light weight but of large volume must be transported to some distance.

BAG-FASTENING.—CONSTANT LE DUC, South Park, N. J. The fastening of this inventor has staples secured to one side of the bag-opening and projecting from the inner side of the bag. The other side has slots which receive the staples. A flap is connected with the side having the staples. A bar is attached to the flap and is provided with means for engaging the staples to lock the two sides together.

MEAT-BEATER.—MARSHALL E. HUNT, Belle Plain, Iowa. This device for beating meat in order to cause it to become tender has a handle, a body-bar attached rigidly thereto and extending transversely with reference to the handle, and a number of fingers projecting transversely with reference to the handle-bar and supported rigidly thereon. The fingers extend parallel with one another from the side of the body-bar opposite the handle, and are each provided with a series of annular projections spaced apart. These projections cut into the meat, but do not mutilate it beyond the necessary degree to make it tender.

SHAFT OR TONGUE COUPLING.—KNUT BULAND, Linn Grove, Iowa. The purpose of this invention is to produce a shaft and tongue coupling which will enable the shaft or tongue to be quickly removed from a carriage and another substituted in its place. This is attained by attaching to the rear end of the shaft or tongue a forwardly-facing hook, which is adapted to engage a pivot-pin; and by locking the hook in position by securing to the shaft a spring-held block adapted to fill the space between the pivot-pin and the axle, when the shaft or tongue is raised, thus preventing the hook from being disengaged until the shaft or tongue has been dropped to such a position as to remove the block.

DUMPING-WAGON.—THOMAS WRIGHT, Jersey City, N. J. In connection with the sill-frame of a wagon-body, and a gear-frame whereon the sill-frame is normally seated, this inventor employs a number of rock-arms pivoted on the side-beams of the gear-frame. Carrier-bars are held in parallel planes by transverse shafts passing through the carrier-bars and also through the ends of the rock-arms. Rollers are located on the outer ends of the transverse shafts. Means are provided for raising the rock-arms to press the rollers upon the sill-frame and adapt the sill-frame to roll thereon.

SLEEPING-BAG.—SARAH WINTERS, Seattle, Wash. This device is composed of a casing constructed of cloth and eider-down. The purpose of the invention is to provide a cover for persons sleeping in arctic climates. The bag is made of a fabric having an inner and outer layer of cloth, between which the eider-down is quilted. The interior of the bag is provided with a pillow. The bag is formed with flaps, so that the person using the bag may be completely inclosed.

DOOR-GUARD.—JEFFERSON NAGLEY, Marysville, Wash. The object of this invention is to provide a means whereby persons will be prevented from placing their fingers accidentally in the door-opening where the hinges are located. To this end, the inventor has devised a guard consisting of a flexible sheet adapted to be secured to the door and to the jamb, crossing the opening at the place where the door is hinged. Auxiliary hinges are attached to the door and jamb, the members of which hinges are carried at an angle to the door and jamb within the flexible sheet.

FEED-REGULATOR.—OLAUS JOHNSON and PEDER P. HOLT, Northwood, N. D. The feed-regulator of these inventors is designed for use upon roller-mills for feeding material uniformly to the burs. In addition to the means for regulating the flow of the material to the burs, provision is also made for catching and holding nails, screws, and other hard objects, which would otherwise injure the burs and stop the mill. The regulator consists of a casing, a fluted feed-roller mounted therein and having one end reduced in size, and spring-plates underlying the reduced end of the roller. The spring-plates are curved beneath the roller so as to come close to the roller and be adapted by reason of this proximity to regulate the flow of feed.

SWIMMING APPLIANCE.—JACOB STROUP, Washoe, Idaho. The object of this invention is to produce a simple device which may be attached to the ankle and foot of a swimmer, and which, when so attached, will be expanded to secure a purchase upon the water when the foot is forced back in making a stroke. To the accomplishment of this object, the invention consists in employing a curved ankle-plate provided with a stirrup or straps by means of which it may be located upon the rear side of the ankle, and with a pair of light metal wings to which are secured webs.

Designs.

COLLAR OR CUFF BUTTON.—FRANK W. TAYLOR, St. Paul, Minn. The spherical head of this button, according to the design, has running through it a bar beveled at its ends. The shank of the button is flattened and formed on the button-disk. The bar enables the button to be readily inserted and prevents its dropping out. The flattened shank prevents the button's turning around.

WALL-PAPER.—ARTHUR MARTIN, Paris, France. This design consists of a bouquet of flowers of different varieties tied by a ribbon knot, the ends of which appear as scrolls, and streamers of honeysuckles connected with the stems of the bouquet.

GRAVE VAULT.—ELZIRA HUBBARD, Carlinville, Ill. The leading feature of this design consists of an arched top having convex sides, end and bottom surfaces, and flanges at the meeting of the top with the body, the flanges interlocking. The shape of the vault is such as to permit ready manipulation of the whole.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for 10 cents each. Please send the name of the patentee, title of the invention, and date of this paper.

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Minerals sent for examination should be distinctly marked or labeled.

(7517) R. H. L. asks: Would you kindly inform me as to the resistance of a mile of No. 10 German silver wire, one mile of No. 10 galvanized iron wire and the weight of one cubic foot of German silver? A. The specific resistance of copper is 1·6, of annealed iron 9·69, and of German silver 20·89. The resistance of one mile of No. 10 A. W. G. hard-drawn pure copper wire is 5·28 ohms. The resistance of an iron wire of same gage is found by dividing 5·28 by 1·6 and multiplying the result by 9·69, which gives 32 ohms nearly. Similarly, the resistance of the German silver wire is found to be 68·94 ohms. The density of German silver varies with its composition, from 8·30 to 8·77, and the weight of a cubic foot varies correspondingly, from 518 pounds to 547 pounds. See Gray's "Physical Tables." Smithsonian Institution's Collections, No. 1038. Tables 264, 65, and 96.

(7518) W. B. asks: What are the carrying capacities of Nos. 24, 22, 20 copper wire? A. These fine wires, judged by the Fire Underwriters' Rules, have no carrying capacities, since their use is forbidden. Still, carrying capacities may be calculated for them upon the same basis as for other wires. The general assumption is that a wire should not be heated by its current above 140° Fah. This will limit the amount of current a wire can carry in different situations. In a heated place it cannot carry so much as in a cool place, in moulding less than in open works, in close coils less than in open ones, with deep winding less than with shallow winding on a spool. It is found that from 1,000 to 4,000 amperes per square inch of cross section are practical limits of carrying capacity. To find allowable current for any wire, multiply its area of cross section by the number of amperes per square inch. At 1,000 amperes per square inch the carrying capacity would be: No. 24, 0·32 ampere; No. 22, 0·64 ampere; No. 20, 0·80 ampere; No. 18, 1·28 amperes. For other rates per square inch the carrying capacity would be in the same proportion.

(7519) H. S. asks: 1. How long does it take to produce a vacuum or a high state of rarefaction in a common 16 candle power incandescent light globe by a Bunsen pump that is connected to faucet of city water supply? A. A high vacuum cannot be produced with a Bunsen pump in this way. The space will always contain water vapor. 2. Can you give me the number of cubic inches rarefied in a certain length of time by above mentioned pump? A. The rate of exhaustion depends upon the size of the pump as compared with the space to be exhausted. Bunsen and Sprengel pumps are, of necessity, of small bore, and therefore slow in action. We doubt if any figure for amount of air removed can be given which would be reliable. 3. What is the best way to make a hole of certain size, say half an inch, in a large glass bottle without receiving fractures? A. To drill a hole in a glass bottle use the broken point of a file, wetting it with a solution made by dissolving camphor in turpentine. Have care not to bear on too hard when the drill is nearly through. Enlarge the hole to required size with a round file wet with the same solution.

(7520) L. A. W. asks: Will you please advise through the columns of your valuable paper a formula for a flour paste, one that will keep indefinitely, or at least for a long time? A. Water, 1 quart; alum, ¾ ounce. Dissolve, and when cold, add flour to make it of the consistence of cream, then bring it to a boil, stirring it all the while. Paste may be preserved with aid of oil of cloves, ten drops to the pound, or an equal amount of carbolic acid.

(7521) H. A. H. writes: Have six cells dry battery which have never been used, but have stood idle for some time. Can they be recharged at slight expense, and how? A. Dry cells should not lose their activity by standing idle. They can only do so by corrosion of the metallic parts or by the drying of the paste in them. You can see if there has been corrosion. If the paste is dry, you can bore a hole through the top and put some water into the cell. After it has soaked a day or two, pour the remaining water out again and stop up the hole with any convenient stopper.

NEW BOOKS, ETC.

REMINISCENCES OF NEAL DOW. Recollections of Eighty Years. Portland, Me.: Evening Press Publishing Company. 1898. Pp. 769. 8vo. Plates. Price $2.50.

The autobiography of a public character like Neal Dow is always attractive. Some of his early reminiscences are particularly interesting. He attended an academy, and he goes on to say, "One attraction to me was a large philosophical apparatus, which was said to be of the best construction and workmanship of its time. Through it I acquired a taste for mechanics in all branches. As one result of this I may here add that I have been a subscriber to the SCIENTIFIC AMERICAN from its first publication, I think, to the present time, and have never failed to carefully read each number when I have been at home with opportunity so to do." This is certainly a handsome compliment to the SCIENTIFIC AMERICAN, coming as it does from so high a source.

ACQUA, ELETTRICITA, TRAZIONE. Questioni ferroviare urgenti. Naples: Tipografia Pontieri e Velardi. 1898. Pp. 117.

PAINTING TO PREVENT CORROSION. With Specifications. By A. H. Sabin, M.S. New York: Edward Smith & Company. 1898.

This is a very handsome little booklet filled with excellent engravings showing corroded metal surfaces and different structures which have been treated with durable metal coatings. The book is handsomely printed, and, while in the nature of a trade publication, it is filled with valuable information.

COMMERCIAL ORGANIC ANALYSIS. A Treatise on the Properties, Proximate Analytical Examination and Modes of Assaying the Various Organic Chemicals and Products employed in the Arts, Manufactures, Medicine. With Concise Methods for the Detection and Determination of their Impurities, Adulterations, and Products of Decomposition. By Alfred H. Allen. Second edition revised and enlarged. Vol. IV. Proteids and Albuminous Principles, Proteoids or Albuminoids. Philadelphia: P. Blakiston's Son & Company. 1898. Pp. 584. Price $4.50.

A few weeks ago it was our privilege to review the first volume of this important work, and we now congratulate the publishers on the second revised and enlarged edition of Volume IV., which takes up proteids and albuminous principles and proteoids or albuminoids. Among the subjects treated are eggs, milk, meat and meat products and proteids of digestion, composition of the blood, gelatine, glue, dyeing, the hair, wool, etc. Those who consider that a thoroughly scientific chemical work must be dull and uninteresting will have their minds disabused of this idea by perusing the volume before us. It is filled with information which is of value to every food manufacturer, to the doctor, and to every chemist.

HAND BOOK OF CORLISS STEAM ENGINES. Describing in a Comprehensive Manner the Erection of Engines, the Adjustment of the Corliss Valve Gear, and the Care and Management of Corliss Steam Engines. By F. W. Shillito, Jr. Bridgeport, Conn.: The American Industrial Publishing Company. 1898. Pp. 224. Price $1.

The demand for an elementary treatise on the Corliss engine has induced the author to undertake the preparation of this volume. Various types of Corliss engines are taken up in order, and information is given regarding their erection and adjustment. The book is well illustrated, but the illustrations do not show up as well as they might, as the paper has an unfortunate bluish tinge.

SHEWEY'S OFFICIAL HANDY REFERENCE POCKET ATLAS AND CYCLOPEDIA. Chicago: A. C. Shewey. 1898. Pp. 94. Price 25 cents.

THE UNIVERSALIST REGISTER. Giving Statistics of the Universalist Church and Other Denominational Information, etc., for 1898. Edited by Richard Eddy, D.D. Boston: Universalist Publishing House. 1898. Pp. 120. Price 20 cents.

DIFFERENTIAL AND INTEGRAL CALCULUS. For Technical Schools and Colleges. By P. A. Lambert, M.A. New York: The Macmillan Company. London: Macmillan & Company, Limited. 1898. Pp. 245. Price $1.50.

The object of this text book is three-fold: by a logical presentation of principles to inspire confidence in the methods of infinitesimal analysis, by numerous problems to aid in acquiring facility in applying these methods, and by applications to problems in physics and engineering and other branches of mathematics, to show the practical value of the calculus. This text book is intended for students who have a working knowledge of elementary geography, algebra, trigonometry, and analytical geometry.

MODEL HOUSES FOR LITTLE MONEY. By W. L. Price. New York: Doubleday & McClure Company. Philadelphia: Curtis Publishing Company. 1898. Pp. 193. 18mo. Illustrated. Price 50 cents.

The present volume is made up from articles which have appeared in the Ladies' Home Journal and it is designed to be of aid in the building of small homes, the designing of which is too frequently left to the builders or others who are ignorant of architecture. The plans are on rather a small scale and the subject cannot be adequately treated in a book of such small dimensions, and on this account it is hardly as successful as "Inside of a Hundred Homes," which we also review. The section relating to the remodeling of doors and windows is the most interesting in the volume.

INSIDE A HUNDRED HOMES. By W. M. Johnson. New York: Doubleday & McClure Company. Philadelphia: Curtis Publishing Company. 1898. Pp. 140. 18mo. Price 50 cents.

The little volume before us contains photographic glimpses into a hundred of the most tasteful homes in America, where taste has gone further than money. The illustrations give hundreds of new ideas furnished by these actually existing rooms, which have not the cold formality of rooms shown by the large decorators and furniture dealers. It shows the extraordinary progress of modern book making when such a beautiful little volume can be produced at such a moderate cost.

The "Drama of Glass," by Kate Field, published by the Libbey Glass Company, of Toledo, Ohio, is one of the handsomest little trade publications which we have ever seen. The little half tones are exquisite examples of the photo-engraver's art. It will be remembered that the Libbey Glass Company had one of the most remarkable exhibits at the World's Fair, and there is no doubt that this exhibit of artistic cut glass has done much to popularize cut glass in the last few years, as many persons were able to see for the first time what cut glass really is and how it is made.

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Railway nut wrench, J. M. Certain	613,969
Railway spike, R. Dodson	613,797
Railway switch, self acting, C. H. Strauss	613,827
Railway track, C. A. Sundstrom	614,036
Ram, steam, W. Druhl	613,977
Razor, safety, W. Greenfield	614,049
Reel. See Oil cloth stock reel. Ribbon reel.	
Regulator. See Draught regulator. Electric regulator.	
Ribbon reel, F. R. Vernon	613,742
Roller. See Shade roller.	
Ropeway, aerial, J. W. & H. White	614,046
Rotary engine, F. G. Hubbard	613,682
Rotary engine, R. P. Jarvis	614,001
Rotary motor, Campbell & Lounsberry	613,852
Safe or vault, J. H. Howard	613,680
Sander feeding device, W. H. Kilbourn	613,861
Sash cord fastener, W. M. Morton	613,932
Sash fastener, G. H. Poor	613,714
Saw, band, J. Johnson	614,003
Saw, circular, S. T. Johnson	614,053
Saw setting device, J. S. Henderson	613,817
Scaffold safety attachment, M. Cody	613,971
Screen. See Paper pulp screen. Portable screen.	
Seal lock, O. B. Kirkpatrick	613,928
Seams of vessels fluid tight, means for making, J. E. Liddy	613,693
Seeding machine, W. H. Davis	613,667
Self measuring tank for liquids, C. F. & P. F. Lewis	613,690
Sewer pipe delivering and inverting apparatus, C. W. Vaughn	613,741
Shackle, A. E. Line	614,014
Shade roller, E. F. Hartshorn	613,800
Shaft straightening machine, L. H. Brightman	613,754
Shears. See Animal shears. Pruning shears.	
Shears, A. Zinsgraf	613,873
Shoe, A. Belaire	613,958
Shoe upper, G. L. Motteler	613,821
Signal. See Indicator signal.	
Sled, bob, W. G. Scott	613,889
Sled, foot propelled, A. Ringborg	613,940
Sleigh runner, J. L. Mason	613,699
Smelting furnace, J. H. Ross	613,868
Snap hook, vehicle pole, C. A. Nauman	613,822
Soda fountain, J. B. Herron	613,678
Speed indicator, J. Spitzmiller	613,731
Sprayer, L. Knetzger	613,905
Sprocket wheel, G. T. Buddle	613,756
Stamp, combined adjustable postmarking and canceling, W. S. Reed	613,824
Stamp, hand, G. A. Rentschler	613,721
Stand. See Flower stand. Flower or other stand. Washstand.	
Station indicator, J. E. Carter	613,967
Steam boiler, N. F. & W. T. Anderson	613,813
Steam generator header, sectional, A. Heberer	613,838
Stock guard, J. M. Lee	614,013
Stopper. See Bottle stopper.	
Stove, sheet iron, J. A. Schneider	613,781
Street flushing machine, M. A. Rich	613,910
Stropping machine, A. W. Scheuber	613,825
Suit, union, A. Allen	613,953
Swinging gate, H. E. Koch	614,011
Switch. See Electric switch. Railway switch.	
Talking machine, L. F. Douglass	613,670
Tank. See Self leveling tank.	
Tank heater, W. R. Dunkel	613,837
Target, panoramic, C. Dickenson	613,855
Tawing hides or skins, etc., H. Dannenbaum	613,898
Thill coupling, C. J. Shetterly	613,849
Thill iron, J. Howell	613,996
Threshing machine, C. V. Newton	613,908
Threshing machine cylinder, J. A. Anderson	613,654
Tinning machine, J. Monto	613,704
Tire bolter and cutter, V. Reynolds	613,722

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