SCIENTIFIC AMERICAN

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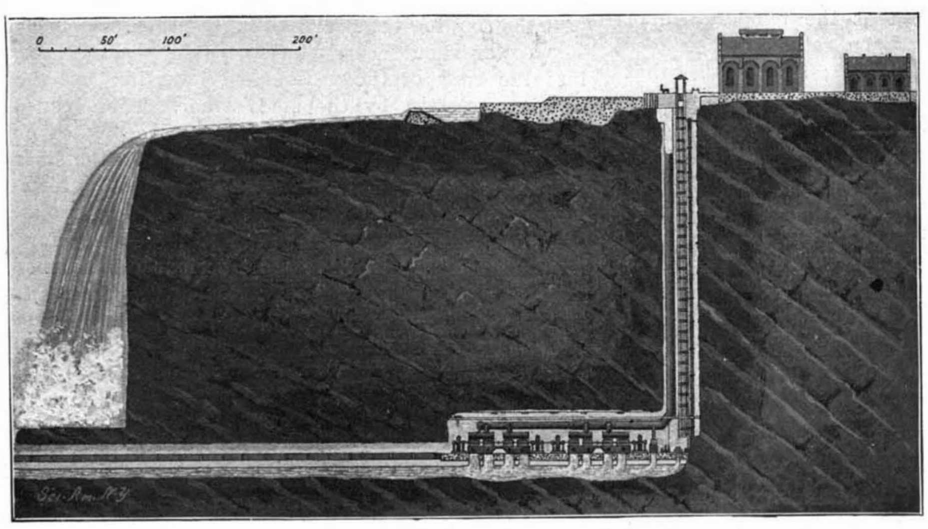
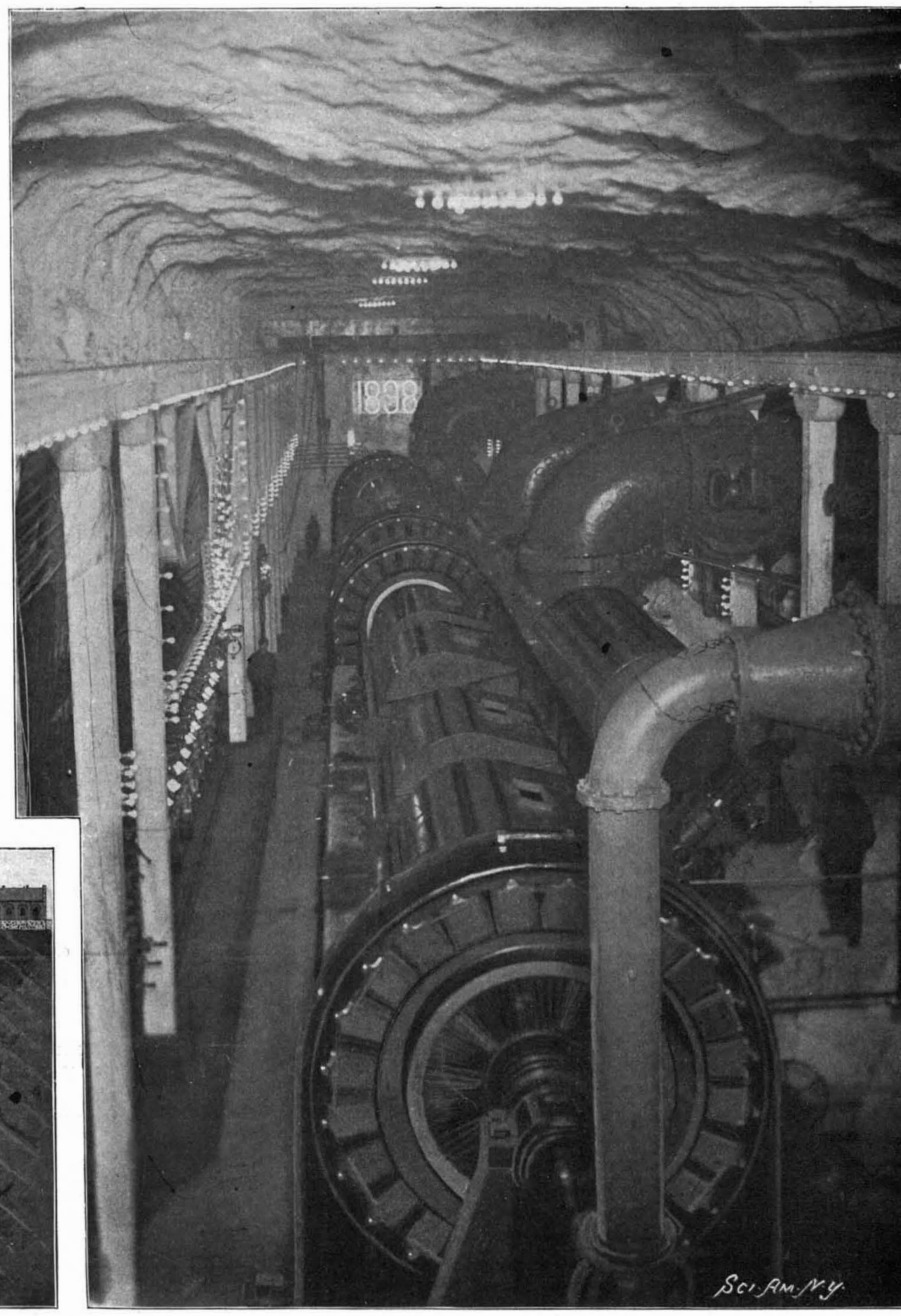
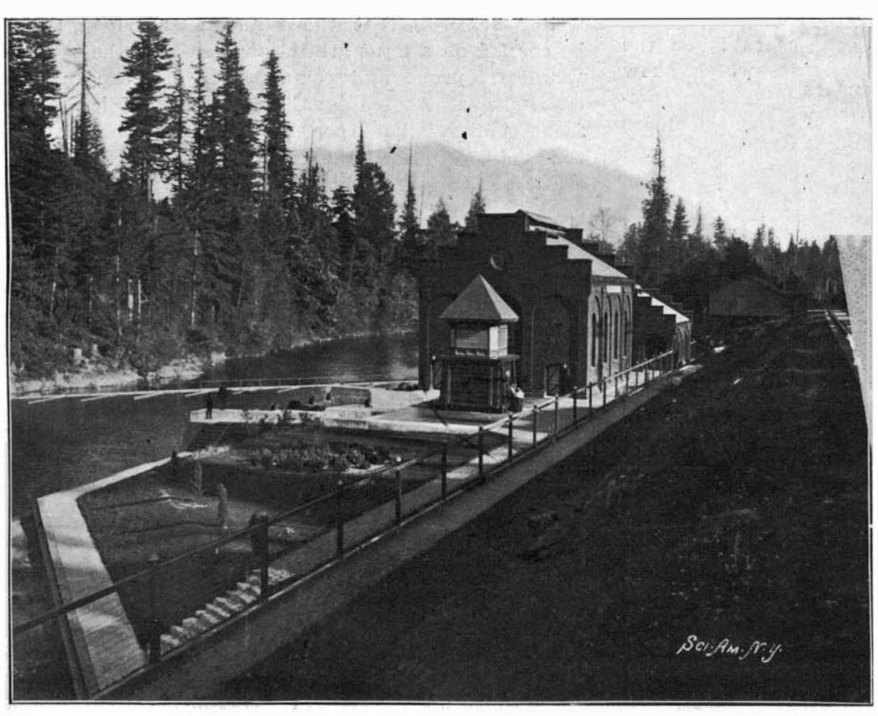
The Snoqualmie Falls.



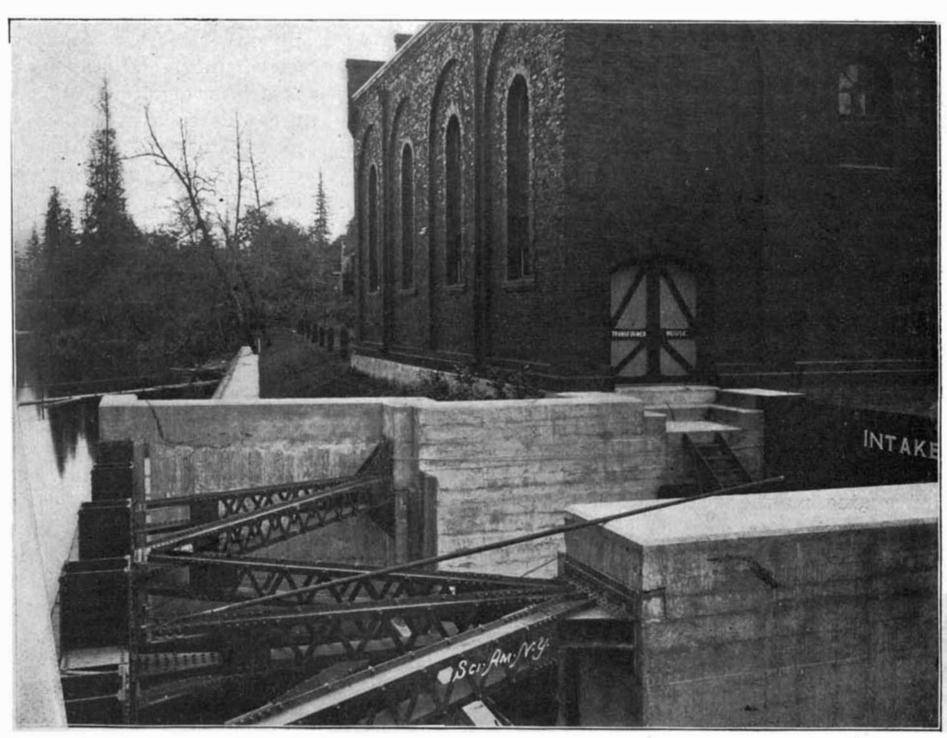
Longitudinal Section Showing Shaft with Penstock, the Underground Power House and the Tailrace to the River Below the Falls, Depth of Fall, 270 Feet.



Interior View of the Subterranean Power House. Excavated Out of the Solid Rock.



The Headworks Above the Falls, Showing Intake, Transformer House, etc.



The Intake From the River.

THE SNOQUALMIE FALLS POWER PLANT.—[See page 137.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, AUGUST 30, 1902.

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

EXPRESS TRAINS OF THE FUTURE.

That the express train of the near future will not necessarily be hauled by electric locomotives is evidently the belief of the German Society of Mechanical Engineers, who have offered a series of prizes for the best-designed high-speed express train capable of carrying 100 passengers and their baggage, with every modern convenience of travel, at an average speed of 75 miles an hour for a continuous run of three hours' duration. There is no question that this competition was prompted by the disappointing results of the experiments in high-speed electrical traction, carried out last year on the stretch of military railway between Berlin and Zossen. It will be remembered that the failure of these trials, or rather their somewhat sudden termination, was due, not to the inability of the electrical equipment to drive the train at the high speeds contemplated, but to the unexpected weakness displayed by the track and roadbed, which, under the heavy concentrated and rigid loads of the motor trucks, yielded so seriously as to produce dangerous oscillation of the car. The object of the express train competition is to provide a train suitable for greatly accelerated railway travel, whose steam locomotive shall be able to exert the necessary power without imposing greater strains than the comparatively light track of the present state railways of Russia can endure. The Berlin-Zossen trials proved that the track of the state railways, as at present laid, is altogether too light for high-speed electric travel, and the German Society of Mechanical Engineers believe that it is possible to design a high-speed, steam locomotive train that would accomplish the desired result without damage to the track and roadbed. The trials demonstrated practically the fact, which might very well have been foreseen, that the steam locomotive with its high center of gravity and its spring-supported load, is far less severe upon a track than the electric locomotive with its low center of gravity, and its large proportion of non-spring-supported load. The effect of a low center of gravity is felt in rounding curves, and when the engine or cars begin to oscillate laterally from one rail to the other. With a high center of gravity the lateral blow against the rail is considerably cushioned and the lower the center of gravity, the more direct and hammer-like is the impact. This is a point that has been well understood by steam locomotive builders and engineers, and when the first of our American express engines with boilers placed above the drivers were introduced, it was found that, despite their great weight, they were actually easier on track, at least as regards lateral displacement, than the old type of locomotive with low boiler and low center of gravity. Of course, in the very nature of things, an electric locomotive carries its weights low, and hence at very high speed loads particular attention will have to be given to the lateral strength of the track and roadbed.

During the electrical experiments of last year an endeavor was made to gather data regarding the air resistance at varying rates of speed, and it was shown that the head-on pressure increased at a much more rapid ratio than the speed, though apparently not as fast as the square of the speed. As a result of the data so gathered, an endeavor is to be made to reduce air resistance by clothing the whole train from pilot of engine to the rear platform of the last car in sheet steel, with suitable sliding joints between the cars to give the necessary flexibility in rounding curves. This sheeting is to finish at the engine in a wedge-shaped front. Our readers will here be reminded of the experimental train designed by Adams and tested in some high-speed runs. The train in question made a good speed record, considering the moderate power of the engine that hauled it; and we think the probabilities are that if good results are secured with the proposed experimental train in German many not a little of its success will be due to this special feature of its construction. According to the German technical publications, care will be taken in the construction of the locomotive to minimize the racking effect of the engine on the track, by carrying the weight upon a large number of wheels, twelve in all being used. There will be a four-wheeled truck at the front, followed by a pair of coupled drivers and a four-wheeled trailing truck beneath the firebox. The engine will be a three-cylinder compound, with the cranks arranged so as to secure a perfectly even turning movement.

LIGHT ON THE LIQUID FUEL QUESTION.

In a paper recently read by Mr. Edwin L. Orde before the Institution of Mechanical Engineers, at Newcastle-on-Tyne, on the subject of liquid fuel, the author stated that close examination of the literature which has appeared on the subject, seems to show that from some cause or another, many undoubted advantages which liquid fuel offers have either not been fully appreciated, or if appreciated, not pursued with sufficient determination to insure their realization in actual practice. In explanation it has been suggested that the reason why liquid fuel has a higher calorific value than solid fuel of the same chemical composition is, that some of the heat has been rendered latent in passing it from the solid to the liquid form; but the author points out on the other hand that experiments fail to show the existence of this latent heat, quoting as an authority Dr. Paul, who holds that the best results that can be obtained from liquid fuel are an evaporation of 16 pounds of water at 212 deg. F., which is about 50 per cent more than any good coal will give in an efficient boiler. The most important point made in the paper was the explanation as to why liquid fuel does not give evaporative results in actual practice corresponding to those obtained in laboratory tests. Mr. Orde attributes the difference to the fact that crude oil exclusively is used in boiler furnaces, and that this oil contains a great amount of water. Ten per cent is the proportion quoted in the paper, although, as a matter of fact, many oils contain a higher percentage than this. The presence of this water destroys the conditions necessary for perfect combustion. Its first effect is to reduce the temperature of the flames and increase their length, thus moving the point of highest combustion further into the furnace, with the result, first, that a large portion of the heating surface of the furnace is rendered useless; secondly, that the temperature of the combustion chamber may be raised to a higher point than is good for its material; and thirdly, that the last stage of combustion takes place in the smoke-box and uptake. The existence of a low furnace temperature is suggested, furthermore, by the fact that in cases where no smoke was being formed and the air supply was not more than 20 per cent above the amount that was chemically necessary for the combustion of the fuel, the evaporative work of the boiler was poor.

In commenting editorially upon Mr. Orde's paper The Engineer states that it has authentic evidence of oil being shipped from oil wells which contained as high as 40 per cent of water, this large amount having been added, not fraudulently, but having flowed naturally into the wells, which are usually driven through water-bearing strata. As crude oil is nearly as heavy as water, and only separates from the latter after a long rest in the tanks, it follows that on shipboard, where the bunkers are in constant motion, separation is impossible and the water is carried with the oil into the furnaces. In concluding his paper Mr. Orde quotes actual results obtained by successful installations of burning apparatus on the steamers of three different companies, which show the difference in consumption of liquid fuel as compared with coal. In the case of the four steamers quoted, there is an advantage in favor of liquid fuel of 27 per cent, 28.6 per cent, 35.5 per cent and 36 per cent. The conclusion arrived at is that except in the case of steamers which are engaged in carrying oil as cargo, or those which are employed in the oil-producing region, liquid fuel cannot show sufficient pecuniary advantage over coal to render its entire adoption advisable.

THE RECENT "BELLEISLE" EXPERIMENTS.

In a characteristic discussion of the recent "Belleisle" experiments, Mr. F. T. Jane, the well-known author of "All the World's Fighting Ships," sums up the experiments as having two main objects: First, to ascertain the effect of lyddite on a conning tower, and, second, to ascertain the effect of shells on torpedo nets. After a careful analysis of the results, he points out the main lessons that are to be learned and presents his own suggestions as to how far they should modify future battleship design. The whole article as given in The Engineer will be found in full in the current issue of the SUPPLEMENT, and it will be sufficient to give here a brief review of Mr. Jane's analysis of this interesting trial. It is pointed out that in the first case the experiment was invalid because the conning tower of the "Belleisle" was not of a modern pattern, being entered from below instead of, as is now the practice, from the rear. Attention is drawn to the fact that the gas from the exploding lyddite shells was only able to act upon the top of the tower, whereas in the modern type of conning tower, which has a doorway through the rear wall with a curved screen to partially cover it, the blast of an exploding shell would be able, if the latter came from a wide arc on either beam, to enter between the screen and tower and find its way, with deadly impact, throughout the whole of the interior of the tower. In the "Belleisle" tower the gas could only enter through the peep-hole slot at the top, and hence there would be something of an air-cushion effect before the pressure reached the floor of the conning tower, on which, before the firing, a live rat had been placed to test the effect upon a living being. As we take it, Mr. Jane's argument is that though the modern conning tower with open rear entrance and so-called protecting screens may keep out shells, it will not prevent destruction of the inmates by the shock of the shell gases. He suggests the construction of a double-deck conning tower, to accommodate a steersman in the upper compartment, and a reserve steersman below. He would place the commander of the ship on the roof of the turret, this roof to be extended to form a wide, circular platform, around which platform would be hung a wall of splinter nets, the idea of this arrangement being that the splinter nets would catch the lighter flying fragments, but would not present sufficient resistance to burst the storm of explosive shells, to which the captain himself would offer but a small target. He suggests that the best position for the captain in the heat of action would be prone upon this upper roof with his mouth above the speaking tubes, etc., which would lead down into the conning tower below. The suggestion that the captain should fight his ship practically in the open is warranted by the fact that in the Spanish-American war the commanders of our vessels preferred, like Admiral Dewey, to carry on the action from the bridge, where they could obtain a clear view, rather than be cooped up within the restricted outlook of the conning tower.

Early in the action the bridge of the "Belleisle" was struck and completely wrecked, the mass of wreckage being swept away and carried overboard. From this it is argued that it would be folly to support the conning tower or fighting position on a bridge. The tower should carry its full diameter well down into the body of the vessel, and have its base thoroughly protected by the side armor. There can be no question as to the necessity, as above pointed out, for giving most thorough protection both to the steersman and the reserve steersman; for should the former be killed or disabled at a critical moment in battle it is easily conceivable that the delay in sending for a "replace-man" might have most serious consequences, and, possibly, be fatal to the ship. By building the conning tower in two stories, and having the "replace-man" in the story below, the risk of the ship running wild is reduced to a minimum.

The awful destruction wrought by the lyddite shells and the dense clouds of dust and fragments produced by the explosion indicate that there are two other most important accessories that demand attention; the first, the important matter of placing the range-finder, and the second, signaling. Ordinarily the range-finder is carried on the bridge, but the short work made of this structure on the "Belleisle" shows that some other position must be found, and the writer suggests that the range-finder tripod should be carried on a light grating, upon which the operator would lie prone and communicate the ranges by a transmitter. As to signaling, the "Belleisle" experiment confirms the experience gained at the battle of the Yalu, where the signal halyards were entirely swept away; for the bombardment gave little promise of the survival of even the light masts. There are two methods of signaling suggested, one a small captive balloon carrying flags which may be hoisted and cut away and sacrificed when done with, and the other suggestion is the use of colored shell for simple signals.

When the writer comes to the question of the effect of high-explosive shell fire on the personnel of the ship, we think that he is dealing with what, after all, is the most vulnerable point of attack in the modern warship. We are satisfied that in a battle carried out at moderate ranges between ships whose crews are fairly proficient marksmen the fight will be determined by the decimation of the crews, rather than by the destruction of the ships. Unquestionably many will be placed hors de combat by mere concussion, whether by the impact of shells on the outside of the turrets and casemates, or by the atmospheric shock and asphyxiation due to the bursting of high-explosive shells within the inclosed spaces of the ships. It is true, as Mr. Jane points out, that the actual effects of gun fire on the personnel is a matter of conjecture, and unless volunteers can be found who will place themselves within such a vessel as the

"Belleisle" when she is under fire, and secure the enormously valuable data which can only be obtained in this way, we shall remain in comparative ignorance of the actual destructibility of modern gun fire. At the same time it is probable that public sentiment would array itself strongly against the proposal to risk the sacrifice of human life in such an experiment.

GEORGE M. HOPKINS.

It is with most profound sorrow that we record the decease on the 17th inst. at Cheshire, Mass., of Mr. George M. Hopkins, so long identified with the SCIENTIFIC AMERICAN as Associate Editor.

It was while enjoying a vacation trolley outing with his wife in this beautiful locality among the Berkshire Mountains that Mr. Hopkins became suddenly ill on the 15th, and despite the best medical treatment, never recovered. His sudden demise will be a great shock to his intimate associates in the SCIENTIFIC AMERICAN.

Mr. George M. Hopkins was born in Oakfield, Genesee county, New York, November 21, 1842, and while a lad went with his father and family to Albion, Orleans county, New York, where he received the usual public school education. He early displayed a liking for mechanics, having a natural ability to discover the reason of things in a mechanical way as they were studied. His father encouraged him to pursue matters to his liking by having him obtain practical information in the workshops at Albion.

On May 10, 1864, he was married to Helen M. Mills, daughter of Dr. A. B. Mills, of Albion, N. Y. Later, in 1866, we find he was granted his first patent for an apparatus for turning leaves of music, after which followed some forty-three other patents; among them, in 1871, was an electro-magnetic sewing machine, and from 1880 to 1885 he was granted two patents for telegraph relays, five patents on telephone transmitters and two patents on telephone receivers. His telephone transmitter patents were acquired by the People's Telephone Company at that time and their utility was well demonstrated. He was also interested in gas engine construction and secured several patents in that line, showing that his activity as an inventor never failed him in whatever branch he applied his mind.

He early made the acquaintance of Thomas A. Edison, in whose laboratory he worked, and the friendship continued throughout the epoch of the telephone and electric light development, and to the present time.

On May 10, 1876, he became connected with the SCIENTIFIC AMERICAN, beginning his work as an attorney in the Patent Department; it was soon noticed that he evinced a fondness for experimenting in matters connected with physics, especially in a more simple and direct way than was customary. He was encouraged in this work and from time to time the results were published in the SCIENTIFIC AMERICAN. The experiments were so simple and clear that any boy could understand them. The value of the published experiments was that they were based on actual manufacture of the apparatus and trial before publication. It is needless to add that these many different publications formed the nucleus of Mr. Hopkins' popular book, "Experimental Science," which has been of such assistânce to many thousands of students of physics.

Some months ago Mr. Hopkins undertook a thorough revision of the book, with a view to bringing it up to date, that many of the remarkable discoveries of the last few years might be included.

It is a great gratification to feel that this work was entirely completed, and that the proofs had been thoroughly revised and read by Mr. Hopkins before he started on his vacation several weeks ago. The popularity of the work is shown by the fact that the twenty-third edition has just been published. Our illustration is from a recent photograph and is regarded as an excellent likeness of Mr. Hopkins.

Of late years he gave particular attention to literary work, editing the special department of "Notes and Queries," and contributing to our columns a series of scientific articles which were marked by the clearness and brevity by which his work is easily recognized. Mr. Hopkins possessed in a marked degree the literary qualifications of a scientific writer. To his simplicity and clearness of style, no doubt, was largely due the great popularity of his writings, which attracted and held the interest of the widely diversified classes of readers who were interested in the subjects he discussed and subscribed for his published works. It is certain, moreover, that his directness and purity of style were one expression of the character of the man himself; for our late associate was possessed of sterling traits that won for him the invariable respect and admiration of all those with whom he had business relations.

His disposition was most kindly, amiable and attractive. He was ever ready to render assistance and freely impart such knowledge as he possessed.

Mr. Hopkins occupied his leisure hours with the practice of photography as a stepping stone for the study of art. He enjoyed painting small pictures as a pastime, using his photographs as a guide. He was fond of broad effects. On another page we give his method of producing them.

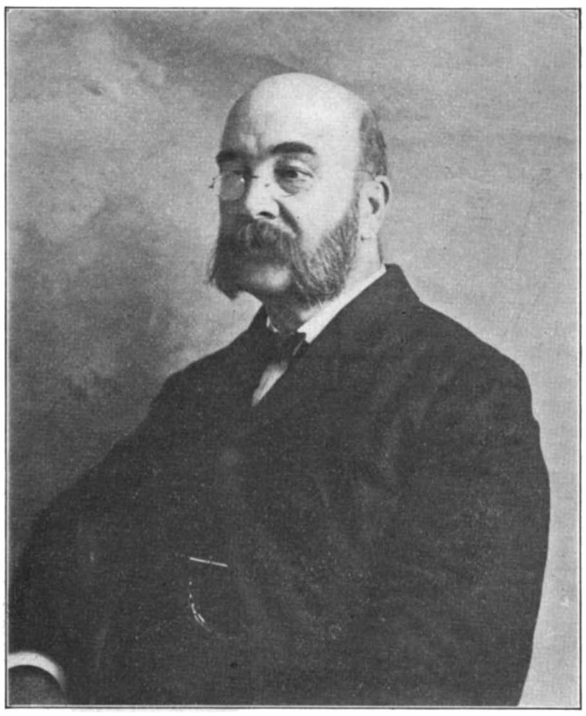
He was a member of a number of societies. His residence was in Brooklyn, New York, where, we are informed, he left a most remarkable collection of scientific apparatus, which exceeds in interest the equipment of many institutions of learning.

He leaves a wife and one son, Mr. Albert A. Hopkins, who was formerly with the SCIENTIFIC AMERICAN for several years and is author of "Magic" and "The Scientific American Cyclopedia of Receipts, Notes and Queries." One brother, Mr. I. N. Hopkins, also survives him.

Mr. George M. Hopkins was greatly beloved in the church he attended in Brooklyn and was held in high esteem by all who knew him. We shall miss him and we know our numerous readers will, but we believe the work of his life, "Experimental Science," will live and the memory of his name will endure with it as one who knew how to teach science with rare simplicity.

THE LAYING OF A PACIFIC CABLE.

The President has consented to authorize the Pacific Commercial Cable Company to lay a cable across the Pacific to the Philippines, thus ending the fight which has been waged for fifteen years by rival firms. The Mackay-Bennett Company will probably soon begin work. The route to be followed extends from San Francisco to Guam and thence to Manila. The estimated time of laying the cable is fourteen months from the beginning of the work. Heretofore all messages have been sent to the Philippines over an English line from Hong Kong. The owners of this line have a franchise monopoly granted by the Chinese government. Under the favored nation clause of the treaty between the United States and China the American government has the right to claim a similar franchise for an American cable company. It is expected that advantage will be taken of this treaty relation, for by getting a terminal in China the cable company will obtain 700 miles of new cable lines. The Pacific cable will then connect with the Atlantic cable lines in China so that messages can be sent to all parts of the world by American cables.



GEORGE M. HOPKINS.

ELECTRIFIED HOUSES.

An instance of non-familiarity with simple scientific facts is illustrated by an article that goes the rounds of the press once or twice annually, namely, the story of the electrified house. The article usually states that some one has discovered that everything he touches in his house, the radiators, picture frames, banquet lamps, etc., give him an electric shock. Hence, he fears there is some connection between the arc-light wires and the water pipes near his residence. The electric light inspector is, therefore, summoned, and reports that the wires of his company are intact and that e electricity must come
from some other sourc does not dawn on any
of the people consultec the discoverer of the
phenomenon is unconsci performing one of the
simplest and oldest of e atic experiments, the
shuffling of his shoes ov dry carpet raising
the potential of his body eral thousand volts,
which discharge at every op y. One may even
get electric discharges from ckles to the brass
lock of a hand-bag which he be carrying while
walking on a stone pavement cold, dry weather.
But, dismissing newspaper it is somewhat
astonishing, in view of the ways in which in
cold, dry countries electricit unintentionally developed and manifested by sparking, that the first knowledge concerning this phenomenon did not come to the ancients in this way rather than by the attraction of light substances by amber. The explanation of this, however, may be that the scientists of bygone days did not reside in cold, dry countries.—Cassier's Magazine.

SCIENCE NOTES.

The radiations of radium have proved to be of rare value in medicine. It is found that a metallic screen interposed between the eye and a vial containing radium in no way prevents the healthy eye from seeing it. If the retina of a blind person be healthy, it will be effected by radium rays even though the cornea be opaque to light rays. Consequently the radiations from radium can be used to discover whether or not the retina of a blind person is healthy.

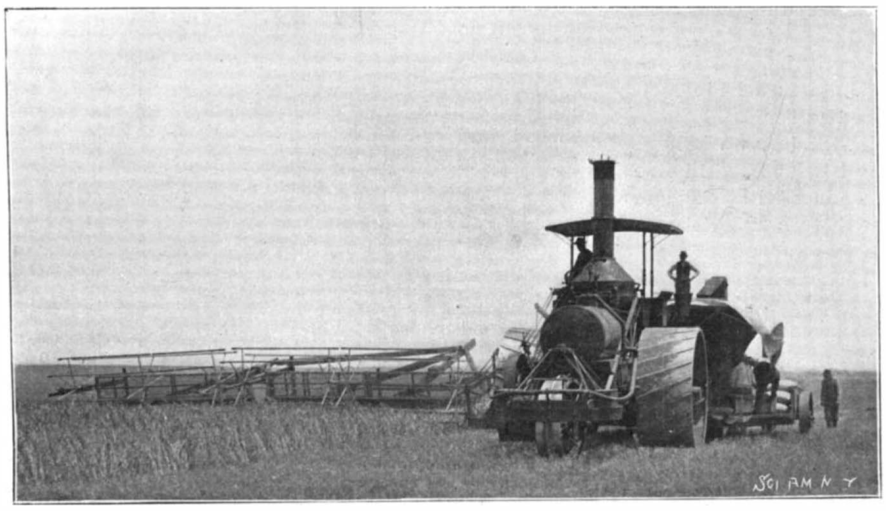
The expedition dispatched last summer to Gambia, on the West Coast of Africa, by the Liverpool School of Tropical Medicine has discovered another malaria-spreading animal, the parasite trypanosoma. This parasite resembles a minute worm, and is very similar to the blood parasite which is the cause of the devastating disease prevalent among cattle, horses, etc., and in Africa, India and other tropical countries known as the tsetse fly disease, nagana and surra. In the case of animals it has been proved that these diseases are communicated through the agency of certain biting insects, such as the tsetse fly. The expedition discovered the trypanosoma parasite in the blood of a native child. Since the return of the expedition a special study of the question has been made at the laboratories of the Liverpool school and it has now been resolved to dispatch a further new expedition to the West Coast to investigate the conditions in which the disease occurs in both Europeans and natives and its distribution, and also to ascertain how it is conveyed from man to man; whether by biting insects or by other means.

The fitting out of the Scottish South Pole Expedition, which is to be carried out under the auspices of the Scottish National Antarctic Expedition, is rapidly approaching completion. The expedition is to be under the command of Mr. W. S. Bruce. The Norwegian whaling vessel "Hecla," renamed the "Scotia," purchased to carry the party, is now being reconstructed on the Clyde, at Troon, under the superintendence of Mr. G. L. Watson, the well-known yacht designer. The "Scotia" is a bark-rigged auxiliary screw steamer of about 400 tons register. New deck-houses are being built, a larger one aft and a smaller one forward divided into a laboratory and cook's galley. A second laboratory and a dark-room are being fitted between decks. The ship is being specially fitted to carry on oceanographical research, both physical and biological. Two drums, each containing 6,000 fathoms of cable, for trawling in the deepest parts of the Southern and Antarctic oceans, are being taken. The expedition intends to follow the track of Weddell, and to explore the Ross deep, working eastward from the Falkland Islands.

The Zoological Garden of London has lately received a young animal known as the Panda. This animal, a small mammifer of the Procyonidæ family, constitutes a unique species in the genus Aelurus (*A. fulgus*), and comes from the Himalayas, where it is found at altitudes varying from 6,000 to 11,000 feet. It is also found in the mountains to the north of the Assam as far as the Yuman region. Its ordinary name is "red cat-bear," the name being due to its appearance and its plantigrade walk, also to the reddish color of the fur. The Aelurus genus exists in the fossil state, and one species, that of the *A. Anglicus*, is found in England in the pliocene layers. The Panda is not often seen in Europe. The first specimen which arrived at London was sent in 1869, but its two companions died *en route*. The survivor did not live longer than seven months. It was made the subject of careful observations by zoologists, especially by Sir William Flower and Mr. A. E. Bartlett. It is interesting to note that the Panda now in London often uses his forepaws like arms and hands. Mr. Hodgson, who observed the species in the East Indies, never saw the Panda act in this way and use his anterior members to seize objects. A second Panda was sent to London in 1876. The habits of the animal are nocturnal, and during the day he sleeps almost constantly. He seeks his nourishment in the evening or very early morning, living upon herbs, buds, roots, and will also eat eggs and insects. The character of the animal is rather mild; the large claws with which his fingers are provided are used not for attack or defense, but mainly to climb trees, in which he passes a good part of his time, except in the periods when he seeks his food, this being generally obtained on the ground. He is not timid, but does not like to be touched. When a person extends his hand toward him, he sits down, and agitates his arms as if to strike, but his anger is short lived and he allows himself to be observed without much inquietude.

A MAMMOTH COMBINED HARVESTER.

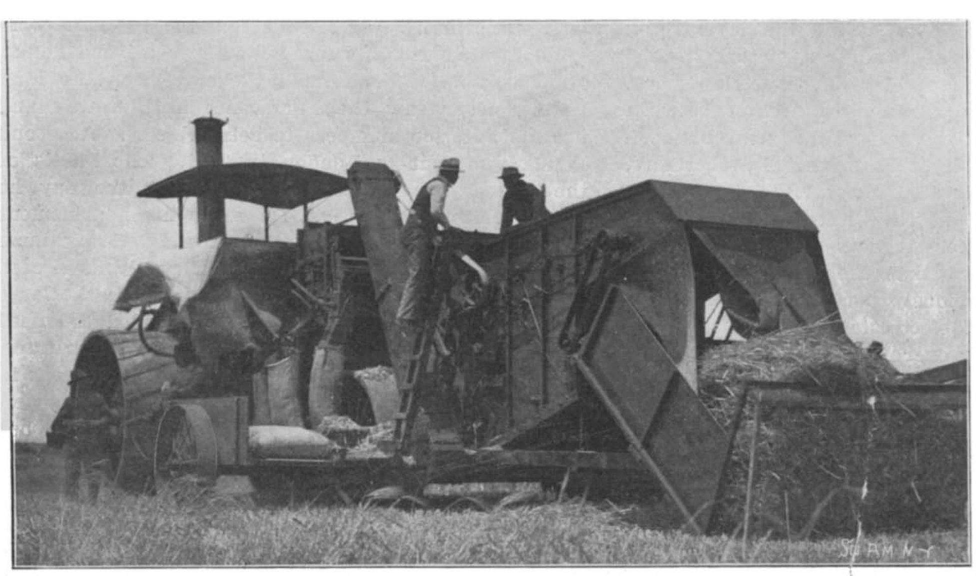
Our Western States with their thousands of acres of farms are continually astonishing the world with the enormous proportions of their agricultural machinery. Just now our attention is called to a combined harvester, which we illustrate herewith, and which is claimed to be the largest in the world. This harvester has a very wide reach, having a cutting-bar 35 feet long. The entire process of harvesting and threshing is accomplished in the machine. The stalks are cut and conveyed by a suitable means to the threshing mechanism. Here by the use of a system of cylinder, separator and recleaner, the grain is separated out, cleaned, and fed into sacks, as shown in one of our illustrations; the straw at the same time is conducted to the straw box at the rear of the machine. The threshing cylinder is 28 inches in diameter and the separator has a width of 54 inches. An automatic governor on the fans governs the blast so that at any speed at which the harvester may be traveling, the wind is automatically regulated and prevents clogging of the shoe and the carrying of grain over into the straw—a difficulty which often occurs in harvesters which are regulated by hand, because this part of the operation is very often forgotten or neglected.



FRONT VIEW OF THE COMBINED HARVESTER.

The harvester is entirely steam-driven and is connected by suitable coupling to a 50 horse power traction engine by which it is propelled. The usual method of operating such machines is by means of gearing and universal joint connection with the traction engine. This machine is, however, entirely independent of the traction engine for its motive power, being provided with an auxiliary engine of 8½-inch bore and 7-inch stroke, which is located on the frame of the harvester. This engine is driven by steam, conducted through a flexible tube from the boiler of the traction engine. It furnishes all the necessary power for operating the mechanism and fills a deficiency which will be readily appreciated by those who are acquainted with the requirements of such a machine. Heretofore these parts were dependent upon the travel of the traction engine for their operation. Now a steady, uniform motion is assured at all times, no matter what the condition of the grain may be, or at what speed the traction engine may be traveling.

The traction engine is designed to burn either coal, wood, oil or straw. When straw is used as fuel, an endless carrier is provided for conveying the material from the straw-box to the fuel-box of the engine. It is interesting to note that in California, where this machine is in use, oil has proved to be the most economical fuel, the consumption per day being coal, 1 ton at $8.50 per ton; wood, 2 cords at $4.50 per cord; oil, 330 gallons, at 70 cents per barrel. The capacity of this machine is from 1,000 to 1,500 sacks, or from 70 to 100 acres harvested in a day. This too, at a cost not exceeding 50 cents per acre for cutting, threshing, recleaning and sacking the grain.



A MAMMOTH COMBINED HARVESTER—THE THRESHING MECHANISM.

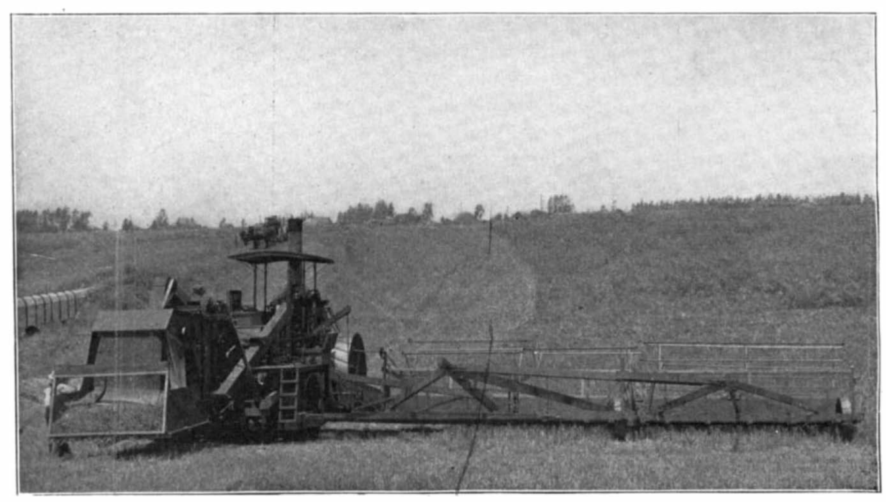
A Large Western Cotton Mill.

BY DAY ALLEN WILLEY.

The erection of a cotton mill in the vicinity of Kansas City, Mo., is of unusual interest not only on account of the remarkable size of the proposed plant but from the fact that it is to be located in a new site for the textile industry and marks the beginning of what may be an important industrial development in the Southwest. The mills will contain an equipment of 12,000 looms and 500,000 spindles—being by far the largest plant of the kind in the world. The Amoskeag Manufacturing Company of New England is at present the most extensive, being greater in dimensions than any of the factories in the Lancashire district of Great Britain, but the Western company will exceed the Amoskeag by 200,000 spindles and 2,000 looms. The equipment will be installed for manufacturing plain sheetings ranging in size from 2½-yard drills to print cloths as well as 4 and 5-yard sheetings. The yarns produced will run from Nos. 8 to 20 for the drills and 30 to 50 for the larger goods. A further idea of the capacity of the plant can be gained when it is stated that its estimated annual output when running to its full capacity will be 75,000,000 pounds of finished goods and its consumption of cotton 170,000 bales.

The mechanical features connected with the building of the Western factory are also of unusual interest. Its electrical equipment will be very elaborate in character and contain the latest devices for the economical driving of the weaving and spinning rooms by motors. No water power is to be secured at the site, as at many points in the Piedmont section of the South and in New England, so that the necessary current will be generated by steam power, the engines being direct connected to large dynamos or belted to them. From the generators the current will be distributed to the battery or series of motors each operating its individual set of looms or spindles. The plan followed in general will be similar to that utilized in equipping the Olympia Cotton Mill, of Columbia, S. C., where the machinery is driven entirely by electricity. The motors serving the spinning frames are to be of 150 horse power each operated at a current ranging from 575 to 580 volts, and are of the three-phase pattern. Each motor will serve 10,000 spindles, so that the total number alone in this department will be 50. Motors of the same size will be installed in the weave rooms on an average of one to 750 looms, representing five looms per horse power. The motors will be attached to the ceiling and connected with the apparatus by as short circuits of wiring as possible with the view of economizing power to the greatest possible extent. By this system it is calculated that a saving ranging from 15 to 20 per cent in power will be effected, compared with a plant operated by steam direct, for it will be noted that one section of the factory can be operated by its own motor entirely independent of the others, allowing others allowing any part of the equipment to be run during a dull season or while repairs are being made to the other portions, yet without waste of power or needless wear and tear of equipment. It is hardly necessary to say that the textile industry as yet is comparatively unknown west of the Mississippi River. In fact it has scarcely obtained a foothold even in Texas, which in recent years has produced over one-third of the American cotton crop. A few statistics will emphasize this fact. Out of about 425 mills now in operation in all the Southern States, but 15 are running in Texas, Louisiana, Arkansas and Missouri, combined with two or three in Indian and Oklahoma Territories. All combined represent but 140,000 spindles out of the 4,375,000 in the South. As will be noted, the Kansas City plant when entirely completed will contain over one-tenth of the total number of spindles at present installed in the South. It is unnecessary to say that raw material is abundant, as the last few years have demonstrated that Indian and Oklahoma Territories, as well as Arkansas, are as favorably situated for raising middling cotton of a good grade as the territory in Georgia and the Carolinas. They have equal advantages, not only in climate, but in quality of soil. Already the two Territories mentioned plant 700,000 acres annually in the staple, while the average acreage of Texas is nearly 8,000,000.

As it is expected to provide the plant described with furnaces for burning oil or for solid fuel, advantage will be taken of the extensive deposits of petroleum in Texas, which can be shipped to it by rail in tank cars. Coal can be obtained from the McAlester mines in Indian Territory and in this way the question of fuel supply is disposed of. It is expected to secure a fair grade of labor from Kansas City, as well as the farming population in the vicinity, which will be trained by experts from New England and South Carolina. As to the market for the product, the company expects to sell mostly in the West and on the Pacific coast, but will make a grade of goods suitable for the Chinese and Japanese demand. As is well known, the market in the Orient has taken a very large quantity of the goods from the Carolinas, Georgia and Alabama mills within the last few years, and this trade will be catered to.



REAR VIEW—SHOWING THE GREAT REACH.

The Mystery of a Spider's Spinning.

How does a spider spin a thread from one bush to another at a height from the ground and then draw it so tight? asks a correspondent in the New Century. Everyone who has ever walked through a country lane early in the morning has felt the strained threads upon the face, and often these threads are many yards long, but the way in which it is done remains a mystery. He does not fly across, drawing the thread after him, for he has no wings. Neither does he descend to the ground and then climb the opposite bush, for this would lead to immediate and hopeless entanglement of the gossamer filament. How then does he do it?

M. Favier, a French scientist, has discovered that a thread, one yard long, will support by its own buoyancy in the air the weight of a young spider. It would thus be in the power of a juvenile to spin a thread of that length and trust to air currents to carry it across and attach it to an opposite bush so that he himself could then pass over and draw it tight. But many of these threads, to judge from their strength and consistency, are not the work of young spiders, and, as every observer knows, they are often many yards long and drawn so tightly that the face is instantly aware of their presence when breaking them.

The work is nearly always done in the night time, so that observation is difficult.

If the spider had any human nature in his make-up —and many of his habits would lead us to suppose that he has—he would be gratified at the perplexity which he causes and would advertise his performances as zealously as do less gifted human gymnasts and even some popular preachers.

SOME MODIFICATIONS OF THE NORMAL PHOTOGRAPH.

BY GEORGE M. HOPKINS.

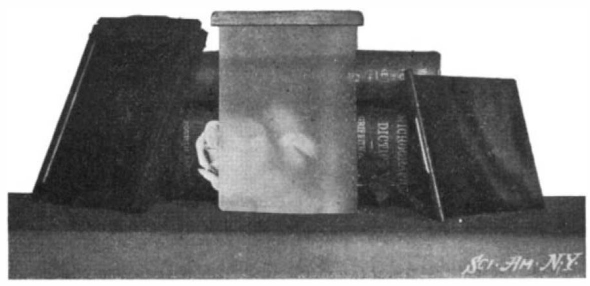
The amateur photographer begins with an ordinary camera, becomes dissatisfied and procures a better one, and frequently proceeds in the same manner until he is satisfied that he has secured the best instrument that can be obtained. It cuts the photographic image from the center to the edge of the plate with fidelity, and he derives great satisfaction in possessing as good a lens as can be made. But before very long he learns that a picture photographically perfect lacks a great deal in true artistic feeling and quality, and he begins to remedy the defects of the perfect lens by throwing the plate out of focus, or by using a larger stop, or both, and thus secures to some extent the broad effect that he has learned to admire.

In addition to following out these suggestions he may produce artistic effects in other ways which recommend themselves to the experimenter in photography. One of the simplest methods of obtaining a soft ethereal effect consists in interposing between the lens and the plate a piece of ground glass, glass coated with ground glass substitute, or ground glass celluloid, placed at different distances from the plate, according to the effect desired. A very good scheme is to withdraw the slide from the plateholder and replace it by a slide of translucent ground glass celluloid, like that shown in one of the illustrations, taking care to exclude the entrance of light by changing the slides under the focusing cloth, the exposure being made through the ground glass celluloid. The resulting picture, whether portrait or landscape, is soft in outline, and is possessed of mellow lights and shades. The finer details of the photographic image are omitted, and the much-desired breadth is secured. If broader effects are desired a square of finely-ground glass can be placed in the camera within or inside of the reversible back. Of course, the farther the glass or celluloid is removed from the sensitive plate the more details are omitted from the negative. If it is desired to show more of the detail than is possible with a translucent slide of the kind described a thin sheet of crystal glass of the size of the plate may be coated with ground glass substitute and placed in the holder along with the plate, with either the film or coated side out, according to the effect desired. The ground glass celluloid when placed either side out in contact with the sensitive film produces a desirable effect. If it is difficult to get ground glass celluloid a piece of fine, thin tracing paper may be secured by its corners to a thin piece of glass (an old negative glass, thoroughly cleaned will answer). The effect will be quite broad if the glass side is placed next the sensitive film, and the negative will be very soft if the tissue paper is placed next the sensitive film. These interposed films absorb more or less of the light, and necessitate an increased exposure, but the increase is very slight and can be determined only by experiment in each case. A lantern slide produced from a negative of this kind, if well colored, appears on the screen more like a painting than a photograph.

Another peculiar effect is secured by placing over the sensitive plate a thickness of fine, thin muslin stretched over a frame of common tin, or thin brass plate, the frame being placed in the holder along with the plate. The muslin should be wet when mounted and secured to the frame by stratena or some other adhesive cement. Broader effects may be produced by removing the muslin screen to the reversible back.

Lantern slides printed from ordinary negatives through fine ground glass, or ground glass substitute, lend themselves beautifully to coloring, as they are broader and more like paintings than other colored slides.

A painter who dislikes to copy an ordinary photograph, on account of the difficulty of omitting detail, will find a copy of a good photograph taken through ground glass or tracing paper much more agreeable to follow than the photo with its many details. Half-tones may also be copied in this way.



TRANSLUCENT SLIDE.

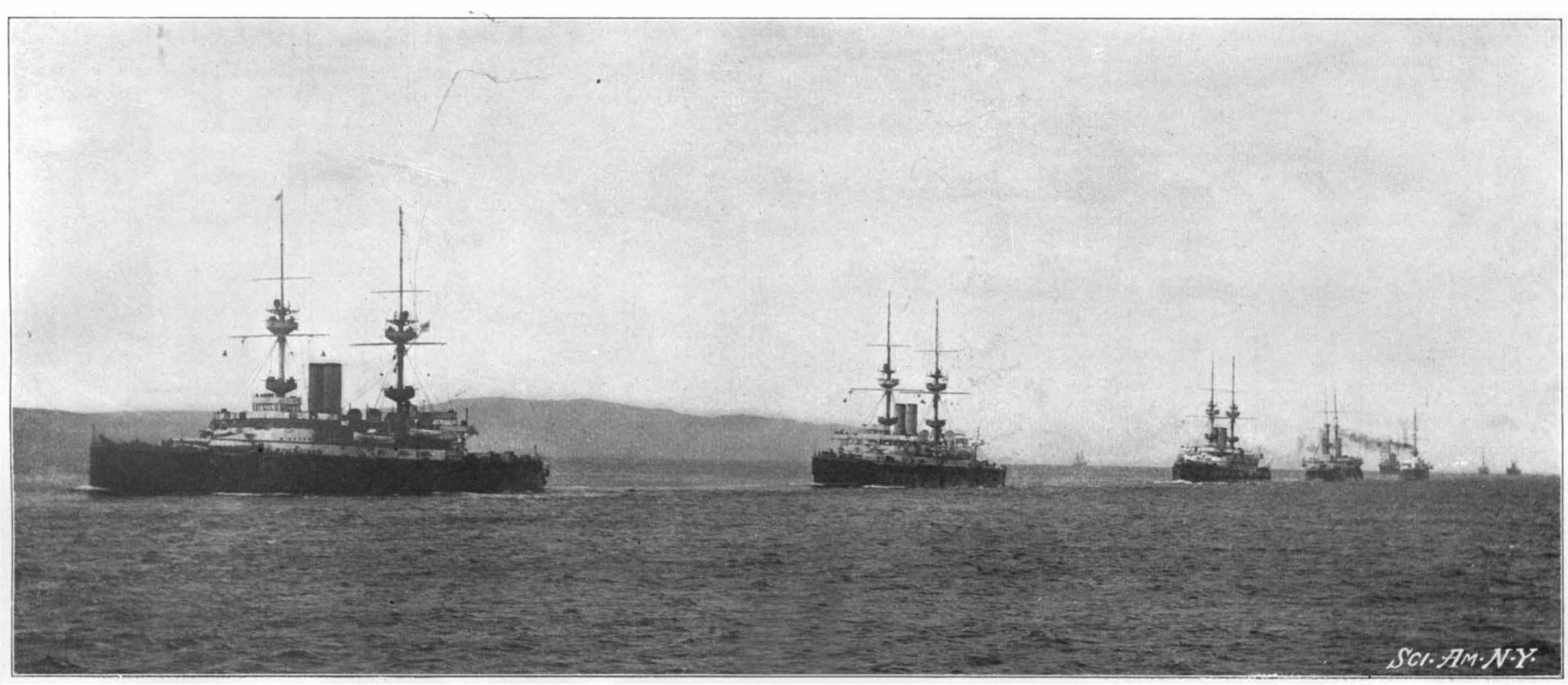
PHOTOGRAPH TAKEN WITH TRANSLUCENT SLIDE.

This may seem to the ultra-photographer, who takes the greatest interest in sharpness, depth and multitudinous detail, as a retrograde movement, tending toward the degradation of photography, but the true artist will find use for photographic pictures with reduced detail.

THE CORONATION NAVAL REVIEW.

As far as the numbers and strength of the British ships were concerned, the postponement of the coronation naval review detracted nothing from the splendor of the naval pageant of August 16; although the necessity for the withdrawal of most of the foreign warships caused the event to lose some of its international character. The only foreign ships that were present at the review were the Japanese armored cruiser "Asama," of 9,700 tons displacement, and the 4,180-ton protected cruiser "Takasago," with the Italian armored cruiser "Carl Alberto," of 6,500 tons, and the 4,100-ton Portuguese cruiser "Dom Carlos I." Outside of these four vessels the great fleet of 103 ships was marshalled from the British navy, without withdrawing a single vessel from the Mediterranean or any foreign station or from the reserve fleet. The ships were those of the Channel squadron, the Home or Defense fleet, and the Cruiser squadron, the last named being the latter-day representative of the famous Flying Squadron which was organized when Emperor William sent his famous message at the time of the Jamestown raid. Of the 107 vessels present, 4 were foreign ships, 20 were battleships, 24 were cruisers and the balance was made up of torpedo-boat destroyers, torpedo boats and other miscellaneous craft. The fleet was anchored in five long lines which covered some 25 square miles of the sea, the line of visiting yachts being drawn up in position at the southeastern end. The battleships line included such vessels as the "Prince George," "Hannibal," "Jupiter" and "Majestic," with the "Trafalgar," "Nile," "Royal Sovereign," and other vessels of from 12,000 to 14,900 tons displacement. The most modern and formidable of the cruisers was the armored vessel "Sutlej," of 14,000 tons and 23 knots speed. She was followed by the "Narcissus," "Galatea," "Niobe," "Crescent" (late flagship of the North Atlantic squadron) and the "Endymion." A one-gun signal from the battleship "Royal Sovereign" at 2 o'clock announced the departure of the King in the new yacht "Victoria and Albert" from Cowes. The crews of the fleet at once manned shipped and simultaneously from over 100 vessels there thundered forth a salute of twenty-one guns, the firing being taken up by the shore batteries and the crash of artillery lasting for at least a quarter of an hour. The royal yacht then passed up and down the lines, and at 4 o'clock, at the finish of the review, as she came to her moorings escorted by a flotilla of torpedo-boat destroyers, another royal salute was fired. At night every vessel in the fleet at a given signal burst into a blaze of electric lights, the scheme of illumination consisting of a row of incandescent lights at the water line and at the upper deck, the outlining of the masts and funnels by similar lines of light. This was followed by an elaborate colored searchlight display by every vessel of the fleet, which formed the closing feature of the day's festivities.

In the accounts of the review cabled over to this country there has been a great deal of misleading criticism, which would lead the public to infer that the quality and efficiency of the British navy is in the inverse ratio of its numbers. As a matter of fact, the vessels engaged in the review were not by any means the most modern and formidable in the British navy, the battleships, for instance, and most of the cruisers having been designed nearly a decade and a half ago. Hence, it is entirely misleading to compare the vessels present at the review with foreign vessels which have only just been turned out from the builders' yards. These battleships are of the same date as our "Oregon" and "Massachusetts." The



British Battleships Proceeding nead in Column of Line Ahead.

THE CORO[illegible] REVIEW.

latest vessels of the British navy were, as has been mentioned above, doing duty on the Mediterranean and foreign stations, from which they could not be spared, even for such an important occasion as the coronation of the King.

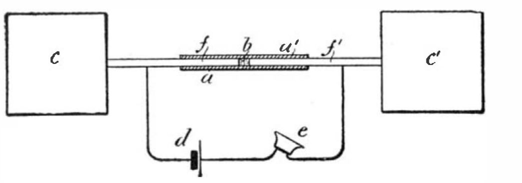
ELECTRICAL RESONANCE AND ITS RELATION TO SYNTONIC WIRELESS TELEGRAPHY—II.

BY A. FREDERICK COLLINS.

(Continued from page 120.)

Having developed the theory that light and electric or Hertzian waves are electromagnetic and that both originated from the same cause and are propagated by the same medium, the next step toward the new art of wireless telegraphy was when Branly observed

FIG. 4.



that electric waves acted on metal filings very much like light waves on selenium, i. e., lowered its resistency; these filings were placed in a glass tube for convenience in operating, and to its evolution is largely due the practicability of the wireless telegraph. Branly's radio-conductor, as he named the tube, entirely supplanted the wire-ring detector of Hertz, owing to its wonderful sensibility to the electric waves. Lodge renamed this electric eye a coherer, which has almost entirely supplanted its original appellation of radio-conductor. The coherer with battery and telephone receiver shown diagramatically in Fig. 4 is the fundamental receiving apparatus required for wireless telegraphy.

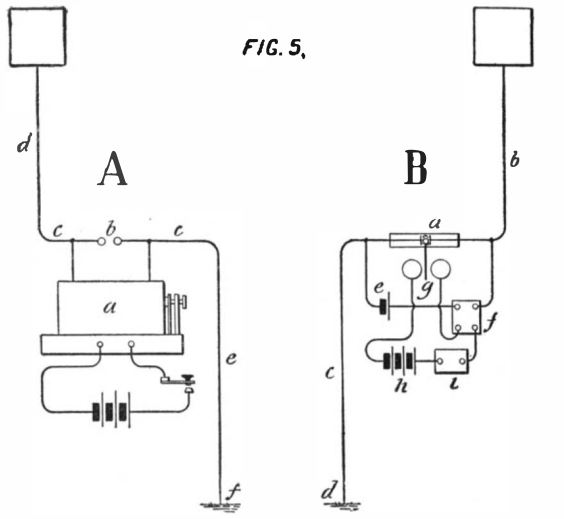
WIRELESS TELEGRAPHY.

The apparatus employed in wireless telegraphy consists of the Ruhmkorff coil and oscillator, as in the Hertzian experiments, but with the addition of a long vertical wire or antenna, suspended from a mast, its lower terminal connected with one arm of the oscillator; a second wire leading from the opposite oscillator arm to a sheet of metal in the earth. Fig. 5, *A*, shows the arrangement. The receiving device consists of the coherer with a vertical wire leading from one of its conductor plugs to a mast as in the transmitter; the opposite coherer conductor plug is connected with an earthed plate of metal. In series with the coherer are a battery and relay, and in an auxillary circuit are placed the tapping device to decohere the filings in the tube and a Morse register for recording the messages on tape. The receiver is illustrated in Fig. 5, *B*. Now when the waves are emitted by the transmitter, *A*, at a distance from the receiver, *B*, they are propagated through the electro-magnetic medium or ether, and every impinging wire on the vertical wire attached to the coherer, *B*, decreases its resistance from thousands of ohms to a few tens or even less; the resistance of the circuit, including the coherer, battery and relay is now reduced sufficiently to offer little opposition to the current from the battery, the relay armature is drawn into contact and actuates the circuit controlling the register.

RESONANCE.

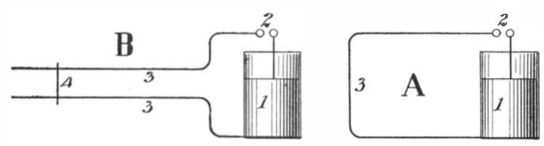
With this brief description of the *modus operandi* for wireless telegraphy it will be interesting to ascertain the laws governing the electrical resonance effects between the transmitter and receiver and the appara-

FIG. 5,



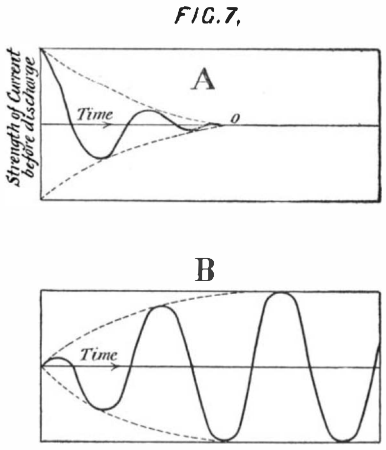
tus necessary to transmit waves to "any one or more of a number of different instruments in various localities." This is accomplished by prolonging a series of rapid electric oscillations of a particular frequency on the transmitter and having the receiving circuit so balanced in its coefficients of inductance, capacity and resistance as to respond to that frequency or some multiple or sub-multiple of it. This is clearly shown in the case of Lodge's syntonic jars. Fig. 6, *A*, is a Leyden jar, 1, having a spark-gap, 2, and a circuit formed of a rectangular conductor, 3. At *B*1, is a second Leyden jar of equal capacity to *A*1, a spark-gap, 2, of microscopic size and a circuit, 3, made variable by the sliding wire, 4. If the jar, *A*1, is now charged and then discharged through the gap, 2, oscillations will be set up in the circuit, *A*3, of definite frequency and if the inductance capacity and resistance of both circuits, *A*3 and *B*3, are equal, then oscillations having the same periodicity will occur in *B*3. The scale upon which these experiments are made may be greatly extended; the Ruhmkorff coil and Hertz oscillator may be substituted for the Leyden jar at *A*1, and a coherer for the micrometer spark-gap of *B*2. But in substituting these essential factors two great difficulties are encountered; first, an open circuit, i. e., Hertz oscillator, emits waves with such energy that only two or three swings of the high frequency current take place before it is *damped* out or the current

FIG. 6.



dissipated, as shown in the diagram, Fig. 7, *A*. Waves emitted by this system are propagated to great distances, but the oscillations producing them are not sufficiently prolonged to create oscillations of similar frequency in the receiving circuit. In the closed circuit oscillator of the Lodge syntonic jar type the oscillations are quite persistent and in consequence the emitted waves are very feeble; this precludes its use for commercial wireless telegraphy. Such a closed circuit oscillator will set up in a receiver in tune with it oscillations of remarkable persistency, depicted graphically in Fig. 7, *B*. The second difficulty in changing from the experimental apparatus to that required in practice is the tremendous additional capacity loaded on the oscillator and coherer circuits by connecting one arm of either to the earth.

FIG. 7.



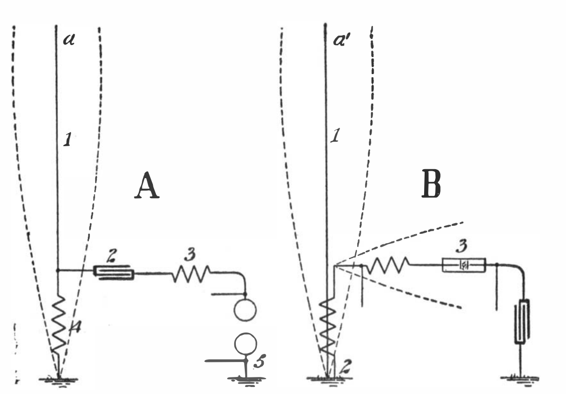
The capacity of the earth is so great that practically all oscillators and coherer circuits are tuned or syntonized, and by inserting other values of capacities and inductances in the form of inductance coils and condensers, the value of the earthed systems is but little changed.

SYNTONIZATION.

To systems employing pure resonance effects in which both transmitting and receiving circuits are tuned by inductance and capacity, the name *syntonic* has been given. By clever arrangement of the devices the objectionable features of the closed oscillator are partially eliminated and its good features partly retained, in other words, a compromise has been effected.

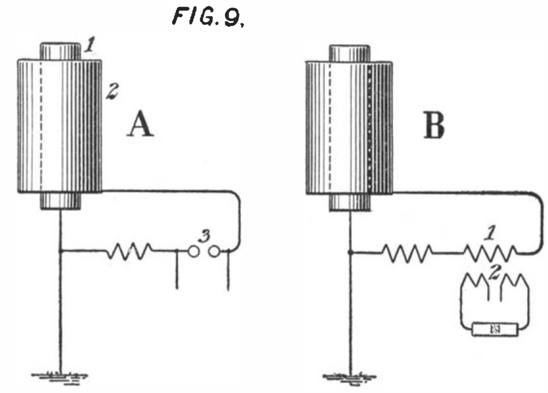
The three principal syntonic systems are the Slaby-

FIG. 8.



Arco, the Braun and the Marconi. The Slaby-Arco syntonic wireless telegraph is shown in diagram, Fig. 8, *A*, *B*. It is assumed by the inventors that electric oscillations in the vertical wire, 1, are like the mechanical vibrations of a flexible steel bar with the greatest amplitude at *a*, *a'*, *A*, *B*, with the ether as the connecting medium. The coherer then should be attached to the highest point of the wire, *a'*. The terminal of the vertical wire or antenna forming contact with the earth is, according to Dr. Slaby's theory, the nodal point of the electric waves. At this point a second wire, 2, having inductance and capacity equal to the wire, 1, is connected in, with the opposite terminal attached to the coherer, 3, thus the amplitude of the wave is again the greatest, and the maximum effect obtained without attaching the coherer to the upper terminal of the vertical wire. The transmitter is arranged similarly in its relation to the antenna. An adjustable condenser, 2, and inductance coil, 3, permit the periodicity of oscillation to be changed to a

FIG. 9.

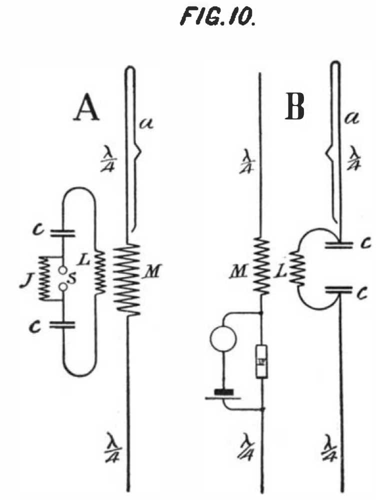


value suitable for the receiver. The coil, 4, serves to regulate the harmonies between the vertical wire emitting them and the oscillator system producing them. One terminal of the oscillator system, 5, leads to earth, which forms, virtually, a loop or closed circuit as in the Lodge syntonic jar. This system was exhibited by Dr. A. Slaby and Count d'Arco before the German Emperor in 1899 when two messages were sent and received simultaneously from different stations without interfering.

In the Marconi syntonic wireless telegraph system the feeble radiation of the closed circuit has been obviated by a widely different method from that of Slaby. Marconi has worked along the lines laid down by Lodge, producing the emitter shown in Fig. 9, *A*. It consists essentially of two concentric copper cylinders, one within the other, but separated by an insulating film of air. The inner cylinder, 1, is connected with the earth and one terminal of the spark-gap, 3. The outer cylinder, 2, is connected to the opposite terminal of the spark-gap, the whole representing a huge Leyden jar, the current surging to and fro, equalizing the difference of potential. The receiver is shown at *B*, Fig. 9. The system is arranged like that of the transmitter. One of the greatest improvements in commercial apparatus is that of the transformer coil shown, 1, 2. The coherer, instead of being placed in the electric wave system direct, is arranged in a separate circuit. The free periods of the oscillations set up are not affected by the high resistance of the coherer, and the oscillations may be stepped up or stepped down, as in the case with commercial alternating current transformers. This arrangement was tested between Biot and Calvi, near Nice, by Marconi, who has since fully described the equipment in a paper before the Society of Arts.

Another syntonic wireless system is that of Dr. F. Braun and has been described in the Scientific American Supplement. Fig. 10, *A* and *B*, shows the arrangement of the transmitter and the receiver. *J* is the secondary of the induction coil, *S* the spark-gap, *c*, *c* condensers, and *L* the inductance primary, the whole forming a closed circuit, the oscillations being very persistent; *M* is the secondary of the transformer, and with the conductors $\frac{\lambda}{4}$ an open oscillator system is produced. This arrangement has all the advantages of the closed and open oscillators combined. The re-

FIG. 10.



ceiver, *B*, consists of the vertical wire, *a*, condensers, *c*, *c*, and the inductance coil, *L*, forming the closed circuit and the secondary, *M*, and conductors, $\frac{\lambda}{4}$ included in one of them is the coherer and receiving apparatus. The conductors marked *a*, *a*, *A* and *B*, are the antenna and all others marked $\frac{\lambda}{4}$ are of equal length, but are coiled up loosely. This system is now in use in Germany and has given satisfaction over distances of 40 miles.

This represents the state of the art wherein the simultaneous transmission of wireless messages in the same field of force without interference is accomplished at the present time. The whole future of wireless telegraphy depends on the great problem of electrical resonance in its relation to the requirements of practice, rather than on the distance over which the waves may be propagated. Wireless telegraphy is a new art with possibilities practically unlimited when a simple, practical and sure method is attained for syntonizing the instruments. The laws of high-frequency, high-potential currents are well understood, as are those of electrical resonance, but the function of the earth being imperfectly understood has blocked the way very materially to the application of these principles.

The evolution of wireless telegraphy has been rapid and in less time than was required to perfect the telephone a system of wireless transmission of intelligence should be in operation fulfilling all the requirements of commercial usage.

THE SNOQUALMIE FALLS POWER PLANT.

BY ENOS BROWN.

The electrical power transmission plant at Snoqualmie Falls, State of Washington, if not the greatest in the amount of power produced in the far West, is in many respects, the most remarkable. The natural advantages at this point for a power plant of this kind are not excelled anywhere, and though the obstacles presented offered but little difficulty, from an engineering point of view, the skill with which every material feature of the undertaking has been subordinated in order to secure intended results, has been so masterly, as to make this famous plant one absolutely unique in the annals of like undertakings. Art has here supplemented natural forces and the result has yet to be surpassed.

Niagara is greater in many respects; less in the attitude of the fall, but presenting no problem of economical administration of the water flow; but at Snoqualmie severe questions of water storage, seasonal variations in the flow, floods and drought, had to be confronted. A combination of almost every feature embraced in transmission of electrical energy is demonstrated in this wonderful plant.

The Snoqualmie River rises in the Cascade Mountains and drains a comparatively small area, but the rainfall, from 90 to 150 inches annually, assures a volume to the stream entirely disproportioned to the extent of the watershed. Moreover, the sources of the river are amid snows, accumulated during the winter months and yielding constant reinforcements during the season of droughts. Floods pouring 10,000 cubic feet of water a second occur every season, the flow diminishing to one-tenth that amount in the month of September; but the regulation of the flow offers no difficulties. Lakes abound in the upper courses of the river with narrow outlets which, if dammed, would hold the superabundant floods and permit an ultimate and regular volume in the stream, and afford, at all times, 200,000 available horse power. At present 30,000 horse power is produced. The greater power may be had whenever the rapidly extending manufacturing interests of the country demand it.

Thirty-one miles from Seattle, the Snoqualmie descends in one leap over a basaltic rock barrier 270 feet high. Less than four years ago the scene at this point was one of wild grandeur, and forest solitude. To-day, a transformation is presented. The banks have been restrained and terraced. The great pines have disappeared. Dwellings and apartments of architectural symmetry decorate the landscape, and a busy community has grown up beside the cataract.

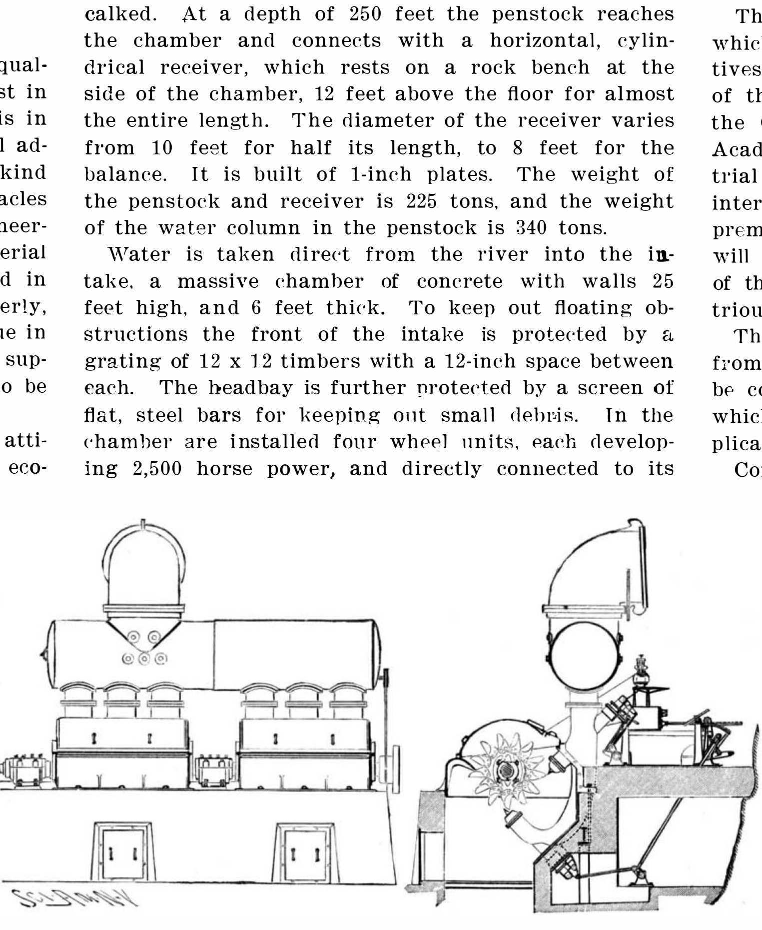
The Snoqualmie Light and Power Company was organized in 1898, and soon after surveys of the river and watershed were undertaken, and plans for their development adopted.

A dam of concrete was constructed just beyond the crest of the falls, for the purpose of raising the low water elevation of the river to a minimum depth of 8 feet. The dam is 218 feet long between piers, and varies in height from 3 to 10 feet, with a level crest 8 feet wide, sloping up and down stream, with base varying from 16 to 35 feet in breadth. The dam is strengthened by steel rails fastened into the rock bottom and projecting upward into the concrete. It is calculated, if the demand for power required it, that the present dam could be increased to a height of 50 feet, and a lake formed 15 miles in length and of an average depth of 25 feet, increasing the available power to 200,000.

About 100 feet above the dam, a shaft is sunk, 10 x 27 feet in dimensions, descending 270 feet to the level of the river below the falls. A tunnel, 12 feet wide, and 24 feet high, is driven from the face of the ledge below the falls, to intersect the shaft. The tunnel is 650 feet long with a fall of 2 feet in that distance. At the foot of the shaft, and extending over the tunnel, is a chamber 200 feet in length, 40 feet wide, and 30 feet high, excavated in the solid rock. This chamber is unique in power transmission plants, housing, as it does, water-wheels and electric generators, 270 feet underground. The tunnel underneath forms the tailrace. The floor of the chamber is of concrete, the walls are of rock, and are whitewashed. Hundreds of incandescent lamps illuminate this great artificially constructed cave. As more water-wheels and generators are required, this chamber will be continued to an additional length of 200 feet.

The main shaft has three compartments; an elevator in the center, with a chamber for the great cables, and a penstock on each side. The steel bulkhead composing the central shaft extends from the surface to the chamber below, and is built of steel plates strengthened by horizontal bars on the outside. The penstock is a steel pipe 7½ feet in diameter, passing through a concrete roof, which keeps the shaft watertight. The plates are in eight-foot courses, 1 inch in thickness at the lower half, and decreasing to ⅞ and ½ inch. The joints are heavily riveted and calked. At a depth of 250 feet the penstock reaches the chamber and connects with a horizontal, cylindrical receiver, which rests on a rock bench at the side of the chamber, 12 feet above the floor for almost the entire length. The diameter of the receiver varies from 10 feet for half its length, to 8 feet for the balance. It is built of 1-inch plates. The weight of the penstock and receiver is 225 tons, and the weight of the water column in the penstock is 340 tons.

Water is taken direct from the river into the intake, a massive chamber of concrete with walls 25 feet high, and 6 feet thick. To keep out floating obstructions the front of the intake is protected by a grating of 12 x 12 timbers with a 12-inch space between each. The headbay is further protected by a screen of flat, steel bars for keeping out small debris. In the chamber are installed four wheel units, each developing 2,500 horse power, and directly connected to its generator. The vessels are of the tangential type. The receiver has four supply openings controlled by individual double-screen gate valves, of 48 inches inside diameter, weighing 23,000 pounds each. This receiver is horizontal, and the openings are on its side, and open toward the cavity. Bolted direct to the gate valve is an elbow casting that directs the water downward into the distributing receiver. This elbow is 48 inches inside diameter, and is bolted directly to the flanged opening of the distributing receiver. The water flowing into the receiver is discharged from the six openings along the bottom, into the six multiple nozzles that direct and regulate the water that is applied to the wheels. The six wheels are divided into two groups of three, each being in a separate housing, with a bearing between. Regulating lips are used on the nozzles, which throw a perfect and unbroken stream and are controlled by a governor. The wheels are 45 inches in diameter, with thirteen buckets each. The weight of each unit is about 100,000 pounds, exclusive of the weight of water in the receiver house. The foundations were required to be of a massive and substantial character. The tailrace is beneath the foundations, so that the water drops into it from the wheels and flows out into the river below the falls.



FRONT VIEW AND CROSS-SECTION OF RECEIVER AND WATER WHEELS OF THE SNOQUALMIE POWER PLANT.

The generators are of the revolving armature type and deliver a 3-phase current; each weighs 100,000 pounds and stands 14 feet high. The armature winding consists of 266 bars with one bar to each slot and is closed-circuit winding. The speed is 300 revolutions per minute.

There are provided two separate 125-volt exciters, each of 75 kilowatts, driver a 100 horse power wheel mounted on steel h

From the feed panels of witchboard 24 aluminium cables are provided f lucting the 1,000-volt current up the elevator sha ie transformer. The transformer house is firepi d is 40 x 60 feet in dimensions.

The character of the traversed by the transmission line is, gene speaking, mountainous, though in places, flat lling. Daily inspection is made of the line's condition. The right of way is cleared for a distance of 300 feet on each side of the line. The transmission lines are of aluminium. The conductivity of this metal is 60 per cent that of copper, and consequently the cables are 66 per cent greater in cross section than copper cables of the same capacity. Even at the increased size the saving in weight by the use of aluminium is nearly 50 per cent. The cost also is less.

The terminal station at Seattle is located in the business district and is a building of large dimensions and of considerable architectural pretension.

The street railroads of Seattle, many manufactories, beside public and private lighting, are supplied by the Snoqualmie Company. Tacoma, a city of 40,000 inhabitants, which is supplied from the falls, is also provided with a large and fully equipped substation.

The next move will be to connect with the city of Everett with its population of 10,000 and extensive lumbering establishments. This work is now in hand.

More News of the Galileo Ferraris Award.

The commission for the Galileo Ferraris award, which was instituted in 1898, composed of representatives of the Executive Committee of the Association of the General Italian Exposition, in Turin, 1898, of the Chamber of Commerce and Arts, of the Royal Academy of Sciences and of the Royal Italian Industrial Museum of Turin, has decided to reopen an international competition for the conferring of this premium on the occasion of the inauguration, which will take place in the second half of September next, of the monument to be erected in Turin to this illustrious scientist.

The premium consists of 15,000 lire and interest from 1899 up to the date of the assignment, and will be conferred upon the author of any invention from which results a notable progress in the industrial applications of electricity.

Competitors can present papers, projects and drawings, as well as machines, apparatus or constructions relating to their inventions.

The jury nominated by the association above named will have most ample powers to execute practical experiments with the inventions presented.

Competitors must present their requests and deliver their works, machines, apparatus or anything else connected with their inventions, not later than the 18th day of September, 1902, at the office of the secretary of the association, which office is located at the administrative committee headquarters of the First International Exposition of Modern Decorative Art, 1902, in the palace of the Chamber of Commerce and Arts of Turin, via Ospedale, No. 28.

The "Cedric" Launched.

The new steamship "Cedric," built by Messrs. Harland & Wolff for the White Star Line, was launched at Belfast on August 21. She is a vessel of 21,000 tons gross. Her length is 700 feet and she is 75 feet beam.

Tunnel Signals for the New York Central Railroad.

The New York Central Railroad has tested the experimental installment of the Miller visible engine signal and direct-circuit on all its trains running through the Park Avenue tunnel. The test is said to have been very successful, the engine signals working perfectly and duplicating the block signals. There are two sets of signals in the cab of the engine, one in the front and the other in the rear, to be used when the engine moves back. When the track is clear a white light is displayed, but as soon as danger threatens, the red light in the lower bulb glows red, no matter what the indications of a block-signal may be.

The Current Supplement.

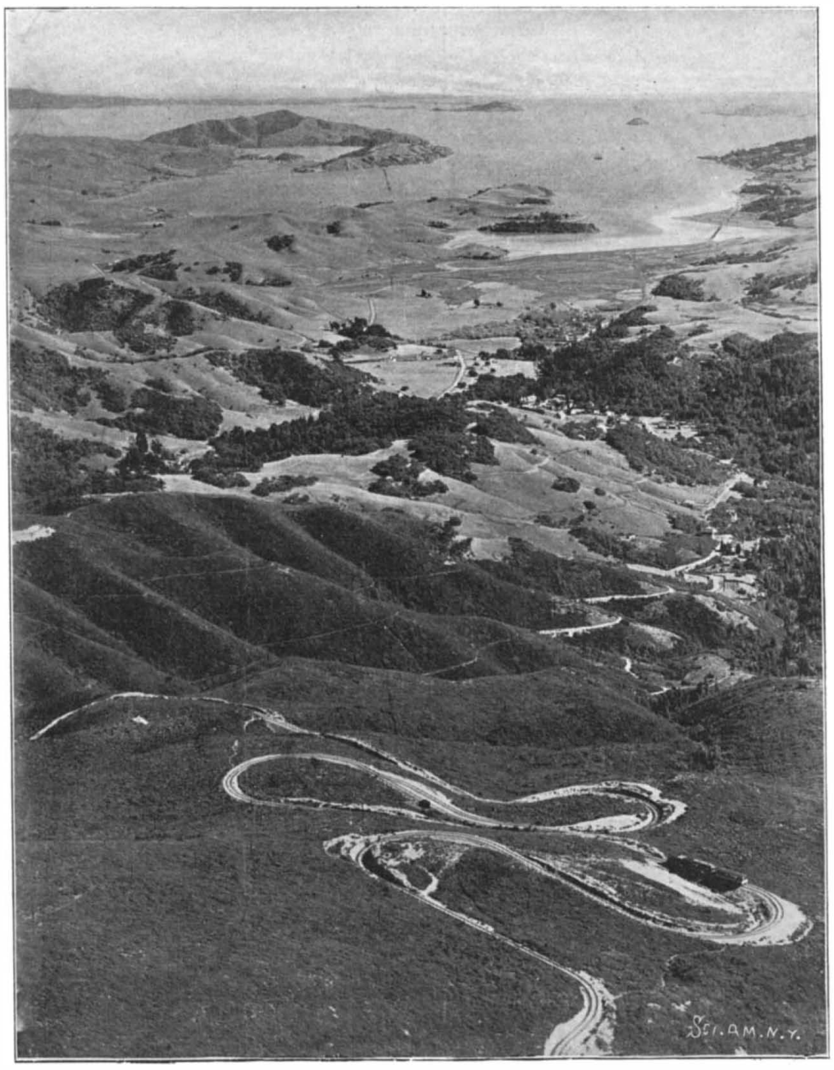
The current SUPPLEMENT is replete with articles that cover almost every field of science. The naval architect will read with interest the description of the building of the battleship "Nebraska," and Mr. Fred T. Jane's shrewd criticism of the "Belleisle" experiment and his study of an ideal conning tower. Engineers will doubtless appreciate the discussions of experiments on railway and road bridges and a description of the largest hydro-electric plant in Europe. Of no slight importance is a copiously illustrated account of the Meray-Rozar electrotypographic machine, as well as a report on the international exhibition of alcohol motors. Other articles of interest are Mr. Henry's paper on Chinese drugs and medicinal plants, and an account of physiological effects of diminished air pressure. "Psychological Apparatus" is the title of an interesting essay. Mr. Mason's monograph on the harpoon is concluded. That the Trade Notes and Selected Formulæ also find their place in the current SUPPLEMENT goes without saying.

REMARKABLE ENGINEERING FEATS IN RAILROAD WORK.

BY CHARLES F. HOLDER.

The modern plan of reaching high mountains, typified by the Rigi, the road up Vesuvius, the Mauch Chunk, Pike's Peak and Mt. Lowe roads, has been put into operation with much success at Mt. Tamalpais, north of San Francisco. This mountain forms one of the sentinels of the Golden Gate, rising directly out of a thickly-wooded country which one hundred years ago boasted some of the finest and largest redwoods in the entire range. Mt. Tamalpais has long been famous as the only lofty mountain in the immediate vicinity of San Francisco. Reached by a hard trail, but fully repaying the climb, the view is grand and impressive; the ocean stretching away on one side, the Golden Gate at its feet, and to the west the summits of tall mountains piercing the sky.

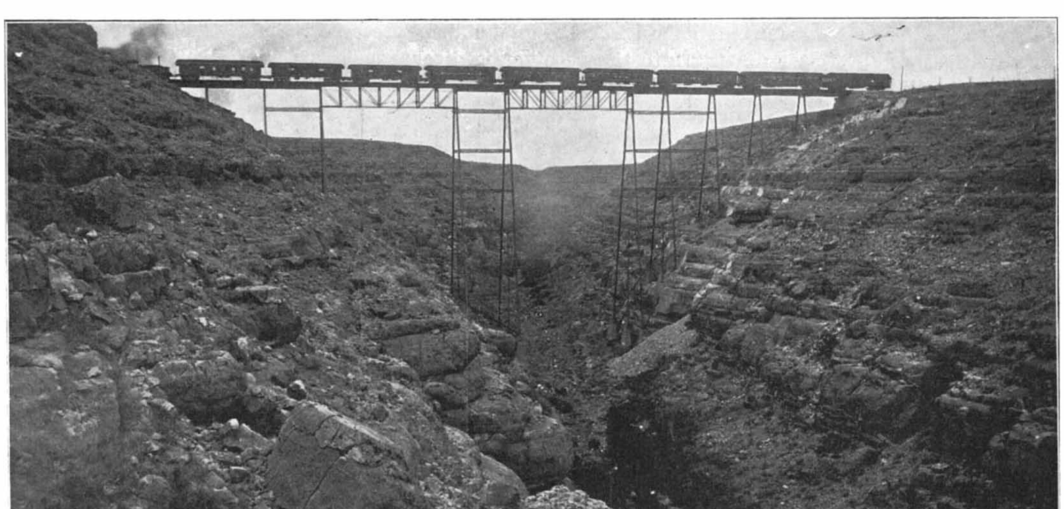
The approach to the mountain is from the bay, in the vicinity of which are many attractive places, as Sausolito, San Rafael and the little bays which have become noted for the houseboat fleet of San Francisco. The foothills of the range are extremely steep and cut by many cañons —a peculiarity of Californa mountains, each hog-back, or divide, having numerous lateral cañons, all of which are deep but well wooded. No little ingenuity was necessary in solving the engineering problem to make a possible ascent, but in the accompanying illustration it will be seen that the work was accomplished by a remarkable series of long reaches and gradual ascents up the sides of the largest cañons, and finally by a succession of loops known popularly as the bow-knot. Coming up out of the cañon which it has crossed, at the head, the road sweeps to the west, turns to the east, making another end to the bow, then quickly turns backward and downward to rise and complete a second bow, during which it proceeds on a regular grade to the summit, from which the traveler looks directly down upon the winding and circuitous track which has solved an exceedingly difficult problem in mountain climbing.



VIEW LOOKING DOWN THE MOUNT TAMALPAIS RAILROAD, SAN FRANCISCO.

Among the interesting, indeed striking, engineering feats of the West, is the bridge of the Atlantic and Pacific Railroad crossing Canon Diablo, which has long been noted in the engineering world. The photograph here given shows the train in the act of spanning the bridge, completely filling it, and from the middle car the view down into this remarkable gorge is awe-inspiring, the cañon being a miniature Grand Cañon. The bridge is carried on ten piers.

The Cañon itself is extremely interesting, appearing on a vast mesa without apparent cause, worn out by the rushing water of ages, the remarkable strata telling that at one time the ocean swept over the locality. Not far from the Cañon Diablo one of the largest meteors known fell some time in the past, and among the natives there is a legend that it struck the earth at the head of the cañon and ploughed out the vast fissure as it is seen to-day. Unfortunately scientific investigation does not bear out the fact, and the meteor story merely stands as a picturesque feature to be repeated to the visiting tenderfoot. Hundreds of specimens, or fragments of this gigantic meteor, have been picked up from time to time.



CANON DIABLO VIADUCT ON THE ATLANTIC AND PACIFIC RAILROAD.

Another interesting bridge is that which crosses the Rio Grande in Texas, constructed by the engineers of the Southern Pacific Company, being remarkable for its expanse and height, and adding to the attractions of the road. Not far from the Rio Grande the writer observed from the train a valley which might well have been named the father of dust spouts. The valley appeared to be about three miles in width, rising gently to the north for several miles and entailing a heavy grade, so that the train was some time in passing. At least ten lofty dust spouts were seen—majestic pillars as large as water spouts sailing down the valley from the north, finally being dissipated or destroyed by some counter current, others continually forming at the upper end of the valley. The latter was arid and sandy—a picture of heat and desolation—and the "spouts" were due to some peculiarity of its formation.

The Greatest of All Oil Wells.

The recent oil strike in Texas has aroused so much interest throughout the country, that a brief description of the greatest oil well will not be out of place. The well in question was opened last year in the Bibi-Eibat fields in Russia. According to the United States consul at Batum, this well, during the first two or three days after it was struck, surpassed all records. As many as 180,000 barrels of oil have been taken from it during a day. It continued flowing until it produced over 2,000,000 barrels, when it stopped. Another big well was struck in the Romani district, which produced nearly 1,000,000 barrels in December and was still flowing about 25,000 barrels a day up to January 31, the date of the consul's latest information. Such a strike in the United States would mean millions to the fortunate owner of the well. But it seems it is not so in Russia. On this point the consul says:

"I think it is sufficientl interesting to mention that it is generally believed that the owners of the big well which produced more than 2,000,000 barrels in a little more than thirty days lost money by it. Without explanation, this seems impossible. The fact is that the well is on government territory, leased at a fixed royalty of 5 kopeks (2.5 cents) per pood (36.112 pounds), and the owners of the well realized very little above that figure for their production. Furthermore, they were compelled to pay heavy damages to neighboring property owners and to owners of property in the village, more than a mile away, as part of the time the well was flowing there was a high wind blowing, which carried the oil over the village, and, it is said, the owners of the well must pay for repainting about all the houses in the village. One-fourth to one-half a kopeck per pood does not go far toward damages of this sort. I must add that this was not the first time the village mentioned was damaged by a flowing well, as some years ago a well was struck in the Bibi-Eibat field which acted in the same manner, the wind carrying a spray of oil to the outskirts of Baku, about two and a half miles, and deluging the village which lies between Bibi-Eibat and Baku. The newspapers stated at the time that the owner of the well had to pay damages amounting to $50,000, as he had to pay for repainting the entire village, including a fine Russian church."

As the big wells recently struck in Texas have attracted so much attention, the consul gives particulars as to the depth and finishings of the great Russian gushers. The Bibi-Eibat well is 1,813 feet deep, and is finished with a 14-inch pipe. The Romani well is 1,841 feet deep, and is finished with a 11¼-inch pipe. The following comparison made by the consul of the cost of production in the Russian oil fields, as compared with the cost in the United States, is also interesting:

"The increased depth of drilling not only increases the first cost of the wells, but adds steadily and materially to the cost of raising the oil by pumping, because pumping at Baku is not done as in the United States—by means of rods and working barrel—but the oil is baled out with what is known in the United States as the bailer; but at Baku this instrument is, of course, much larger than is commonly used in the United States, as its diameter is as large as will run easily inside the pipe in the well, while its length is generally between thirty and forty feet. Of course, the deeper the well the longer, and, consequently, the fewer the runs of the bailer. Then, cleaning out, deepening, and repairing wells is a big expense. The wells are generally long lived, but require as much more expense to keep them in order than American wells, as they cost more originally. They cannot be pumped as steadily, and, consequently, there are fewer pumping days in the year."

The consul says that while the experiment of raising oil by means of compressed air is still an experiment, some of the foreign companies are equipping their wells in part with air compressors, which, he understands, are manufactured in the United States.

A Swedish invention which ought to have a good future is a system of oiling piston rods, cylinders, slide rods, and slide guides on locomotives, which has been invented by T. F. Malmros, of Gothenburg, locomotive engineer on the State railroads. Formerly cylinders and slide guides have, at best, received necessary lubrication from the central steam-lubricating apparatus, but piston rods and slide rods with packings have been lubricated by means of old-fashioned oil cups, with wick feed, which method, for many reasons, has proved unsatisfactory—especially when metal packings are used. Mr. Malmros, by introducing intermixed oil and steam, coming from the central steam-lubricating apparatus, through gland bushings expressly constructed for this purpose, has effected a good and economical lubrication of packings and rods, as well as of the cylinders and slide guides. The system has for five years been tested on one of the express engines of the State railroads—used for the fastest train in Sweden, with a speed considerably exceeding 37 miles per hour—and with good results. The State railroads have applied the new lubricating system to a number of the old and new locomotives

THE UNITED STATES NAVAL OBSERVATORY AT WASHINGTON.

BY FREDERICK MOORE.

The United States Naval Observatory is the youngest among the great astronomical institutions of the nation, but it has developed in a remarkably brief time into one fit to rank with Greenwich and Poulkowa. We hear less of it, however, than we do of many of the private institutions in this country, for its object is not the further discovery of the unknown, but the development and application of the known. Of course, the former is the more brilliant object, but it would undoubtedly incur an expense to the government greater than the value of the discoveries. When a discovery is made, if it is of any importance, it has to be followed up and elaborated upon before it can be made useful to mankind. Here comes the hard work which the world does not see and here the great majority of astronomers fail.

Unfortunately the class who can see and feel the consequence of the astronomer's labor is extremely small, and it is but little realized that a second of error in a ship's chronometer at the equator means a variation of 16 2-3 miles east or west of the mariner's calculation of his position.

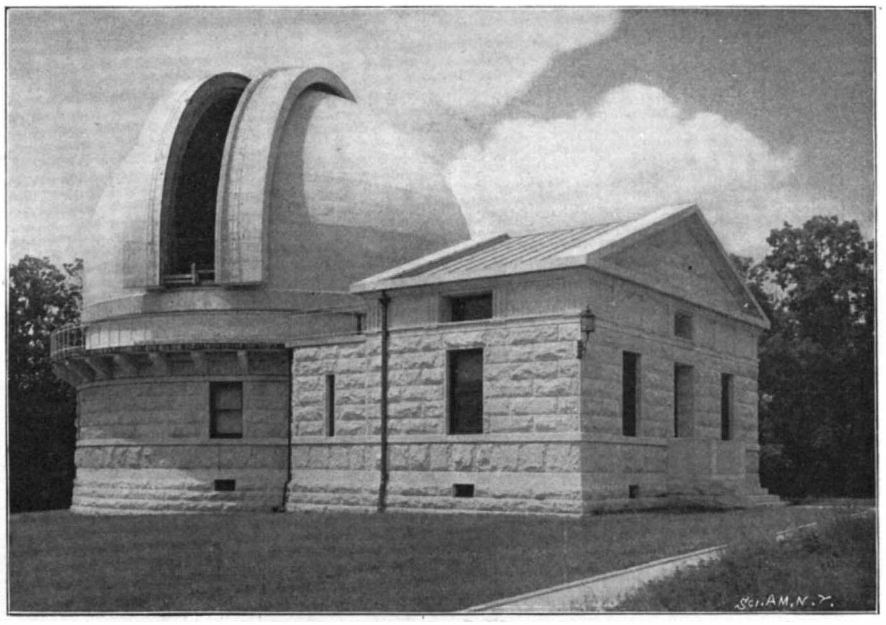
Recently great changes have occurred in the scientific staff of the institution by the retirement of the older professors, notably Doctors Newcomb and Hall, and the succession to their responsibilities of a younger staff, comprising Profs. Skinner, See, Updegraff, Eichelberger, Littell, and Prof. Harshman, Director of the Nautical Almanac.

It is remarkable that although in scientific achievement this country has led the way since its incipiency, it eked out the first sixty years of its existence, and attained some mighty marine achievements, practically without so indispensable an institution as a naval observatory. We depended on Greenwich, Poulkowa and Paris, and on college observatories here almost entirely until 1842.

Few visitors to Washington in the early days of the past century did not have pointed out to them from the north door of the Senate wing of the Capitol the site of the old "Washington property." The house named in our first President's will stood near the old Capitol until both were burned in 1814 by the British vandal, Cockburn. Close on this well-remembered site, stood, in 1833, an unpretending wooden structure 16 feet square, erected at the expense of a lieutenant in the navy, and equipped with a 5-foot Troughton Transit. This was our Naval Observatory in embryo. The transit was one of the instruments made for the Coast Survey under the direction and supervision of Mr. Hassler, its first superintendent, during his long detention in England throughout the war of 1812. Under an act in 1807 the institution was established, but the appointment of the superintendent did not take effect until 1811. While on a visit to London to secure instruments, then so slowly constructed, he was detained. The survey was arrested by Congress soon after his return and the instruments he had procured and the "fixed observatory" remained in statu quo. In 1832 the Coast Survey was revived, but an observatory was peremptorily forbidden by law. The transit was loaned, then, to Lieut. Wilkes for his "observatory."

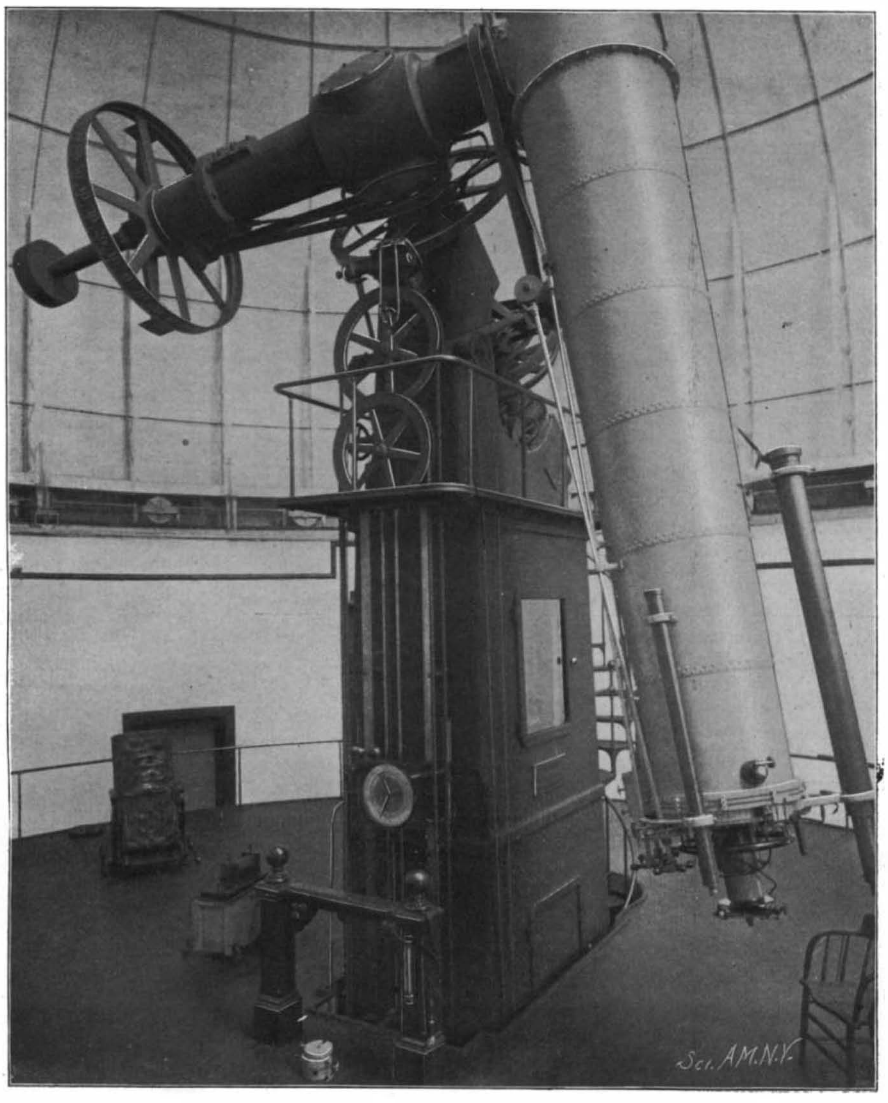
Lieut. Wilkes' observations were made only for obtaining clock errors needed for the determining of true time and the rating of naval chronometers then under his charge. The testing of all chronometers and other naval instruments used by our ships was at once found wise and useful, and the secretary of the navy took it upon himself to establish this little observatory under the name of "A Depot for Charts and Instruments," by placing an officer in charge and permitting him to have his own little observatory and do his own work. "The depot" was all Wilkes or any of his successors dared to call it until 1842, when the present institution was established.

In 1838 a new call was made upon the depot which changed the whole current of its future. An exploring expedition was about to sail for the south seas. It would be of prime importance, in determining the longitude of places visited by the expedition, that corresponding observations be taken at home to compare with those of the party, on its return. Secretary Paulding gave the observations to Lieut. Gilliss, Wilkes' successor, and Prof. Bond of Cambridge. An achromatic telescope was added to his equipment by the Navy Department and for four years Lieut. Gilliss worked diligently and accurately, bringing forth the plaudits of the

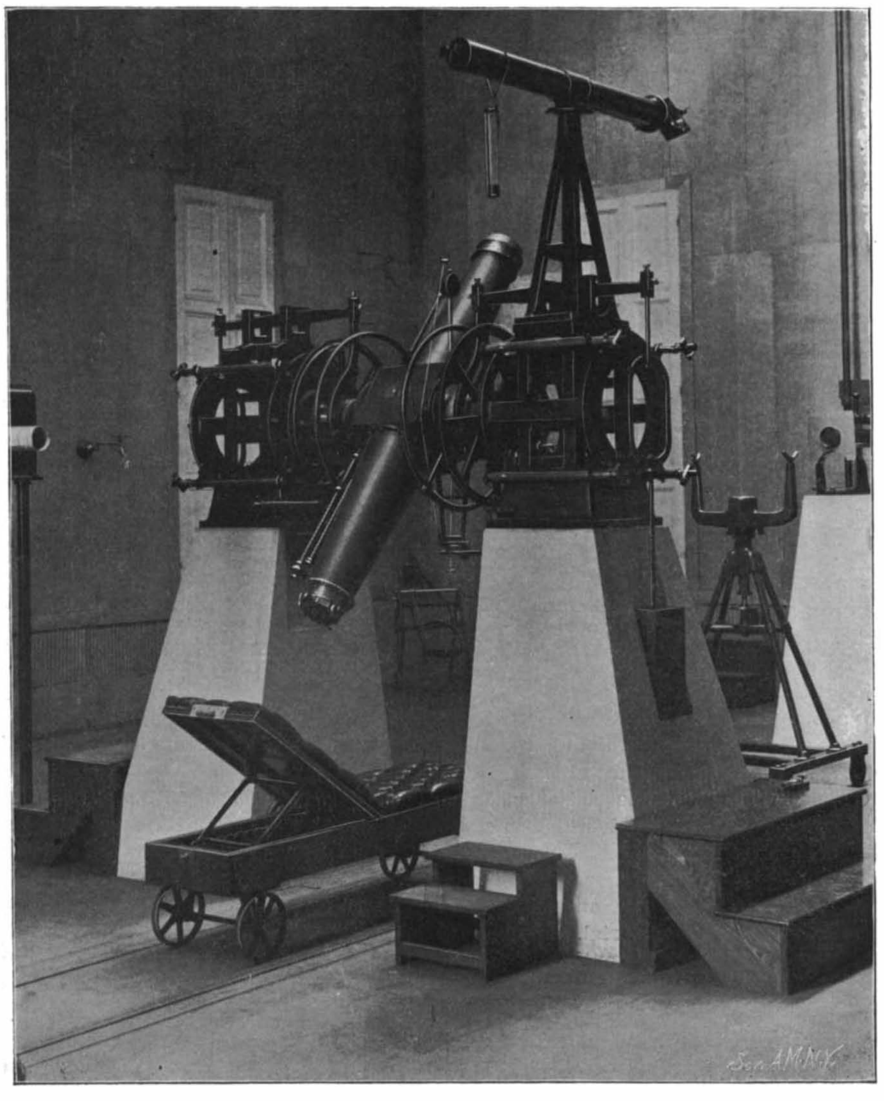


WHERE THE GREAT EQUATORIAL IS HOUSED.

SCIENTIFIC LIBRARY OF THE NAVAL ACADEMY.



PART OF THE GREAT EQUATORIAL.



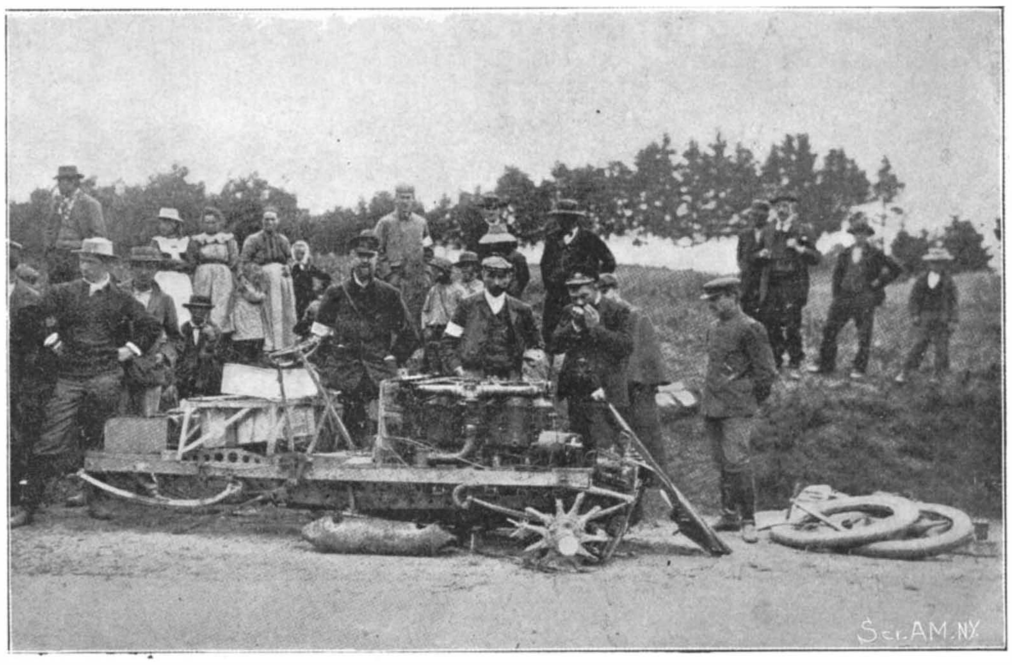
ONE OF THE SMALLER TRANSITS.

European astronomers. He continued with his insignificant equipment until finally an appropriation of $25,000 was secured—still for a depot of charts and instruments. The observatory had been urged time and again, but for partisan reasons it was as often forbidden.

The site chosen by President Tyler was fraught with historic interest. It embraced the whole of reservation No. 4, made by the old commissioners of Washington for a national university—a favorite idea of George Washington. It was the landing place of Braddock, and at a later day was known as Camp Hill, from its being occupied by the American forces the day before their advance upon the retreat from Bladensburg. The square embraced a little over 19 acres and commanded a splendid view of Washington, Alexandria, Georgetown and Arlington.

Berlin, Paris, Greenwich and Vienna presented some 200 rare volumes of the highest standard as a nucleus for an astronomical library. This branch has grown from that to one numbering 22,000 volumes and pamphlets, and stands to-day second to Poulkawa only.

The institution grew rapidly, and in 1874 installed the largest telescope then in existence, the famous 26-inch equatorial. It was set in place just in time to observe the transit of Venus, which occurs but once in a lifetime and offers a valuable method of determining the sun's parallax (the base time measurement of celestial distances). The transit is the astronomers' great event of the century and it befell Prof. Newcomb to be in charge of the greatest telescope.



THE WRECK OF JENATZY'S CAR.

The site was soon discovered to be a bad location, because, being almost in the heart of the city there was constantly some vibration, but it was not until 1884 that appropriation and other necessary bills could be gotten through Congress for the purchase of enough ground on Georgetown Heights to properly isolate the institution.

In 1893 the new home was ready for occupancy.

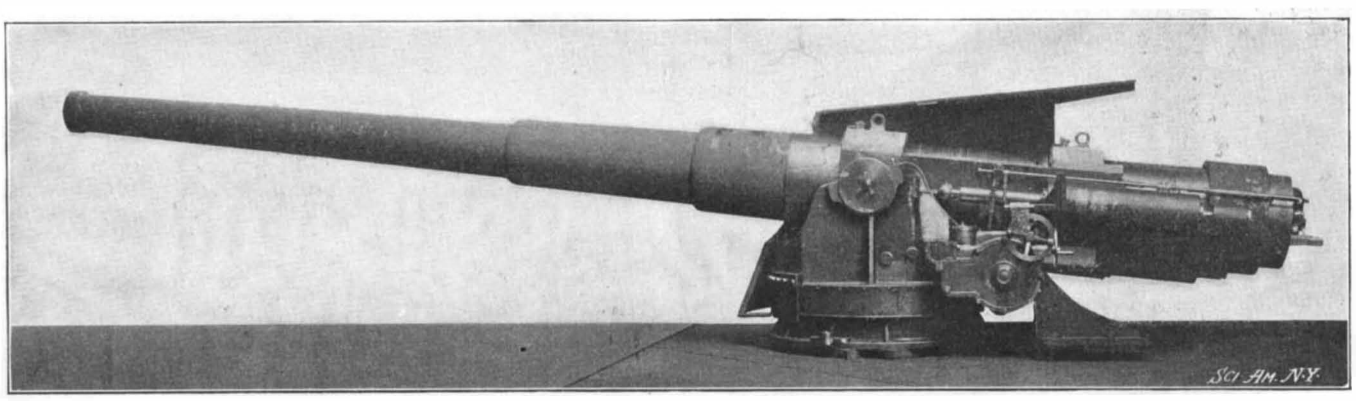
The dome that houses the great equatorial is a wonderful piece of mechanism. It is so perfectly balanced that its great weight of six tons can be swung or raised and lowered like a see-saw by one man without much effort. The dome rolls around on a circular wall so as to present an opening toward any part of the heavens. The whole floor rises and falls by hydraulic power to suit the convenience of the observer.

The great equatorial is in the hands of Prof. T. J. J. See, who is now at work measuring by daylight as well as by night the diameters of the principal planets and their satellites. The comparison of the daylight with the night work enables the observer to eliminate the effects of irradiation, which heretofore has been studied very little by astronomers. The light planet against the light sky of day has no irradiation as it has at night. He is also, by an elaborate series of observations in summer and in winter, making a special study of the screw of a new micrometer, designed to eliminate the effects of changes of temperature upon the scale. The degree of accuracy obtainable in this work is about one part in twenty thousand. This will give the micrometer investigation the necessary degree of refinement for the measurement of the stellar parallax, upon which he is at work also, and which is the most delicate work ever undertaken by a practical astronomer.

Beside the 26-inch equatorial, the observatory is equipped with a 9-inch transit circle, a 6-inch transit circle, a 12-inch equatorial, a prime vertical transit instrument, a 6-inch azimuth and a 40-foot photoheliograph. With this last, photographs are taken of the sun daily whenever the weather and other circumstances will permit. During last year one hundred and sixteen photographs were made of the sun. A very delicate plate with a special fine-grained lantern-slide emulsion giving contrast and fine definition has to be used, and the plates specially developed.

The effort to bring the department of meridian observations for time to a state of the highest efficiency and up to the most modern standard of requirement has included not only a recent thorough overhauling of both meridian instruments, but also an examination and improvement in the clock system. In this connection a vault was dug in the basement of the clock house, 8 feet square and 7 high. The construction of the vault is intended to be such that it will keep the temperature very nearly constant throughout the year. A 9-inch brick wall incloses the wooden house of the dimensions stated, with an air space of one foot between, which contains hot-water pipes for heating. The whole is roofed over with boards inclosing a 6-inch layer of asbestos wool. The vault contains three brick piers for clocks and one smaller pier which may be used in mounting a pendulum apparatus for testing the minor irregularities of clock rates. Triple doors are provided and means for slow ventilation. The location is on the summit of a hill, and drainage conditions are such that the basement in which the vault is situated is remarkably dry. There is little fear of damage from rust. In the early days of the observatory, in a similar experiment the clock built by Kessels, a most delicate instrument, and the most valuable of its kind in the country, was almost ruined.

An observation for time is taken about every other day. There are three standard clocks always in use and two to which the Western Union wires are attached for transmitting the noon signals. Every day, except Sundays, these signals go out. An average error of 0.13 seconds is recorded for the past year. The Kessels clock will not stand being attached to the wires, and with the others it gives the time about as accurately as it can be given. The chronometer room is maintained at an even temperature and is treated almost as delicately as is the room for the great clocks.



SCHNEIDER-CANET 9.45-INCH GUN ON NAVAL MOUNT.

Weight of Gun, 20.5 tons. Weight of Projectile, 330 pounds. Initial Velocity, 2,780 feet. Muzzle Energy, 17,748 tons. Theoretical Perforation of Iron at Muzzle. 32.8 inches per second.

A NEW SCHNEIDER-CANET NAVAL GUN.

Our illustration shows a new 9.45-inch gun for naval or coast defence purposes, which has recently been brought out by the well-known French firm of Schneider & Co. The weight of the gun itself with breech mechanism is 20½ tons, while that of the carriage without the shield is 13¼ tons. The projectile used weighs 330 pounds and its initial velocity is 2,780 feet per second.

The diameter of the gun at the breech end is 36.22 inches. The breech is closed by a plastic obturator, or metallic plug, that can be locked in place or withdrawn by three and a half turns of the operating handle. Electric or percussion firing is employed as desired, with single control on the left of the gun-carriage. This mechanism is easily accessible for the gunner, who is suitably protected against premature discharges.

The gun-carriage is of forged steel and carries two diametrically opposite recoil cylinders, as well as a compressed-air recuperator, which is independent of them and is placed on the lower side. The recoil cylinders are suitably arranged for putting the gun out of or in battery by means of a pump. This enables the gunner to continue firing in case of damage to the recuperator, whatever may be the angle of elevation.

Vertical aiming is facilitated by the interposition of live roller rings between the trunnions of the carriage and the trunnion bedplate of the frame. The elevating hand-wheel, which is placed conveniently for the gunner, drives a toothed sector fastened to the carriage, by means of an endless screw and special helicoidal wheel furnished with friction packing washers to avoid shocks when firing. Horizontal aiming is accomplished by the traversing of the whole carriage, which turns on a ball-bearing traverse base ring. It is traversed by a hand wheel turned by the gunner. This wheel is connected with a pinion that meshes with a circular rack fastened by means of an irreversible mechanism of great efficiency. This mechanism, while assuring the absolute irreversibility of the system, permits of one man revolving the movable weight of 40¾ tons at a sufficiently rapid rate to follow an object moving at a speed of 34 knots and distant 1,640 feet.

Finally, this new 9.45-inch gun on a naval carriage offers the same facility of manipulation as has heretofore been obtained with rapid-fire guns of smaller bore.

THE ARDENNES CIRCUIT.

With the completion of the *Circuit des Ardennes*, Englishmen have again scored a signal victory. The winner of the race was Mr. Charles Jarrott, who finished some nine minutes ahead of his nearest competitor, in a 70 horse power Panhard.

The race was run on a sort of huge track, measuring 85.4 kilometers to the lap, with no great grades to speak of. There were no controls, no halts of any kind to check the contestants. The race may, therefore, be regarded simply as a test of powerfully engined, high-geared cars under conditions offering the least resistance. For that reason the contest stands in sharp contrast to the hilly Paris-Vienna race.

Eighty-five kilometers in the opinion of many is a rather short lap. Indeed, the many accidents which happened in the circuit amply bear out the criticisms that have been made on this score. Pierre de Crawhaze, toward the end of a third lap, collided with M. Coppee. One wheel of de Crawhaze's car flew off, the other broke from the axle, and the car was dragged along for two hundred yards. No one was hurt. On the second lap one of Jenatzy's front wheels whirled through the air, while the car was traveling at about 65 miles an hour. The vehicle was overturned, and the driver and his assistant crawled out from under the ruins, not seriously injured. De Caters, on a Mors, was lost on the third lap in a cloud of dust raised by Jarrott, jumped on a wall, and impaled his car. On the same lap Roland in a Gobron-Brillie ran off the road and out of the race. Charron collided with a carriage at a speed of 90 kilometers an hour, and reduced his own vehicle and the carriage to splinters and scrap iron.

The race itself offered not a little excitement. It was a nip and tuck struggle between Jarrott and Gabriel. They were never more than 6 minutes apart at any of the turning points. For a long time it was uncertain whether Jarrott or Gabriel would win. At the end of the first lap Gabriel had gained two minutes; at the second he had gained one minute. At the half Jarrott led by less than half a minute. When the fourth lap began Jarrott led by a minute, and at the fifth lap Gabriel was one minute ahead. But when the sixth and last lap came, a chain accident put Gabriel out of the race, and Jarrott shot ahead. Zbrowski and Mr. Vanderbilt, both Americans, finished creditably. The times of the chief contestants for the total distance of 512.41 kilometers are as follows: Jarrott, 5h. 53m. 39s.; Gabriel, 6h. 2m. 45s.; Vanderbilt, 6h. 22m. 11s.; Rigolly, 6h. 52m. 16s.; Zbrowski, 6h. 44m. 40s.; Girardot, 6h. 55m. 55s. After racing 512 kilometers Mr. Jarrott made a run of 100 kilometers to Sedan to get a bed.

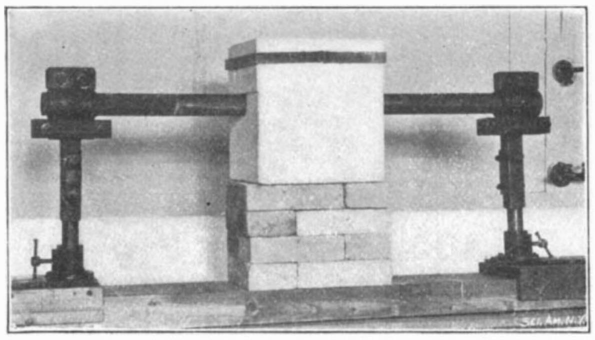
FORMATION OF THE DIAMOND BY THE ELECTRIC FURNACE.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Among the important discoveries made by M. Moissan with the electric furnace, none is more striking than the artificial production of the diamond. While the specimens he obtained were of almost microscopic size, it is none the less true that crystallized carbon has been obtained, and it is the object of the present article to show some of the steps in the process and the results which were finally reached. Before commencing the work M. Moissan made a series of researches upon the different forms of carbon, both those which occur in nature and the different varieties of graphite formed by the electric furnace. From these studies he became convinced that if the diamond could be reproduced, the first crystals obtained would be of microscopic size.

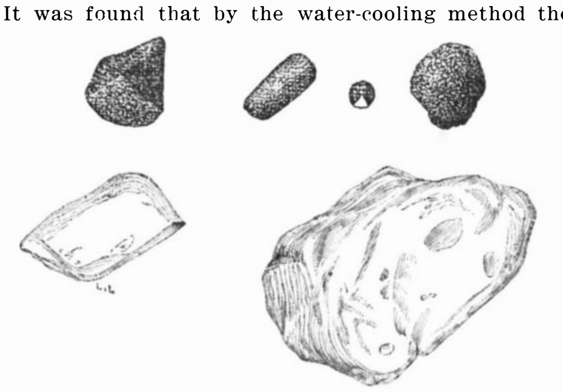
It may be considered that the diamond of nature has been formed in the midst of a liquid or pasty mass, and the natural question is, what solvent has been used for the carbon. M. Moissan found that iron in fusion is the best solvent for carbon, and he was led to search for the crystallization of carbon in melted iron under high pressure. A meteoric iron from the Diablo Cañon, Arizona, shows in the midst of the metallic mass two small transparent diamonds. Here nature seems to have been taken in the act. The iron containing the carbon must have been at first in the liquid state, and owing to a sudden cooling there occurred a violent contraction of the mass, and the carbon passed from a density of 2.0 to that of 3.5, giving the diamond. From these considerations M. Moissan was led to the experiments in which he succeeded in producing microscopic crystals of carbon which gave all the characteristics of the diamond.

To carry this out he utilized the pressure produced by the increase in volume of a mass of iron when passing from the liquid to the solid state. Solid iron, as is well known, has a less density than the melted metal; pig iron, for instance, floats on a bath of melted iron. Like water, iron increases in volume at the moment of solidifying. The iron is now to be saturated with carbon at a high temperature and then suddenly cooled at the surface. The interior, while still liquid, is thus subjected to a high pressure. The iron must be saturated with carbon at a high temperature, and for this the electric furnace is used; the iron then dissolves a great quantity of carbon which it afterward abandons in the form of graphite or crystallized carbon. The electric furnace is of the type shown in the engravings. A block of chalk or quicklime, having a cover of the same material, contains a central cavity for the carbon crucible. The carbons are moved back and forth on their sliding supports and the arc is formed just over the crucible. In the first experiment 15 ounces of soft Swedish iron were placed in the crucible and covered with sugar-charcoal. The crucible is then heated under the arc with a current of 350 amperes at 600 volts; the cover of the furnace is removed and the crucible taken out and plunged into cold water. When cold, the metallic mass is attacked by hydrochloric acid to dissolve all the iron, and there remain three kinds of carbon; graphite, a brown-colored carbon (such as was observed in the Diablo Cañon specimen) and lastly a very small quantity of a denser carbon. All the carbon except the latter was dissolved out by a series of reactions, and the portions of very high density were separated by placing in bromoform. This liquid has a density as high as 2.9, and only the heavy particles fell to the bottom, consisting of black and transparent diamonds. By using a still denser liquid, the iodide of methylene, which has a density of 3.4, the black diamonds were made to float, and only the transparent crystals fell to the bottom. The former were first examined; under the microscope they have a gray-black appearance and their density is above 3. Some of them have well-defined angles and approach the cubical form. They will easily scratch the polished surface of a ruby. It only remained to burn them in oxygen, and this was done by placing them on a support inside a platinum tube through which a current of oxygen was passed; the tube was heated to 1,20‸ deg. C. by a blowpipe flame. The black diamonds were found to burn easily in oxygen, giving carbonic acid gas and leaving a trace of residue. The transparent fragments were, of course, the most interesting. They had the characteristic brilliant appearance and oily luster of the unpolished diamond. Their surface showed a number of parallel striæ. Some of them were round and others appeared as broken fragments; others, again, were cubical or of irregular form. The density of all these specimens was about 3.5 (seeing that they sank in the iodide of methylene). They scratched the ruby very deeply and could be burned in oxygen with scarcely a trace of ash. The yield of crystallized carbon is very small by this method, and a long series of reactions must be made in order to obtain a minute quantity of the crystals. A second method was employed, using a small cylinder of soft iron which is bored out and closed by a screw stopper. The cavity formed is nearly filled with sugar carbon, which is strongly compressed by the screw. A quantity of soft iron is melted in the crucible and the cylinder is quickly plunged in the liquid bath. The crucible is then taken out and plunged into a bucket of water. In the meantime the cylinder has melted and the center of the mass is saturated with carbon. By the sudden cooling, a layer of solid iron is formed on the surface of the mass, and when this crust is at low redness the whole is taken out and cooled in the air. On breaking the mass a portion rich in carbon is found at the center in which are minute diamonds, both black and transparent. One of the clear specimens measures nearly 0.02 inch and answers to all the tests for the diamond. Another specimen was very pure and well crystallized.



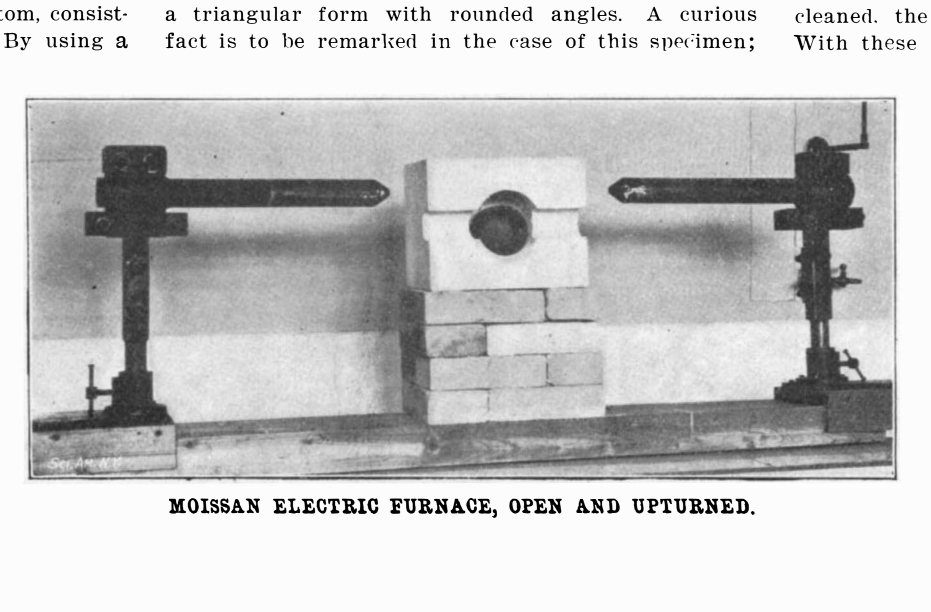
MOISSAN DIAMOND-MAKING FURNACE.

It was found that by the water-cooling method the mass is surrounded by a layer of water vapor, and the cooling takes place rather by radiation across the vapor than by conduction, and is thus not rapid enough. To cool the mass more quickly and give a more sudden compression a bath of melted metal, preferably lead, was employed, and the resulting diamonds were found to be of better quality. In this case the crucible containing the iron, melted and saturated with carbon at 3,000 deg. C., is quickly plunged to the bottom of a bath of melted lead. The mass, which was at first pasty, becomes liquid on cooling and sends to the surface of the lead bath a number of small globules of iron, like shot. These globules contain the diamonds, which are separated as before. The striking point about this method is the brilliancy of the specimens which are obtained. One of the transparent diamonds whose diameter reached 0.02 inch, presented a triangular form with rounded angles. A curious fact is to be remarked in the case of this specimen; after three months it split into several fragments, and a second specimen became almost reduced to powder. This phenomenon is identical with that which occurs with some of the Cape diamonds, and it may be attributed to the unstable equilibrium of the mass which has been formed at a high pressure. Some of the specimens from the latter process are smooth and brilliant, while others have a shagreen surface; widely varying forms are obtained, from those which appear to be an assemblage of crystalline masses to specimens looking like a drop which has been suddenly solidified. The shagreen surface of the latter is identical with that of certain Brazil diamonds.



DIAMONDS MADE BY THE ELECTRIC FURNACE.

An interesting experiment was that of letting the melted iron fall through a hole in the bottom of the electric furnace in the form of globules or shot. One of the carbons is hollow, and through it an iron rod can be slid into the arc (Fig. 2). The melted globules drop into a vessel of mercury placed underneath the furnace. The spheres thus obtained gave black and transparent diamonds; the latter were small, but remarkably regular in form. Some of them were octahedra, measuring less than 1-1000 inch in their greatest length. One of the best methods is that of cooling the mass by direct contact with solid metal. A block of copper has a cylindrical hole bored in it in which fits a stopper of the same metal. The iron saturated with carbon is run into the block and the hole quickly corked; in this way the cooling is very rapid. When cold the copper and the outer iron are turned off in a lathe and the diamonds are found in the interior. This method gave a better yield and the specimens were fine and transparent.



MOISSAN ELECTRIC FURNACE, OPEN AND UPTURNED.

Increased Use of Oil Fuel.

BY E. P. WATSON.

The discovery of new sources for the supply of fuel oil has reawakened the possibility of using it in Atlantic liners and other high speed vessels. The objections hitherto have been uncertainty as to the continuance of the present oil fields, the slight margin of saving in comparison with coal in many localities, and want of success in obtaining good results through inexperience in the management of oil fuel, but these disappear, in great part, with the apparently unlimited production of the Texas and other new oil wells, and new types or systems of burners which are an improvement upon their predecessors. Many of the naval powers are now fitting out war vessels to use oil fuel, and others are experimenting with a view to its adoption later on. The German Admiralty have used oil on their China station for auxiliary purposes for months in lieu of coal. The Hamburg-American Company has four ships using liquid fuel wholly, and the North German Lloyd two, while the Dutch mail and cargo boats in the Far East employ oil solely as fuel. There are over thirty depots, or stations now where oil can be procured regularly by vessels, and more are being laid down as rapidly as possible.

Oil fit for fuel purposes has the following chemical composition: Carbon, 88 per cent; hydrogen, 10.75 per cent; oxygen, 1.25 per cent. The two other impurities present in the mass are water and sulphur. The action of water is obvious, while the sulphur if free, not in chemical combination, attacks both iron and steel, and mechanical means to separate the water, if oil is used on ship-board, are necessary. Recent experiments show that two tons of oil are equivalent to three tons of coal, while by volume 36 cubic feet of oil are equal to sixty seven cubic feet of coal as ordinarily stowed in bunkers. This increases the radius of action of a war vessel 50 per cent upon the bunker weight allotted and nearly 90 per cent upon the bunker space, without any alteration of the ship. It is also urged in favor of oil that it is easily supplied in mid-ocean—from transports—while coal presents great difficulties under the same conditions. In commercial work the gains predicted for oil vs. coal are surprising. In high-speed ships the weight and space occupied by the propelling machinery leave no room of any account for freight. The change from coal to oil would add nearly two thousand tons to the carrying capacity of a given ship, while, as oil fires never have to be cleaned, the speed would be constantly maintained. With these and many other advantages in favor of liquid fuel it is not unreasonable to look for its general adoption in the near future, both on land and sea. Many locomotives are now using it, and others are being built for oil service, both in this country and abroad.

Announcement is made that the United States War Department has arranged with Ehrhardt, of Düsseldorf, to re-arm the United States field artillery with Ehrhardt's new piece. The gun which the United States has acquired the right to use is said to be an improvement on the models supplied to Great Britain, of lighter weight and of longer range.

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

CALF-WEANER. — LEWIS H. SAUNDERS, Colby, Kans. In order to prevent a calf or colt from sucking, the inventor employs a device comprising an inner frame of flat cheek-pieces, and an arched nose-yoke. The cheek-pieces are spread apart at their rear ends. To the inner, arched frame an outer, arched barbed frame is pivoted, to the rear ends of which a jaw-strap is secured which passes around the lower jaw of the animal. Should the calf attempt to suck or push the barbs up or down, the outer frame will force the jaw-strap against the lower jaw and hold the jaw shut.

CORN-HUSKER.—ARTHUR W. RICHARDS, Indianola, Iowa. The invention is a corn-husker which is adapted to operate upon the ears of corn after they have been cut from the stalk. The novel features are to be found in two series of rollers provided with pointed teeth. Both series extend in downwardly inclined parallel planes and are simultaneously rotated. The husks adhering to the corn ears are pierced by the teeth, shredded and stripped.

DERRICK.—ALVIN HODGSON, South Ottumwa, Iowa. Mr. Hodgson has devised a simple derrick which will doubtless be found of considerable usefulness on a farm for lifting and moving heavy weights, such as hay racks, wagon bodies, slaughtered animals, and the like. On a base comprising bottom rails, standards are erected, on which a table is supported. A post has a step bearing in the rails; and a plate secured to the post has a bearing in an opening in the table. The beam is mounted to swing on the post; and the winding-drum is carried by the post. Rope connections are provided between the drum and the end of the beam.

CULTIVATOR.—FRANK G. HOAG, Battle Creek, Mich. The inventor has devised a simple, compact, and strong machine which embodies means for the removal and replacement of a central toothed section; which also allows for the lateral adjustment of the toothed side frames, so as to cultivate both sides of a row of growing corn; and which allows the front portions of the side frames to be raised and to swing free.

Apparatus for Special Purposes.

STORAGE SYSTEM.—J. R. RECTOR, Lipan, Texas. In this invention Mr. Rector provides a house for storing perishable goods in which the goods will be kept cool without the necessity of ice or other analogous means of lowering the temperature, the temperature of the house being kept at a sufficiently low degree by a peculiar arrangement of air-circulating passages.

Engineering Improvements.

MARINE-ENGINE GOVERNOR.—MARTIN F. VOLKMANN, Santa Monica, Cal. Mr. Volkmann has provided a simple mechanism which is intended to prevent dangerous racing should the shaft break, the propeller be loosened, or lifted out of the water by the pitching of the vessel. The principle of the invention consists in speeding the governor upon the rise of the propeller from the water.

ENGINE-STOP.—HENRY JONES, Watertown, N. Y. This new engine-stop is arranged immediately and automatically to stop the engine in case of an accident. The arrangement is such that the engine can be shut down or started without interfering with the stop in any way. The stop comprises a cylinder to which a steam pipe leads. A piston reciprocates in the cylinder. Between the piston and the throttle valve is a flexible connection. The valve in the steam-pipe is opened from a governor when its stem drops.

VALVE-LUBRICATOR.—PETER F. LABAN, Altona-on-the-Elbe, Germany. The lubricating liquid is distributed by the movement or action of the valve to different portions of the valve-seat and between the ports in the chest. The valve is so constructed that it will always occupy an operative relation to the point of liquid-feed, so as to be supplied from the latter, notwithstanding the travel or movement of the valve. The lubricant is distributed through the valve-chest by open or exposed ducts or channels, so that it can be taken up by the steam and carried to all parts that require lubrication.

Mechanical Devices.

VELOCIPEDE DRIVING-GEAR.—FRANCIS A. RICH, Karangahake, Auckland, New Zealand. This changeable speed-gear for bicycles comprises an ordinary friction-clutch free-wheel sprocket, and a sprocket consisting of inner and outer members, normally loose relatively to each other. A driven mechanism can be shifted into operative engagement with the free-wheel sprocket, or with the outer member. A rocking clutch connects or disconnects the inner and outer members. A friction-roller on the rocking clutch is engaged by the guide of a rocking plate for the purpose of shifting the clutch.

PORTABLE REVOLVING THEATER. — CHARLES F. BRAMHALL, Kingman, Kans. In this portable revolving theater, there are embodied a central stationary stage and a circular revoluble auditorium. The audience is slowly carried around the stage so as to obtain a full view of all the proceedings. An improved curtain is provided which can be easily and quickly operated.

WASHING-MACHINE.—LAURA B. PARKER, 2874 Washington Street, Ogden, Utah. The machine is of that type in which a concave bed is employed within an outer casing, upon which the convex "rubber" rocks. The present invention is designed to supply this oscillating rubber with an elastic pressure in a more simple manner than heretofore. To that end a spring attachment of peculiar construction is resorted to, which is capable of being applied to all washing-machines of the type mentioned.

GRIPPER FOR PLATEN PRINTING-PRESSES.—ARTHUR L. ANDERSON, Grundy Center, Iowa. Mr. Anderson has devised a simple gripper which will firmly hold the paper to be printed on where a narrow margin is desired. His device can be so adjusted that its inner edge will be close to the desired outside line of the printing, thereby avoiding the annoyance so often experienced when it is desired to print upon an article so as to leave a very narrow margin. Ordinarily the gripper cannot be placed so as to hold the paper by reason of the gage-pin's coming in contact with the gripper. That difficulty is now obviated.

MEANS FOR AUTOMATICALLY CLOSING SWINGING DOORS.—EDWARD F. HUARD, Springfield, Mo. The invention is a closure for ice-houses or vaults. Its object is to provide a self-closing door which guards the opening through which blocks of ice are introduced to the house or vault, preventing an improper rise in the temperature, and the accumulation of fog in the air-space of the house.

HIGH-BALL ARCHER.—WILLIAM H. PEASE, Joliet, Ill. Mr. Pease has invented a simple and ingenious device for throwing a projectile by the power of a rubber-band or the like. The invention comprises a body and an elastic structure which can be releasably held. The operating devices for actuating the structure comprise a trigger-arm, a connection between the trigger-arm and the holding means, a trigger working with the trigger-arm, and a spring actuating the parts normally to release the holding means.

LIFTING-GATE.—ANDERSON MILLER, Shelbyville, Ind. Mr. Miller is the inventor of a gate which embodies much that is new in its construction and operation. Mechanically considered, the gate consists of a post to which a frame is hinged, free to move vertically. The frame comprises top, bottom and side members. A rod connects the top and bottom members and serves as a brace. Upon the rod is a lever. Angle-braces are secured to the top and bottom members at points adjacent to the ends of the rod, and engaging one of the side members at a point between the ends. A cord engages the lever and post and partially encircles the pulley. The handle of the lever being depressed, the cord is pulled, thereby raising the gate.

SNOW-PLOW.—PETER W. MARTIN, Thumb Lake, Mich. The snow-plow can be quickly and easily adjusted to discharge snow at both sides, or to discharge snow at either side. The horses propelling the plow are placed at the back, so that they are not compelled to walk in deep snow, as would be the case were they harnessed at the front.

POTATO-CREAMER.—FREDERICK W. RUCKSTUHL, and ADELE POHLMANN, Manhattan, New York city. This device is arranged to reduce boiled potatoes or the like to a creamy consistency in the smallest possible amount of time. The device is very simple and durable in construction, can be cheaply manufactured and easily manipulated.

GAGE AND BUTT-CUTTER FOR CIGARS. —WILLIAM HEFFLEY, Jackson Township, Lebanon county, Pa. The invention relates to means for gaging the length and clipping the butts of cigars as they are being manufactured. The inventor has devised an apparatus of this character which is of simple construction, compact form, and very convenient in operation, producing a portable implement that can be set to cut off the butts of cigars at a desired length as a finishing operation in their manufacture.

Miscellaneous Inventions.

BANJO ATTACHMENT.—H. M. BRONSON, Brandon, Vt. Mr. Bronson provides an improved attachment for banjos and like instruments which may be conveniently employed and will act to remove all harshness from the tone, rendering the music produced soft and sweet.

UMBRELLA-STICK.—T. H. SMITH, Lansford, Pa. The invention provides an umbrella which may be compactly folded and quickly and conveniently brought into a position for use. The construction is simple and durable, and is so arranged that the strength of the umbrella will not be lessened, also that the umbrella may be readily manipulated by any person of ordinary intelligence.

GEM-SETTING.—R. S. BIEBER, Brooklyn, N. Y. The usual method of setting stones of diamond shape is to fasten the stone by bending small fingers over its edge. This invention is designed to make a more secure setting for the gems by employing a band which encircles the edges of the gem and is held in place by the fingers of the setting.

RANGE-FINDER ATTACHMENT FOR GUNS.—A. P. COLLINS, Manilla, P. I. Sergt. Collins finds from practical experience that it is difficult for the average soldier to gage a distance of between 400 and 2,000 yards with sufficient accuracy to make his fire effective. He has, therefore, devised a simple attachment for use in connection with ordinary firearms which will enable a soldier to determine the range of the object to be fired at and the corresponding adjustment required to be given to the elevating sight.

FOLDING BASKET. — T. J. LANGSTON, Johnston, S. C. Mr. Langston has invented an improved form of basket of that class which have a collapsible body portion and a folding handle frame. The handles are pivoted directly to the body of the basket. The lower ends of the handles are connected with the bottom of the basket and are extended to form legs.

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

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Inquiry No. 3087.—For manufacturers of the C. H. Webb adding machine.

Inquiry No. 3088.—For manufacturers or dealers in glass cloth.

Inquiry No. 3089.—For the address of the Libby Glass Works.

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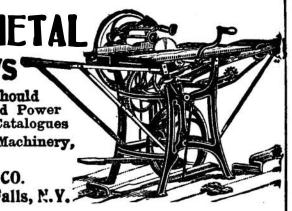

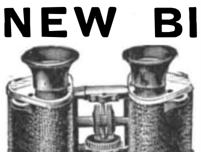

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"Wine that Maketh Glad the Heart of Man," for champagne, G. Rutledge	550

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.

NEW BOOKS ETC.

We have received from the University of Colorado the first number of a new publication entitled "University of Colorado Studies." This first number, at least, is equal to any of the scientific publications issued by the universities in the East. It has the additional merit of covering a very wide field. In this first number, for example, are articles on electricity, chemistry, mathematics, celestial mechanics, metaphysics and psychology—surely a range of subjects not often found in one publication. We wish the "Studies" all possible success.

Chemical Societies of the Nineteenth Century. By Henry Carrington Bolton. Washington, D. C.: Published by the Smithsonian Institution. 1902. 8vo. Pp. 15.

Dr. Bolton has supplemented his Bibliography of Chemistry by a complete list of chemical societies of the nineteenth century, in which are listed practically all organizations of importance, devoted to chemical work.

The Car Motor. Its Nature, Use, and Management. By Sir Henry Thompson, Bart. London and New York: Frederick Warne & Co. 1902. 110 pp., 3 illustrations. Price $1.

The distinguished author of this little volume has written it from practical experience with his own automobile, a 6½ horse power Daimler. The book forms an excellent elementary handbook of convenient pocket size, containing considerable desirable information from an owner who has had experience in driving a gasoline carriage. The rights of the automobilist on the road, and the methods pursued by the English constables in catching "scorchers" are thoroughly discussed, while an appendix of routes within 400 miles of London is by no means the least valuable feature. Considerable matter of legal interest will be found in this small volume, besides the concise instructions mentioned as to driving the different kinds of motor car.

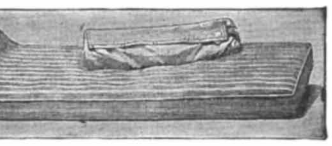
A Bibliography of the Analytical Chemistry of Manganese. 1785-1900. By Henry P. Talbot and John W. Brown. Washington: Published by the Smithsonian Institution. 1902. 8vo. Pp. vi.-124.

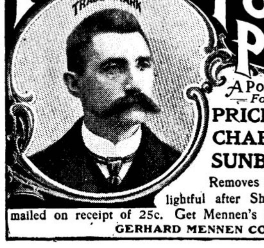
A fitting supplement to Dr. Bolton's Bibliography of Chemistry is this latest addition to the Smithsonian miscellaneous publications. Messrs. Talbot and Brown have reviewed Dr. Bolton's work and selected that portion of the bibliography bearing upon the qualitative detection and quantitative separation and determination of manganese for the use of analytical chemists. From the year 1830 on, however, the authors' work has been entirely independent.

Plattner's Manual of Qualitative and Quantitative Analysis with the Blowpipe. Translated by Henry B. Cornwall, E.M., Ph.D., assisted by John H. Caswell, A.M. Eighth edition, revised after the sixth German edition by Prof. Friedrich Kolbeck, New York: D. Van Nostrand Company. 1902. 8vo. Pp. xi-463. Price $4 net.

There probably has never been a better book prepared on the subject of blowpipe analysis than C. F. Plattner's admirable manual. The present edition, which is the eighth American edition, should be welcomed by students for the reason that it has been thoroughly revised after the latest German edition, thus bringing the book well up-to-date. The adoption of modern chemical notation and the omission of superfluous or antiquated tests considerably improve the work. Spectroscopic methods which properly do not belong in a book of this character are also omitted. Dr. Kolbeck, to whom the last German edition is due, was assistant to Dr. Richter, the unsurpassed master of blowpipe analysis and editor of the early Plattner editions.

FLY PAPERS.—FORMULAS FOR Sticky Fly Papers are contained in Scientific American Supplement Nos. 1057 and 1324. Each issue contains several recipes. Price 10 cents each, from this office, and from all newsdealers.





Notes and Queries.

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

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(8668) A. M. asks: 1. I have made motor described in SUPPLEMENT No. 641 and it runs perfectly as a motor, but will not generate any current when driven as a dynamo. It is series wound. Please let me know the remedy. A. Small motors very often are not wound so that they will excite their own fields and they cannot be used as dynamos, except by disconnecting the field and using a battery to excite the field. 2. Would there be any practical way to run it on 110-volt alternating lighting circuit? A. No.

(8669) H. M. W. writes: We understand there is an easily prepared paper which may be used for the finding of the negative and positive poles of an electric wire. Will you kindly inform us how to make this paper and whether it will keep? We only wish for a small quantity. A. We give below two methods for this purpose, both of which are easy. First method: Dissolve sodium sulphate, a teaspoonful, in a half pint of water, in which also dissolve about the same quantity of potassium iodide and of starch. To dissolve the starch the water must be heated. Soak white blotting paper in this solution and dry it. Cut it into strips of any convenient size, a half inch by two inches is suitable. Keep the paper in a dry place such as a tin box or a glass bottle. To use, moisten a strip and place the two poles upon it, nearer together or farther apart, according to the voltage of the current. A dark spot will appear at the *positive* pole. Second method: Dissolve 15 grains of phenol-phtalein in a half ounce of common alcohol. Dissolve also 20 grains of sodium sulphate in 4 ounces of water. Soak blotting paper in the first solution and drain off the superfluous liquid. Then soak it in the second solution and dry it. Afterward treat it in the same manner as in the first method. A red spot appears at the *negative* pole.

(8670) A. S. writes: Our M. E. Church steeple of Freeport is about 160 feet high, is slate roofed or covered and the top consists of a sheet iron ornament some 12 or 15 feet; the church is of brick. The steeple has been struck and badly damaged by lightning within 3 years, although it stood for 20 odd years before it was first struck. It is thought by some that the large number of overhead telephone wires that go right by the church and the telephone station just across the street tend to attract lightning, which strikes the steeple first, it being a considerably higher point. Some contend that proper lightning rods would prevent damage, while others claim that lightning rods are incapable of carrying the great amount of electricity forming such a bolt of lightning. A. 1. We should not dare to have a building with an iron top disconnected with the earth metallically, as is this church spire. It is an invitation to a visit of the lightning. The lofty Washington Monument, in Washington, was struck and damaged till its metal tip was grounded by a lightning rod, since which it has been repeatedly struck, but without damage. Suitable lightning rods certainly are of service in protecting a building. We should suppose that the telephone wires were a partial protection to a neighborhood. 2. Is it a fact that no suction pump will pump or draw a greater height than 33½ feet before entering the pump, or, in other words, before passing through the valves? If water can be raised a greater height by such a pump before it passes through the pump valves can you tell what distance it can be drawn and what causes the limit if there is any? A. A lifting, or as it is sometimes called, a suction pump, can raise water no more than 28 to 30 feet. Theoretically 34 feet is the limit to which the pressure of the atmosphere can push water up a tube with a vacuum above the water. No pump can exhaust the air above the water perfectly, hence no pump can get water 34 feet above the level of the water below. The pump lifts the air off the water in the pipe; the air outside the pipe pushes on the water in the well and pushes it up into the partial vacuum in the pipe below the valve of the pump. For this see any text book of physics under pumps in pneumatics.

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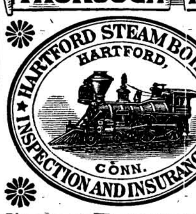

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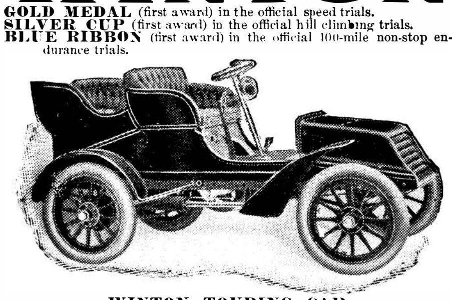

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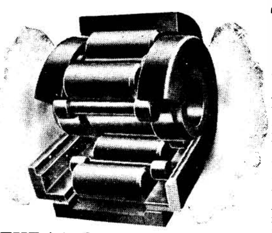

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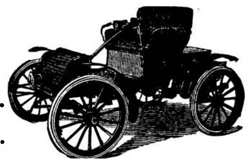

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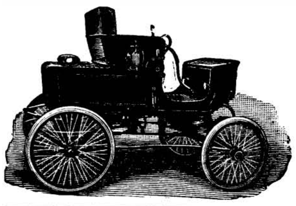

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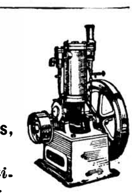

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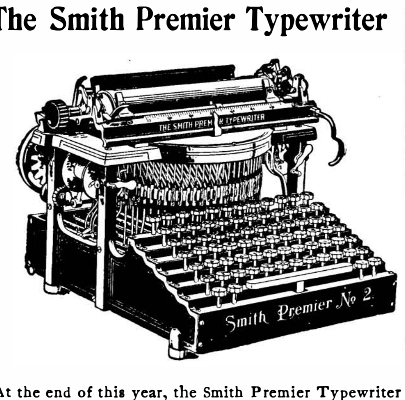

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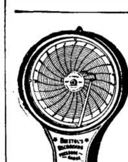

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