SCIENTIFIC AMERICAN

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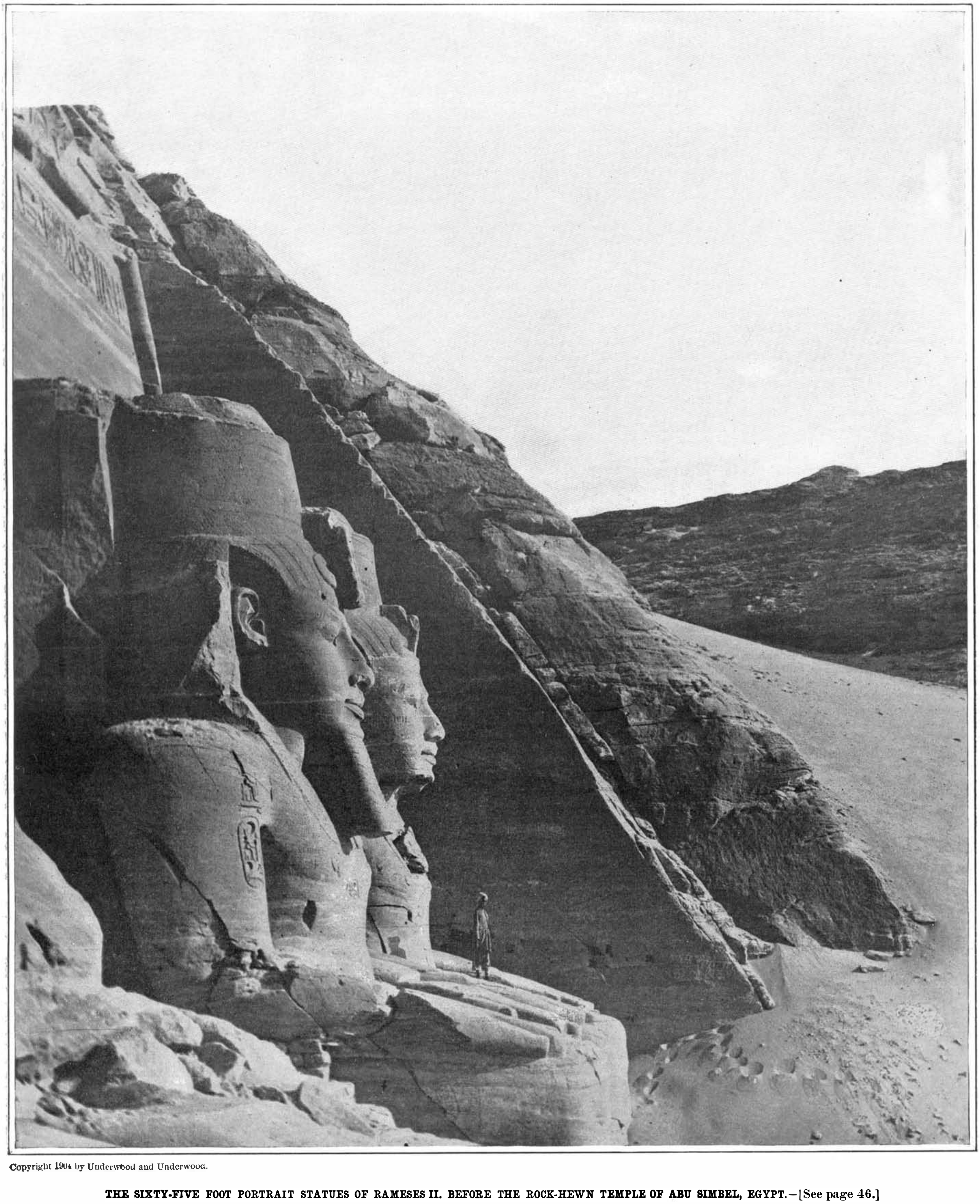

THE SIXTY-FIVE FOOT PORTRAIT STATUES OF RAMESES II. BEFORE THE ROCK-HEWN TEMPLE OF ABU SIMBEL, EGYPT.—[See page 46.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, JULY 15, 1905.

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.

A POOR START.

The most ardent advocates of the Panama Canal must admit that, admirably as the government has handled the matter of the purchase of the Panama Canal property, it has made something approaching to a very pitiful fiasco in its attempt to commence actual construction of the canal.

The SCIENTIFIC AMERICAN for many years past has favored the prosecution of this great work. It was our conviction that if the United States, with its vast experience in great engineering works, once took hold of the Panama enterprise, it would push it through to completion with economy and dispatch. We still believe that the United States can accomplish this great work with economy and dispatch; but we are just as fully satisfied that it will never so accomplish it, unless the halting policy that has thus far marked our efforts at construction be abandoned.

We have spoken above of this country's "vast experience in great engineering works." If this experience is to be applied with practical results at Panama, it must be applied along the same lines on which it has produced such splendid results in the upbuilding, let us say, of the great railroad system of the United States, a system which in its rapidity and economy of construction, is without a parallel in the world. In building that system, and particularly in the later years in which the greater part of the work has been done, the organization of the working forces has been noticeable for its simplicity and directness. The combination of a president, a treasurer, an auditor, and a chief engineer, the last-named absolutely untrammeled when once the main outlines of his work have been passed upon, has enabled this country to construct the various lines of a great railway system over 200,000 miles in length with a smoothness, rapidity, and a dispatch that have won the admiration of the world.

There is absolutely nothing in the Panama situation to prevent the application of the railroad methods of organization in carrying the work through. As far as the constructive features are concerned, it must be a one-man job; and we do not hesitate to say that there are not merely half a dozen but fully a score of civil engineers in America to-day, any one of whom is capable, *if left absolutely untrammeled by unnecessary red tape*, of taking hold of the Panama Canal, enormous undertaking though it be, and pushing it through to completion within a specified time and for a specified cost, and with just as much absence of friction, delay, graft, bickerings, political interferences, and all other petty and pure childishness of that kind, as similar works have been and are being carried through by these same men for the various railroads of this country to-day.

A cubic yard of earth, hard-pan, or rock is about the same thing at Panama as it is in the Rocky Mountains or on the plains of Dakota. In Panama so many million tons of it can be dug up, blasted out, and carted away, with as much certainty as to cost as it can in the mountains or on the plains of the West. A single chief engineer of the Panama Canal, if given an absolutely free hand, can gather around him a staff of engineers just as efficient for their work as any he may have handled when building railroads in a more northern clime. The contractors are ready with their plant and appliances to do just as expeditious work at Panama as in Maine, Missouri, or California, and the work they do will be measured up, appraised, and vouched for by the chief engineer and his subordinates with just as little "lost motion" and with as great dispatch as in the construction or rebuilding of railroads.

If the unfortunate experience of the government in its initial work on the construction of the canal has no other effect than to teach the above lesson, it will not have been for naught. The course of events suggests that the scheme of administration, as at present adopted, is greatly over-elaborated and is so cumbersome that it will ever be in danger of breaking down of its own weight.

We are free to admit that the circumstances of the precipitate withdrawal of the late chief engineer from the work would seem to augur ill for the one-man control of the work above suggested—that is, if we are to believe that, in the motives that prompted Mr. Wallace in his resignation, he represents the ethics of the body of professional men to which he belongs. We candidly believe that he does not. Caustic as were the words of Secretary Taft in commenting upon his withdrawal "for lucre" from a post of such high honor, they were none too severe. On the other hand, it may well be that there were many exasperating hindrances to the work of Mr. Wallace, due to the complicated nature of the administration of the canal, which have influenced his withdrawal. Be that as it may, we are satisfied that if the prerogatives of the present chief engineer of the canal were enlarged to the full scope with which he has been familiar in railroad work; and if the work could be organized on the well-tried lines of directness and simplicity that characterize railroad construction, there would be an end of the present confusion, and the digging of the canal would be pushed through steadily to completion.

PEARY AND THE NORTH POLE.

The start of the ninth journey of Commander Peary to the Far North is marked by the quiet determination that is characteristic of explorers who attempt the perilous quest of the North Pole. And yet it is well understood among those who are familiar with the problem of Arctic exploration, that no expedition for the discovery of the North Pole has started under conditions that were, with a single exception, so favorable to success. That exception, however, is a serious one, and were it imposed upon a less experienced and indomitable leader, it might well mean the wrecking of the whole expedition. We refer to the fact that Peary is short some $30,000 of the sum necessary to thoroughly equip his expedition and provide that margin for contingencies which, in a venture of this kind, should always be a broad one. The explorer starts within a few days. That is certain. The alternative of his setting out amply supplied with every material resource, or of his starting handicapped and burdened with the thought that he is running at all times perilously near to the limit of his resources, depends upon the immediate liberality of those who may feel themselves able to furnish the sum needed for a full equipment. We mention, in passing, that contributions may be forwarded to Herbert L. Bridgman, the treasurer of the Peary Arctic Club, at 52 Wall Street, this city.

If, as we sincerely hope, the necessary funds are immediately forthcoming, Peary will set out for the North Pole under conditions that should command success, that is, as far as success is dependent upon human and not natural conditions. Success is largely a question of the man, of the ship, and the company. Of the man it is scarcely necessary to speak; for in his previous journeys he has exhibited in a high degree the requisite judgment, resolution, and endurance that go to make up a successful Arctic explorer. He is perfectly familiar with the conditions, and in his previous dash for the Pole he went far enough north on the final sledge journey to be able to form a reasonable presumption as to the character of travel that lies between his farthest north and the Pole itself. Elsewhere in this issue we give a description of the ship "Roosevelt." She represents the combined experience of her commander and of many explorers who have preceded him; and the $100,000 that was spent upon her has been devoted entirely to giving her great structural strength both in the hull and the engines, and not a penny of it has been wasted on merely decorative or luxurious features. In fact, the "Roosevelt" is decidedly Spartan-like in the extreme severity of her appointments. The ship's company that goes to the Far North will join at Cape Breton, and it will be composed of men who are familiar with Arctic navigation. It is not upon them, however, that the ultimate success of the expedition will depend, so much as upon the twenty-five selected Eskimos who will make the final dash with Peary for the North Pole. Many of these have been living, for some time past, in the neighborhood of the point on Grant Land from which the sledge journey will be commenced. To these natives the trip, except for its ruggedness and the cutting loose from the outside world, will not involve the novel and untried experiences which the public might naturally suppose. In other words, these hardy, faithful, and courageous people will form an ideal company for the last supreme effort.

In the course of an interview of the writer with Commander Peary on board the "Roosevelt," the explorer outlined the plan of campaign by which he hopes to reach the North Pole in the spring of 1906. He will start early this month from New York and sail to Cape Breton, where the present ship's complement will leave her and the crew which will take her into the Arctic regions will be shipped. Here he will take on the remainder of his stores and five hundred tons of coal. From Cape Breton he will steam at a reduced speed, in order to economize coal, direct for the northern coast of Greenland, the scene of his former explorations. The large amount of ice which has been coming down from the North this year encourages the belief that more than usually open water will be found. When the "Roosevelt" encounters the ice the real battle with the difficulties of the frozen North will commence. It is now that the powerful compound engine and the broad-bladed propellers of the ship will be called on for their supreme effort. Normally the engine horse-power is from 1,000 to 1,100, but as soon as the ice pack is encountered, live steam will be turned into the low-pressure cylinder, and the available thrust on the propeller will represent about 1,500 horse-power. The peculiar form of the bow, and of the underwater sections forward, will now begin to tell, and the good ship will be able to smash her way through ice which would have been impassable to any of Commander Peary's earlier ships.

He expects to reach latitude 83 north, off the most northerly point of Grant Land, before he is frozen in, or by September 15. The winter will be spent in preparing the outfit, and Commander Peary states that this work alone will furnish abundant occupation and interest during the long winter's night. The articles to be made include fur clothing, sledges for the final dash to the Pole, harness for the dogs, whips, tents, stoves, and the preparing and packing of rations. The sun begins to show its rim above the horizon on February 28; but, of course, there is twilight for many days preceding that. Hence, the start on the great sledge journey will be made early in February. The ship will be the base from which the expedition will work, and the complement of fifteen men who constitute its crew will remain on her. The North Pole party will be made up of twenty-five sleds with one Eskimo and six to eight dogs to each sled. They will be heavily loaded down at the start with provisions, outside of which very little will be carried beyond the necessary instruments in the way of sextant, theodolite, aneroid barometer, etc.

Regarding the character of the travel which he would be likely to meet with on the 420-mile journey from the ship to the Pole, Commander Peary frankly admitted that he expected it to be of the very roughest, consisting probably, unless land should be found, of a mass of broken and up-ended ice, presenting a scene of confusion that it would be difficult to describe. He estimates that he will make about ten miles a day on the outward trip, and fifteen miles a day, because of his lighter load, on the return journey. Should the difficulties prove even greater than this rate of speed would indicate, and provisions runs short, it would become necessary to kill off the dogs for food—a contingency which happened on one of his excursions, when the party returned with but one dog left out of the many with which the expedition started. It should be mentioned in closing, that if the necessary funds are forthcoming the explorer will establish wireless communication between the various stations of the expedition—an installation which would contribute not a little to the ultimate success of the venture.

TIME FOR ANOTHER PRINCIPIA.

A general restatement of physical science is now due. The extensive researches in the higher phases and states of matter, beginning with Crookes, and extending to the present, have so enormously expanded all conceptions of nature, that a vast work like Newton's Principia is urgently needed. The new book would be basic, fundamental, and epoch-making. For when gravitation was discovered and its phenomena reduced to rigid law, all men at once saw that it was part of the base of the existing order of things. But Crookes's first vacuum tube made us aware of the existence of phenomena equally important. Radiation is as basic as attraction. And it may easily be imagined to be actually of greater use in the sidereal structure, if one mode of activity can be more potent than another.

There exist without doubt many other phases of radiance besides the Alpha, Beta, and Gamma; as many possibly as there are letters in the alphabet. Every nook and corner of the universe must be, and in the very nature of things is, saturated with radiations, and of many kinds or phases. The researches of J. J. Thomson on corpuscular states of radiance ought to be incorporated into the new Principia without change—word for word, as well as the marvelous papers read by Arrhenius at the International Congress of Science in St. Louis also. And his great paper written in the Lick Observatory in July, 1904, and now published as Bulletin No. 58, should be transferred without change, bodily. This is one of the most remarkable scientific productions of any age. The work of the Curies would make several chapters of the new book. The writer has been in Mount Lowe Observatory for five years, and it does seem that science has received more remarkable and splendid additions than at any time since Newton. For is it not as great to find that there is a flux everywhere within the universe as to detect the laws of gravitation? It may prove to be greater. The sun may not be required to shrink in diameter nine inches daily to maintain its present rate of radiation. The process of receiving and sending out corpuscles is competent to supply all its radio-activity. And it can issue many kinds of radiance, so long as the interchange with other suns is maintained. The problem here now is so much larger than any ever presented to man before, that all others appear to be childlike in comparison. It is to discover, rescue from space, and use these obscure radiations from our own and other suns. All other employments that can be engaged in by human hands are as straws beside this chief of all work and research. Arrhenius shows that many particles, balanced by radiance and attraction, "swim in space" in regions adjacent to suns; but vast quantities not in the clutch of critical forces escape and dart into space. These are surely the corpuscles of electricity exploited by Thomson. For three years the floods of mail received here, letters, essays, pamphlets, books, everything, have one inevitable trend and tendency, and that is: The universe rests on an electrical base. In other words, nothing exists but electricity. This doctrine comes here from all directions. This universe is now maintained by "action at a distance"; that is, radio-activity is its sole support. There is not a trace of a new idea in this. It is exceeding familiar. All have heard of it thus: "Action and reaction are equal." This is flux and flow of radiance in a nutshell.

Then the universe is alive, is a living organism. This is familiar also; it was said in India many thousands of years ago, and has teemed on the pages of all Aryan literature since. None gave it attention, thinking it to be a vagary of some poet. The reception and emission of electrical corpuscles by every sun in existence are the causes of every conceivable phase of radiance. These two combined constitute the life of Nature. All work like that of Roentgen, Lenard and a hundred like them must be put into the great Principia.

It is a wonderful thing to be upon a mountain and watch the scientific literature change. And the most astonishing of all is to behold two things: the rapidity and worldwide unanimity of wheeling into the grand procession or march on the "electrical way." There are electrical "pushes and pulls" everywhere, universal and cosmical. They are so delicate that early physicists in many cases could not detect them. But now they are being explored with comparative ease. Thus every form, phase, condition, state, or type of radiation is corpuscular. Circulation throughout the universe is a rigid proof of conservation. Radiance is manufactured on the surfaces of suns. Radium is all right, and does not conflict with conservation. It receives and pays out like suns. So does everything else. The radiations of most phases of matter are too feeble to be detected by present means. For the words action and reaction are equal. They ought to go into the new Principia thus: Activity and return are equal. Great is the demand from all sides for the Principia.

BURKE'S OWN ACCOUNT OF THE SPONTANEOUS ACTION OF RADIUM ON GELATIN MEDIA.

The following is an abstract of the communication which was made to Nature by Mr. J. Butler Burke, of the Cavendish Laboratory, Cambridge, and which has given rise to so much sensational newspaper discussion:

"In the course of some experiments on the formation of unstable molecular aggregates, notably in phosphorescent bodies, I was led to try whether such dynamically unstable groupings could be produced by the action of radium upon certain organic substances. It will scarcely be necessary to enter here into an account of the many speculative experiments which I have at one time or another tried, but it will suffice if I describe, as briefly as possible, the experiment which, among others, has led to a very curious result, and that is the effect of radium chloride and radium bromide upon gelatin media, such as those generally used for bacterial cultures.

"An extract of meat of 1 pound of beef to 1 liter of water, together with 1 per cent of Witter peptone, 1 per cent of sodium chloride, and 10 per cent of gold-labeled gelatin, was slowly heated in the usual way, sterilized, and then cooled. The gelatin culture medium thus prepared, and commonly known as bouillon, is acted upon by radium salts and some other slightly radio-active bodies in a most remarkable manner. In one experiment the salt was placed in a small hermetically-sealed tube, one end of which was drawn out to a fine point, so that it could be easily broken. This was inserted in a test-tube containing the gelatin medium. The latter was stopped up with cotton wool in the usual way with such experiments, and then sterilized at a temperature of about 130 deg. C. under pressure for about 30 minutes. Cultures without radium were also at various times thus similarly sterilized. When the gelatin had stood for some time and become settled, the fine end of the tube containing the radium salt was broken, from outside, without opening the test-tube, by means of a wire hook in a side tube. The salt, which in this particular experiment consisted of 2½ milligrammes of radium bromide, was thus allowed to drop upon the surface of the gelatin.

"After 24 hours or so in the case of the bromide, and about three or four days in that of the chloride, a peculiar culture-like growth appeared on the surface, and gradually made its way downward, until after a fortnight, in some cases, it had grown fully a centimeter beneath the surface. If the medium was sterilized several times before the radium was dropped on it, so that its color was altered, probably by the inversion of the sugar, the growth was greatly retarded, and was confined chiefly to the surface. It was found that plane polarized light, when transmitted through the tube at right angles to its axis, was rotated left-handedly in that part of the gelatin containing the growth, and in that part alone.

"The controls showed no contamination whatever and no rotation. The test tubes were opened and microscopic slides examined under a twelfth power. Objects were observed which at first sight seemed to be microbes, but as they did not give sub-cultures when inoculated in fresh media they could scarcely be bacteria. The progress of any of the sub-cultures after a month was extremely small, and certainly too small for a bacterial growth. It was not at all obvious how bacteria could have remained in one set of tubes and not in the other, unless the radium salt itself acted as a shield, so to speak, for any spores which may originally have become mixed with the salt, perhaps during its manufacture, and when imbedded in it could resist even the severe process of sterilization to which it was submitted. On heating the culture and re-sterilizing the medium, the bacterial-like forms completely disappeared; but only temporarily, for after some days they were again visible when examined in a microscopic slide. Nay, more, they disappeared in the slides when these were exposed to diffused daylight for some hours, but re-appeared again after a few days when kept in the dark. Thus it seems quite conclusive that whatever they may be, their presence is at any rate due to the spontaneous action of the radium salt upon the culture medium, and not alone to the influence of anything which previously existed therein. When washed they are found to be soluble in warm water, and however much they may resemble microbes, they cannot for this reason be identified with them, as also for the fact that they do not give sub-cultures as bacteria should.

"Prof. Sims Woodhead has very kindly opened some of the test-tubes and examined them from the bacteriological point of view. His observations fully confirm my own. He assures me that they are not bacteria, and suggests that they might possibly be crystals. They are, at any rate, not contaminations. I have tried to identify them with many crystalline bodies, and the nearest approximation to this form appears to be that of the crystals of calcium carbonate, but these are many times larger, and, in fact, of a different order of magnitude altogether, being visible under comparatively low powers; and are, moreover, insoluble in water. A careful and prolonged examination of their structure, behavior, and development leaves little doubt in my mind that they are highly organized bodies, although not bacteria. Unfortunately, the quantity is so very minute that a chemical analysis of their composition is extremely difficult. The amount of salt in the first instance is so small, and the number of aggregates, or whatever they may be, thus produced perhaps still smaller.

"Photographs, together with the numerous results of eye observations, indicate that a continuous growth and development take place, followed by segregation. The stoppage of growth at a particular stage of development is a clear indication of a continuous adjustment of internal to external relations, and thus suggests vitality. They are clearly something more than mere aggregates in so far as they are not merely capable of growth, but also of sub-division, possibly of reproduction, and certainly of decay.

"I have ventured, for convenience, in order to distinguish them from either crystals or microbes, to give them a new name, *radiobes*, which might, on the whole, be more appropriate as indicating their resemblance to microbes, as well as their distinct nature and origin. Some slightly radio-active bodies appear also to produce these effects after many weeks. A more detailed account of these experiments will be published shortly. This note merely contains some of the principal points so far observed."

THE CURRENT SUPPLEMENT.

The current SUPPLEMENT, No. 1541, opens with a well-illustrated and well-written article by Herbert I. Bennett on the building of the Santa Fé Railroad into San Francisco. Carl Lautenschlaeger, who has become well known to Americans by his connection with the New York Metropolitan Opera House, writes on "Theatrical Engineering, Past and Present." It is a well known fact that steamers will perform vibrations of a magnitude that depends upon the design and location of the engine. The well-known German marine engineer, Otto Schlick, has formulated some valuable rules for the construction and arrangement of the marine engine, calculated to minimize these vibrations. It is mainly due to his investigations that modern transatlantic liners may sail at speeds of twenty-four knots. Schlick's investigations have been carried out by means of an instrument of his invention called the Pallograph, described in the current SUPPLEMENT by Dr. Alfred Gradenwitz. The "Dey" Time Register is described by Emile Guarini. Sir William White continues his discussion of submarines. In an entertaining article by T. C. Hepworth, the incongruities and anachronisms of artists are treated. Charpentier finds that odorous substances are definitely acted upon by the N-rays. The results of his researches are summarized in a brief note. Prof. August Smithells writes on the Temperature of Flames. Recent progress in photography is reviewed by Dr. Ludwig Guenther. A history of the telephone is presented by W. H. Sharp, in which the claims of Reis are revived.

OPENING OF EXTENSIONS OF THE NEW YORK CITY SUBWAY.

On Monday, July 10, the Broadway section of the Rapid Transit Subway, comprising two tracks, extending from Wall Street to Battery Place, through which it passes in the form of a loop, as at City Hall Park, and the Lenox Avenue East Side extension from 135th Street under the Harlem River to the elevated section at 149th Street, and thence *via* Westchester Avenue and Boston Road to West Farms, was opened to the public for the first time, trains being run on five minutes headway. This marks approximately the completion of the Manhattan system, except the Washington Heights extension, which is to be in operation before the expiration of the summer.

The tunnel under the Harlem River is composed of two separate tubes, having a space below the roadbed of five feet, to collect seepage that may accidentally leak through. Pumps are provided in the center and at each end to draw this water out in emergencies.

The tunnel is dry at all times, and resembles in appearance the stretch between 33d Street and 42d Street on Fourth Avenue. The bottom of the tunnel is thirty feet below the river surface. The successful termination of this great work is a triumph of American engineering skill, and the facilities afforded will be of lasting benefit to the city and its population.

OFFICIAL METEOROLOGICAL SUMMARY, NEW YORK, N. Y., JUNE, 1905.

Atmospheric pressure: Highest, 30.15; lowest, 29.61; mean, 29.96. Temperature: Highest, 90, date, 18th; lowest, 51, date 8th; mean of max., 77.6; mean of min., 60.1; absolute mean, 68.8; normal, 68.9; deficiency under the mean of 35 years, —0.1. Warmest mean temperature for June, 72, in 1888, 1892, 1899. Coldest mean, 64, 1903. Absolute maximum and minimum for this month for 35 years, 97 and 47. Average daily deficiency since January 1, —0.7. Wind: Prevailing direction, west; total movement, 7.275 miles; average hourly velocity, 10.1 miles; max. velocity, 46 miles per hour. Precipitation, 4.18; greatest, 1.19, date 12th; average for 35 years, 3.29. Excess, +0.89; deficiency since January 1, —3.21. Greatest precipitation, 7.70, 1887; least, 0.86, 1894. Thunderstorms, 2d, 6th, 7th, 19th, 22d, 23d, 26th. Clear days, 7; partly cloudy, 12; cloudy, 11.

Near the end of the 60's, when most of the early bridge companies had been formed, there were, besides the engineers interested in bridge-building firms, only a few experienced bridge engineers in this country. The engineers who were at that time connected with bridge companies were mostly men who had gained their experience in the employ of some railroad company, had worked out their own type of construction, and had experience, not only in designing, but also in superintending the construction and erection of bridge work. Their theoretical knowledge, measured with the present standard, was limited to elementary methods, but their thorough practical training enabled them to combine theory and practice to the best advantage. They understood how to make their designs conform to the methods of the workshop, as well as to facilitate erection. This was really the beginning of the development of American bridge building and of the distinctly American types of construction which at that time differed so materially from those of other countries. The most distinguishing feature of the methods then prevailing in this country, as compared with those of other countries, the influence of which is felt to the present day, is that at that time in America the bridges were designed by experienced specialists, and the work was constructed in shops built and equipped for that special purpose by experienced mechanics trained in that class of work. At first these companies controlled the work in certain territories, or the contracts were awarded to them on account of the reputation of their engineer. However, as competition became keener, railroads desired to purchase their bridges for the lowest price, and invited several firms or companies to submit tenders on the bidders' own designs, which started the competitive system of designing and bidding on bridge work.

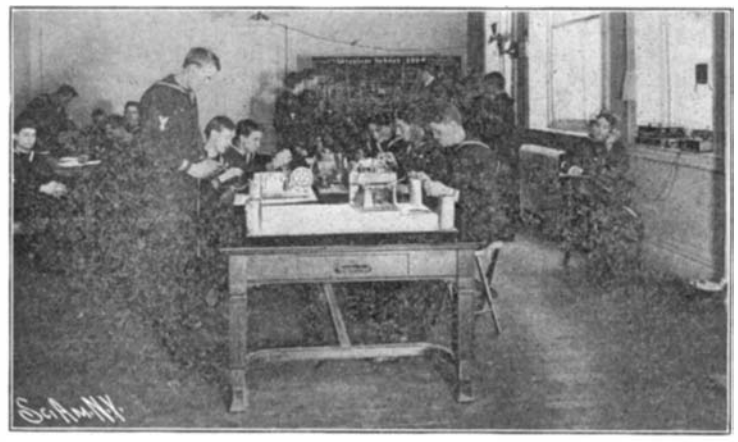
THE NAVY WIRELESS SCHOOL.

BY WALTER L. BEASLEY.

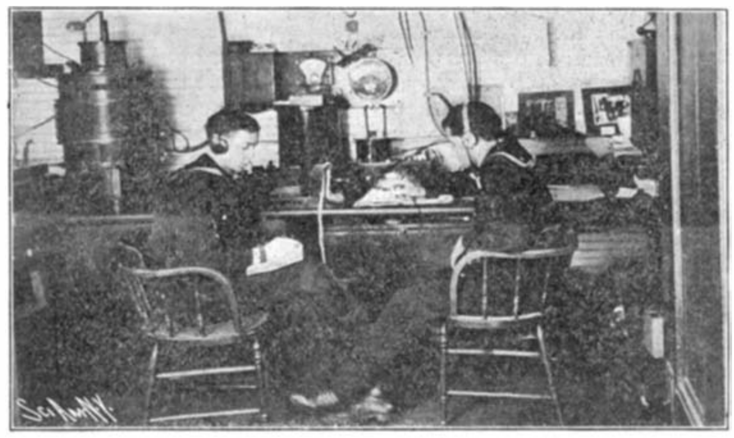
The latest department of instruction in the United States navy is the wireless school in the Brooklyn navy yard. The practical training of young sailor electricians for this new and important branch of the service is the outcome of the rapid development and the extensive application to be made by the navy of this subtle system of communication, both on battleships and coast stations.

The wireless school is quartered in the second story of the Bureau of Equipment building in the Brooklyn navy yard, and is housed on board the receiving ship "Hancock." Lieut. W. A. Edgar, U. S. N., is executive officer of the electrical and wireless school. Chief Electrician Bean, in charge of the navy yard wireless station, is the main instructor, and Chief Electrician Delany is assistant. The class now being drilled have come up from the electrical class located below, where for three months they have been put through a course of electricity in general, which is especially applicable to ship and station requirements, where they are destined to be sent for future duty. In the general electrical class, actual work is given in the handling of electrical machinery, dynamos, and the manipulating of the electrical switchboard, which regulates the interior communication of a modern battleship. A facsimile of those used on a man-of-war is installed in the room, and sections are daily drilled in the operating of the numerous switches, etc. After twelve weeks' preliminary work in general electrical school, they receive their finishing touches by going through a month's practical instruction in the wireless class. After completing four months of thorough and systematic instruction, having obtained in this interval a fair knowledge of adjusting and manipulating the apparatus, they are prepared to graduate. An interesting and picturesque sight is afforded by a peep into Uncle Sam's wireless schoolroom. Passing down the long corridor of the Equipment Building, one hears a series of loud buzzing sounds. On entering the spacious classroom, the visitor is plunged into a veritable beehive community of bustle and sound. Seated around three tables are some twenty-five bright-appearing young sailors, each deeply absorbed in mastering the wireless process. For a limited time each boy is drilled at the sending key; the remainder at the table with pen and paper are engaged in receiving and translating the sounds of the buzzer, the key of the latter being connected to a small battery. The wireless navy code alphabet is made up of a series of dots and dashes of relative length. These are indicated by buzzes received in the ear 'phone, which must be accurately learned by the beginner. They are also printed by the automatic Morse recorder on a tape line. Receiving by ear is, however, the most speedy, and the method generally employed in active service by operators on ship and shore stations.

Class Observing Aerial Wires for Receiving and Sending on a Battleship.



Navy Wireless Class at Work.



Receiving Wireless Messages at Brooklyn Navy Yard.

THE NAVY WIRELESS SCHOOL.

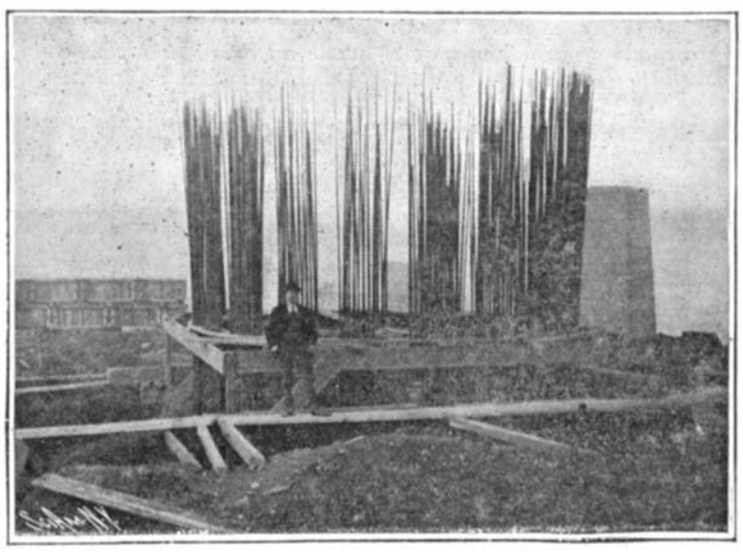
Fridays are examination days, when the instructors test the ability of each individual of the class, and they are marked and rated accordingly. Ten to twelve words per minute is the average sending capacity. Experienced operators send from twelve to fifteen words, and receive as many as thirty. Transmitting is a matter of power. Receiving depends entirely on delicate adjustment of apparatus, as well as a keen-eared operator. Chief Electrician Bean imparts the benefit of his expert experience in the taking apart and putting together of all the main electrical instruments. This is the most vital part of the training of wireless operators, who are destined to be sent, most of them, to remote localities, where they must depend entirely upon their own technical skill in the case, and making repairs of any breakdown of their apparatus, which is most likely to occur. A novel sight to see is a section of the class high aloft on one of the fighting masts of some of the battleships now at the navy yard, being taken up by the wireless officer for an object lesson in examining the method of arranging the aerial wires.

During the thirty-day term, through constant application and daily practice of six hours, and through the scientific and systematic drilling of Chiefs Bean and Delany, the class of wireless aspirants have been so perfected in the art, that they are qualified to graduate, and are competent to enter any ship or shore station of the navy, and to flash a message from one to two hundred miles distance, and receive and translate the same. In order to get a fine body of operators, the government offers liberal pay inducements, including rations, far in excess of the remuneration given to ordinary seamen recruits. The latter receive only $16 per month, while the electrical boy, who enlists and passes the preliminary examination in electricity, is rated as third-class electrician, at $30 per month. Advancement is certain, if accompanied by conscientious and ambitious labor, up to second class, bringing $40, and thence to first class, at $50 per month. The highest rating of chief electrician amounts to $70. The high efficiency of government wireless telegraphs is strikingly illustrated by the Cape Nome and Fort St. Michael stations, which Gen. A. W. Greely, Chief Signal Officer, states transmit 5,000 words easily in an afternoon across the 107 miles of waterway.

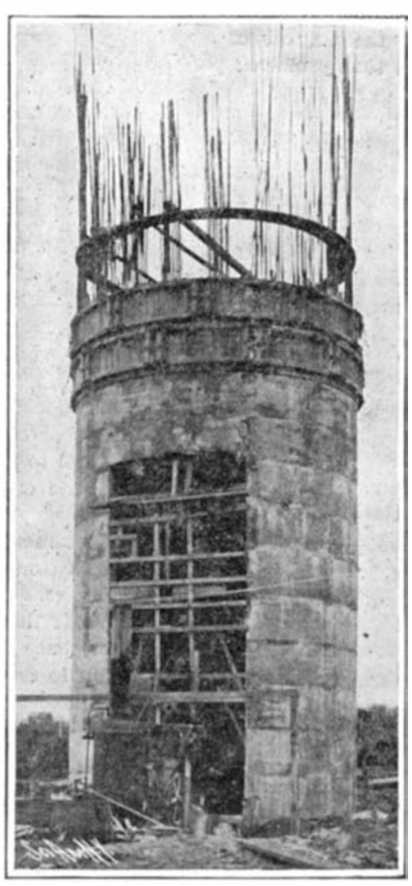
TALLEST CONCRETE CHIMNEY EVER CONSTRUCTED.

Tacoma, Wash., claims to include among its objects of interest the loftiest concrete chimney in the world. It belongs to the Tacoma Smelter Company, and has just been completed.

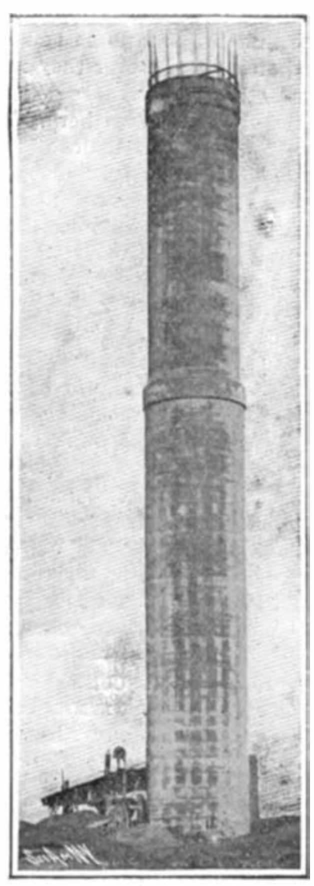
From the base of the foundation to the top of the chimney is 307 feet 6¾ inches, and the cost was $28,000. The stack was built to carry away the poisonous fumes from the smelting works at Tacoma. In its construction 1,225 barrels of cement were used, in addition to which the structure contains 105,000 pounds of T iron, 705 cubic yards of sand, and 231 cubic yards of gravel. Towering more than one hundred yards



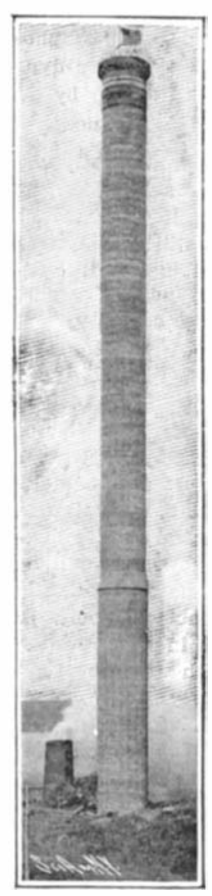
Foundation Completed. First Shell in Place.



On February 21, 1905, the Height was 39 Feet.



On March 28, 1905, the Chimney Had Been Built up to 156 Feet.



The Chimney on May 28, 1905. 307 Feet 6¾ Inches.

TALLEST CONCRETE CHIMNEY EVER CONSTRUCTED.

from the earth, and without a single supporting guy, this chimney, because of its relatively narrow base, presents a very striking appearance.

The concrete foundation of the chimney is 36½ feet square and 6 feet thick. For the chimney proper, the mixture was one part cement and three parts sand.

The chimney is constructed in two parts. From the foundation up to a height of 90 feet there are two distinct shells—one built within the other; while for the rest of its height it is built with a single shell.

The purpose of the double shell is to protect the structure from cracks and strains due to extreme variations of temperature. The inner shell, which is separated from the outer one by an air space of five inches, is designed to shield the outer shell from the direct effect of the intense heat at the base of the chimney; while the outer serves as a like protection to the inner shell, by shielding it from cold weather, which might cause it to crack by cooling too suddenly.

The outer shell also takes up the heavy bending stresses caused by wind pressure. Not only are ordinary conditions guarded against, but the chimney is expected to withstand a tornado. Circulation of air between the shells is secured by the provision of small openings at the bottom.

The entire chimney was built in three-foot sections, and an average of three feet a day was made in the construction of the double section, and six feet per day on the single or upper section. Sectional molds were used, and the entire work was handled from the inside, a scaffolding being built up with the chimney. All materials were raised by means of a cable attached to the drum of the engine that operated the concrete mixer.

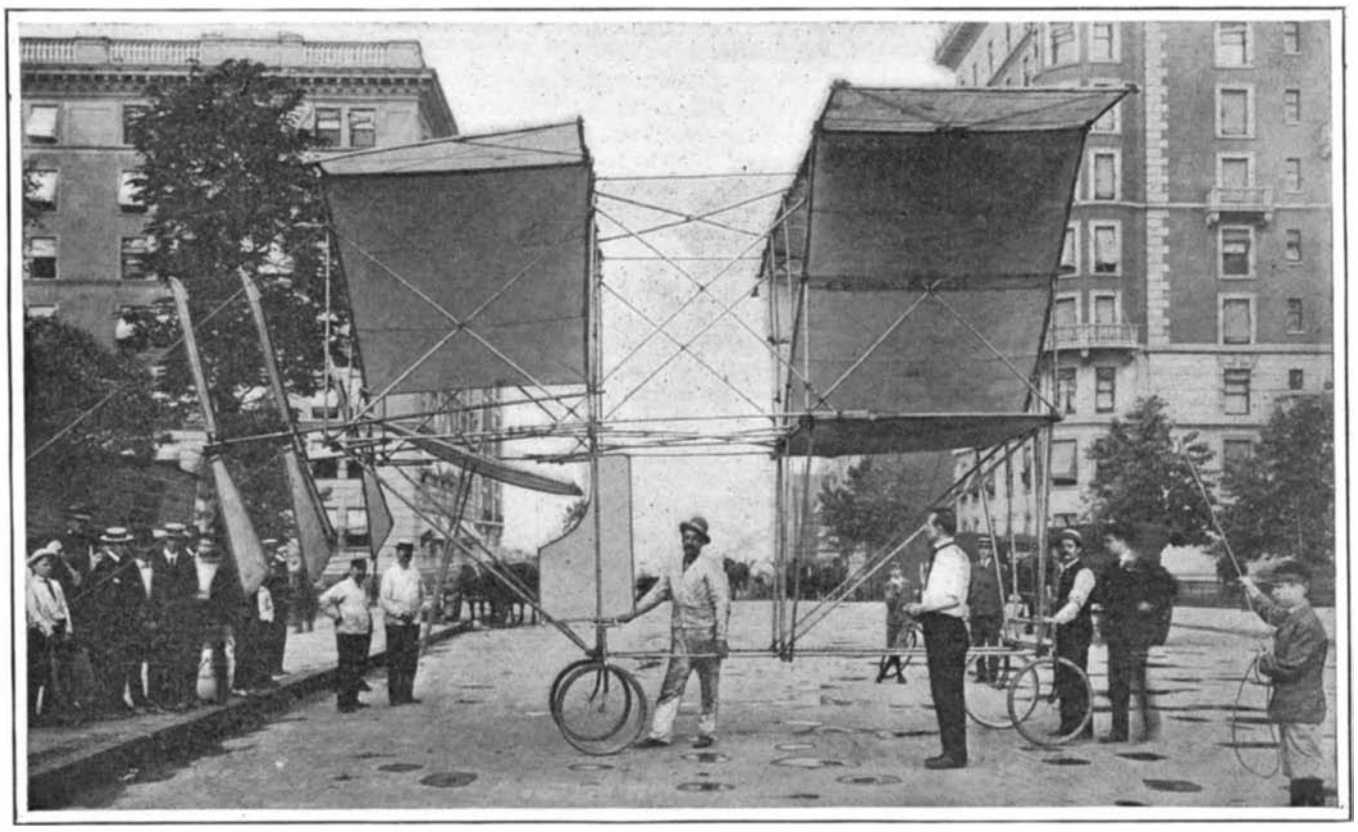
The inside diameter of the chimney is 18 feet, and the outside 21 feet. From base to apex the chimney is reinforced with T iron according to the Weber system.

The bridge built by J. W. Murphy in 1863, over the Lehigh River at Mauch Chunk, for the Lehigh Valley Railroad, was the first pin-connected bridge constructed entirely of wrought iron in its main members; cast iron being used only for joint boxes connecting the compression members. Many bridges of similar construction were built after this, but it was not until after the failure of the Ashtabula Bridge, in 1876, that cast iron was entirely discarded as too unreliable a material to be used in any parts of a railroad bridge.

A NEW AEROPLANE.

BY ISRAEL LUDLOW.

The following points in flying by means of the aeroplane must be cleared, either by study of the past efforts of others, or by personal experiments: The supporting power of the air, the resistance to a forward movement in it, the extent in square feet of the supporting surface, the form of the flying machine, the material of which it is to be built, the power of the motor to be employed, whether propellers or moving wings are to be used, the form of rudders or other expedients for effecting the steering and starting, the maintenance of the equilibrium, and the plan of safely alighting.



Side View of the Ludlow Aeroplane, Showing Arrangement of Supporting Planes, Rudder, and Propellers.

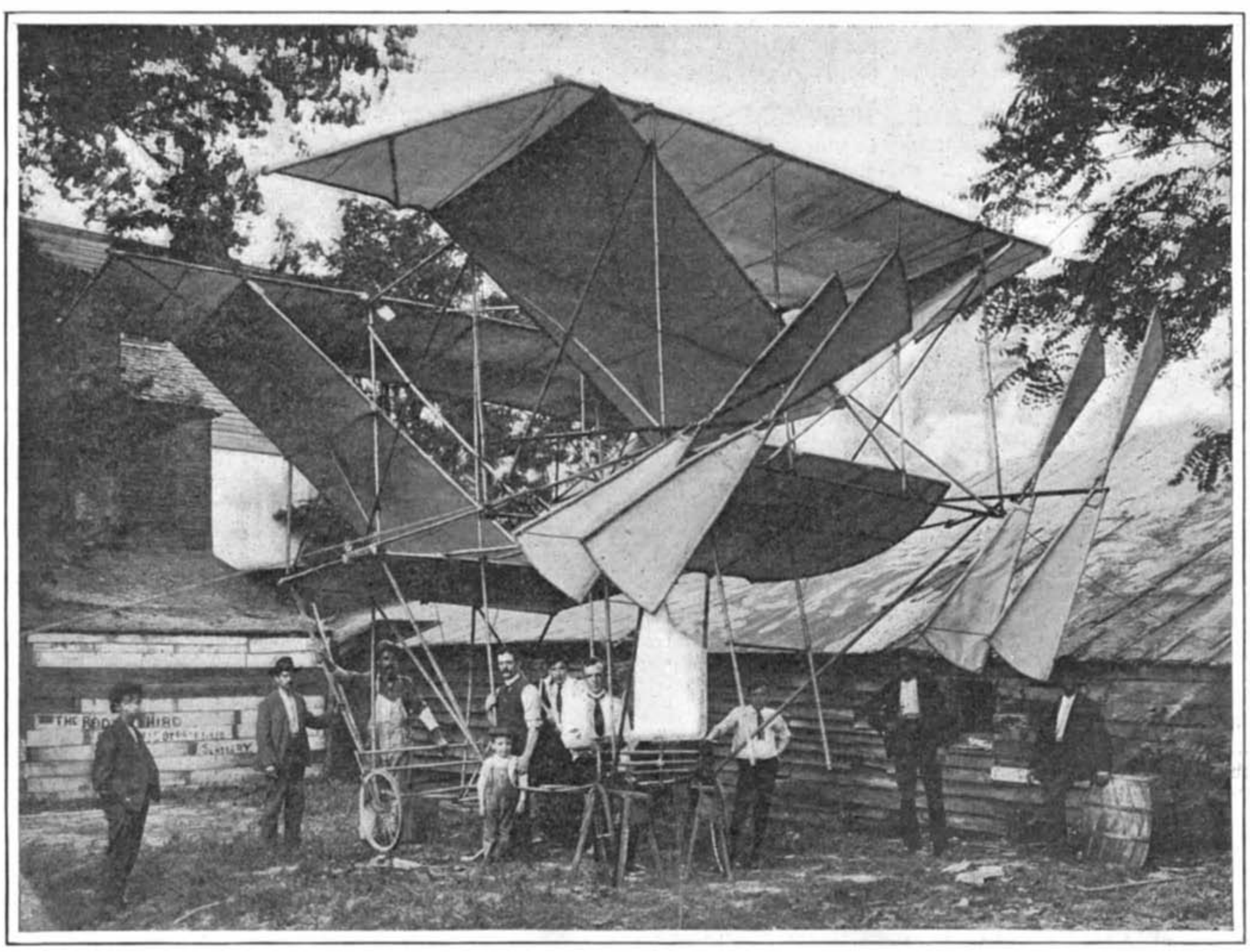
The supporting power of the air has been determined. Prof. S. P. Langley, of the Smithsonian Institution, Washington, D. C., sustained under favorable conditions by aeroplane a maximum of 200 pounds per horse-power expended. This result was reached by placing the aeroplanes at the end of a long arm revolving about a fixed center. Hiram Maxim, Mr. Hargrave, and others have constructed motors weighing less than 10 pounds for each horse-power developed. Propulsion and lifting power are solved problems, and it is obvious that there is the margin between 10 pounds and 200 pounds to carry the weight of the aviator and the flying machine. Care and attention must therefore be devoted to the general form of the machine, with the object of obtaining automatic equilibrium and safe support.

After numerous experiments with models, many of them on different lines from any previously constructed, and many of them very successful and encouraging, I have begun and nearly completed the construction of a full-size flying machine. It is built on the aeroplane principle, that is, it has no gasbag or balloon to support it, but is supported in air only when in motion, and by the upward reaction of the air upon the underside of thin fixed surfaces or aeroplanes, which are slightly inclined to the line of motion.

The framework is of light bamboo, of one and one-quarter inches, and is covered with light canvas treated with a preparation of boiled linseed oil and a drier. The joints are bolted with 3/16-inch bolts, and bound with light yacht marlin. There are two groups of three superimposed aeroplanes placed by pairs in tandem fashion. A large supporting surface with a manageable area and less weight of frame is gained by using superimposed aeroplanes in this manner. The two halves of each of the two middle aeroplanes are set at a diedral angle with each other.

The upper forward aeroplane is a trapezoid in shape. Its forward edge is 13 feet in length, its rear edge is 18 feet. Its sides are 7 feet 3 inches in length, and it has a depth of 6½ feet. The middle front aeroplane forms a diedral angle with the top of its sides reaching the upper aeroplane, and its two halves are 7½ feet long, with a depth of 6½ feet. The lower front aeroplane is rectangular in shape, and has a width of 10 feet and a depth of 6½ feet. The open space dividing the two sets of aeroplanes is 6 feet wide.

The upper rear aeroplane is rectangular in shape, and 21 feet by 6½ feet in width and depth. The two halves of the middle or diedral angle rear aeroplane are each 11 feet wide by 6½ feet in depth. The lower rear aeroplane is rectangular in shape, and 9 feet by 6½ feet in width and depth.



Stern View of the Ludlow Aeroplane, Showing Double Set of Propellers.

A NEW AEROPLANE.

There is a total of 556¼ square feet of surface; but as the supporting surface of the diedral angle aeroplane is not greater than the horizontal projection of such diedral angle aeroplane, the supporting surface is calculated at 491¼ square feet. These diedral angle aeroplanes give direction to the line of flight, prevent oscillation, and overcome a tendency of the machine to turn around on its center of gravity. They also give lateral stability; for when the machine tilts, the halves of the diedral angle of the aeroplanes which are down are more horizontal than those on the other side, and receive consequently greater air pressure, and the equilibrium of the flying machine is recovered.

Longitudinal equilibrium is gained by dividing the air current that passes the under surface of the aeroplanes. It is apparent that any upward or downward tendency of either the fore or aft aeroplanes is counterbalanced by the opposite effects on the other planes. The light connecting rod crossing the open space between the fore and aft aeroplanes forms the fulcrum upon which this force of the wind acts.

The inclosed triangular chamber formed by the diedral angles of the middle aeroplane with the upper aeroplanes gives direction to the air current passing through them, and imparts additional steadiness to the flying machine. The edges of the diedral angle aeroplanes not extending to the edges of the two upper aeroplanes, a further improvement in the stability is gained by leaving the same yielding and elastic under pressure.

The position of the aviator, as that of the motor, is below the aeroplanes. This brings the center of gravity below the center of pressure. By a simple arrangement of levers in connection with the lower front aeroplane, which also is a rudder acting horizontally, automatic equilibrium is imparted to the flying machine by the shifting of the position of the aviator caused by the tilting of the flying machine upward or downward. This pendulum motion of shifting the center of gravity with reference to the center of pressure can be enlarged at will, and made to correspond to the change in the center of pressure produced by the alteration in the angle of incidence or by greater speed, and assists the efforts of the horizontal rudder to correct the undue tendency to ascend or descend.

The machine is mounted on four wheels, the two front ones being capable of guidance. This arrangement permits alighting at an acute angle and rolling upon the ground until momentum is exhausted; or to gain headway by running along the ground before starting in flight.

My weight is 167 pounds. The weight of the flying machine without the motor is 165 pounds. The motor will weigh about 75 pounds. Giving a total weight of 307 pounds, or 1.6 square feet of surface for each pound of weight to be lifted. That this proportion of square feet of surface to pounds in weight is most desirable, was verified by many experiments with models and man-lifting kites.

Examples of this sort in nature are not very conclusive. The dragon-fly and the gnat, if their proportions were magnified until each weighed a pound, would have 25 and 50 square feet of surface respectively. The condor, the largest soaring bird, weighs 17 pounds and has less than 10 square feet of supporting area. The ratio of the wing surface of the swallow to its weight is about 3½ to 1. The giant petrel (*Procellaria gigantea*) a wonderful example of long-sustained flight, with at times absolutely motionless wings, has a ratio of 1.56 square feet of surface to each pound of weight, and is supposed to expend less than 5/100 of a horse-power of effort to keep itself afloat in the air.

At an angle of flight of ten degrees, the air reaction, according to the table compiled by Prof. S. P. Langley, from the result of exhaustive experiments, in which experiments he was aided by an appropriation from the United States government, is 30 per cent of the normal pressure of the air striking the plane at an angle of 90 degrees.

At a velocity of 30 miles an hour, or 2,640 feet per minute, the wind, according to Smeaton's formula, exerts a pressure on a plane at right angles to the current of 4.5 pounds to each square foot of surface. The supporting power of the flying machine running at 30 miles an hour will therefore be 491¼ times 4.5 times 0.30, or 662.85 pounds sustained. Inasmuch as the total weight to be lifted is less than half that figure, and as neither the drift nor the body, the edge of the wings, braces or other resistance will require that large margin of resistance, it is likely that a less speed or a smaller angle of incidence to horizontal progression will be sufficient.

There are two propellers of four blades each, 8 feet in diameter, and varying in width from 5 inches to 18 inches at the extreme edge. The skeleton structure of the propellers is of bamboo, and is covered with light oil canvas. The blades are in pairs, one behind the other, and connected together with diagonal struts and ties, so that in motion the members of one blade will be in compression and the other in tension.

While I have made application for letters patent for various parts of my flying machine, I have no desire to preclude anyone else experimenting along the same lines, and it is because I believe for the general advancement of the science that one should communicate results with others who may be interested in the same field, that I make public these experiments. It will be pleasant to record success at the trial, but progress in this science has so far been built upon failures. If, however, the flying machine should not fly, it will be no reason why this research should be abandoned, for success is often built on failures.

THE TEMPLE OF ABU SIMBEL.

The forgotten and half-obliterated civilization of ancient Egypt has given us few more splendid evidences of its departed magnificence than the ruins of the sanctuaries at Abu Simbel. These are counted among the most stupendous monuments of early Egyptian architecture, and even the gigantic edifices found in Egypt proper are hardly more interesting. Abu Simbel is located on the west bank of the Nile, between Korosko and Wady Halfa, in Nubia. The illustration herewith is of the entrance to the so-called Great Temple, which was dedicated primarily to the gods Ammon-Rē of Thebes and Rē-Harmachis of Heliopolis, though Ptah of Memphis and the deified Rameses II., who founded it nearly thirteen centuries before Christ, were also worshiped by its votaries. Burckhardt, in 1812, first called the attention of Egyptologists to this sanctuary. In subsequent years Belzoni, Lepsius, and Mariette repeatedly freed the temple from the sands of the shifting west desert and laid bare the wonders of the inner chambers. In 1892 Capt. Johnstone, R.E., restored the façade and built two walls to protect the temple from the encroaching sands.

The longer axis of the Great Temple runs almost due east and west, with the entrance at the eastern extremity, so that the rays of the rising sun penetrate even to the innermost sanctuary. The length of the rock-temple, hewn out of the living granite of the hillside, is 180 feet from the threshold of the entrance to the back of the innermost chamber. A flight of steps leads from the river to the fore-court carved out of the steeply sloping cliff. At the rear of this fore-court rises the imposing façade with its rows of graven captives, its hollow cornice and embellished balustrade. The entrance is at the center, flanked on the north and the south by pairs of colossal statues of Rameses II., the northern pair shown in the accompanying engraving. The temple proper consists of an eight-pillared, Great Hypostyle Hall, 58 feet by 54 feet, corresponding to the covered colonnades of the temples built in the open, a four-pillared Small Hypostyle Hall, 36 by 24 feet, a transverse chamber connected with the latter by three doors, and the inner sanctuary. Besides this, there are eight smaller chambers adjoining either the large or small hall, which were evidently used as storerooms for the temple utensils and furniture. The walls, the ceilings, and the square pillars are covered with reliefs, still vividly colored and of great historical value. They usually depict events of importance that occurred during the reign of Rameses II., but in some cases the intention of the artists appears to have been to secure decorative effects only.

Remarkable as the temple proper is, the real interest in the structure centers in the colossi of Rameses II. grouped about the entrance and hewn out of the cliff against which their backs are placed. Each of these gigantic figures, 65 feet in height, is larger than the world-famous colossi of Memnon, and despite the enormous scale on which they are executed, the workmanship is admirable. The pleasing, intelligent countenance and characteristic nose of the great Pharaoh are best preserved in the southernmost statue, though the northern pair shown in the photograph are little inferior. The second colossus has unfortunately been partially destroyed, and the head and shoulders, which have fallen from the rest of the body, lie upon the ground at its base. The supporting stonework under the cracked right arm of the first of the colossi in the photograph was placed in that position by one of the later kings of the 19th Dynasty, probably some ten or eleven centuries B. C.

Rameses II. is shown in the statues with the double crown of Upper and Lower Egypt. His hands rest upon his knees and from his neck depends a ring bearing his name. This is also carved upon the upper arm and between the legs. To the right and left of each colossus and in various other places are smaller figures of other members of the royal family. Upon the southern pair of statues are several Greek, Carian, and Phœnician inscriptions of considerable philological and historical interest, which were carved by soldiers of military expeditions which had penetrated as far as Abu Simbel during the centuries following the construction of the Great Temple.

It is almost impossible to describe the majesty and splendid dignity of these tremendous figures. To be truly appreciated they must be viewed under the dazzling glare of the Egyptian sun or the brilliant whiteness of the Egyptian moon. Even the human figure standing upon the hand of the statue as shown in the photograph helps us but dimly to comprehend with what infinite toil and patience the thousands of slaves and bondsmen, laboring with their primitive tools under the sting of the taskmasters' lashes, hewed these monster human likenesses from the living granite. And even though our understanding of the methods with which they wrought and the purposes for which they raised their edifices is but too often fragmentary, our admiration for these old Egyptian builders is boundless, and we can only regret that Time, the destroyer, made it impossible for us to complete the record.

Correspondence.

Where Did the Photographer Stand?

To the Editor of the Scientific American:

The article in your issue of June 10, 1905, entitled "Where Was the Camera Set Up?" by Prof. William F. Rigge, has been of special interest to me.

I wish to thank the professor for his novel solution of a somewhat difficult problem; and at the same time I take the liberty of calling his attention to the fact that his last statement appears to be somewhat erroneous.

Were the picture plane parallel with the front of the observatory, the mortar lines in the front of the transit room would have retained their normal position in the photograph, but as near as I can tell from the reduced cut, accompanying the article, they vanish at a point on the horizon 347 feet to the right of *O*. This is the vanishing point of east-and-west lines, or *V R*. If a transit is set up at this point and trained on the optical center of the camera, the line will be found to be due east and west, or at right angles with the line from the camera to point *O*. Then train the transit on *O*, and the angle will be found to be very nearly 10 deg. 45 min. and the course will be N. 89 deg. 15 min. W., showing that the plate in the camera formed an angle of about 10 deg. 45 min. with the front of the observatory, instead of about 8 deg., as stated, and the entire front of the building would measure 4 and 9/16 inches instead of 4⅛ inches, as it does in the cut, showing that the lines are reduced a little more than 10 per cent. The angle of the picture plane with the front of the building also accounts for the apparent shortening of the wall space at the left of the door to the equatorial room, which, were they parallel, would show a trifle larger than that between the door and angle at the right.

Pittston, Pa., June 13, 1905. B. F. Crawford.

The Intelligence of a Cat.

To the Editor of the Scientific American:

I have read with much interest the letters in the Scientific American describing how cats opened doors by climbing to the old-fashioned thumb catch and pulling it down with their paws. In confirmation of the evident reasoning powers of cats, I want to relate to you what a cat did that I owned a few years ago.

One night my wife and I were awakened by the door bell ringing. My wife got out of bed and answered the call by asking, "Who's there?" Not receiving a response, she opened the door and in bounded the cat with a "Meouw," as much as to say, "Thank you for letting me in." We could hardly credit the belief that the cat had rung the door bell, but we were convinced of this fact later on. A neighbor called our attention to it soon after by saying that she had seen our cat ring the door bell that afternoon by standing on his hind legs and with his front paws busily engaged in pulling the handle up and down until it rang.

Whenever he wanted to get in the house in the night time he would ring the bell, much to our disgust, so I thought I would lock him up in an old hen coop after supper. This worked well for a few nights, until he got wise to the fact, and then he made himself conspicuous by his absence, and all the calling I could do would not bring him in sight, although he was very much attached to me. Later on, however, after we had gotten sound asleep, the door bell would ring again and I would let him in.

I have owned a number of very smart cats, but this one exhibited greater reasoning powers than any cat I ever saw, but like the good boys and girls in story books, he died young, giving up the ghost soon after he was a year old. C. De Vos.

Coopersville, Mich., July 5, 1905.

American Homes and Gardens.

To the Editor of the Scientific American:

Please accept our most sincere congratulations upon your new departure in the field of literature and magazine publication.

A better title than "American Homes and Gardens" could never have been chosen, and the table of contents, *per se*, gives assurance of unfailing interest from beginning to end.

The success of such an enterprise under the auspices of the Scientific American is a foregone conclusion. The word "American" appeals to everyone who is inspired with love of country and patriotic pride and the word "Homes" is as broad and dear in its signification as the very globe upon which we live. "Gardens," too, conveys the true idea of what the surroundings should be, of beautiful grounds, large or small, as the case may be, which should constitute the real foundation that nature itself has provided for homes everywhere.

Not the "cooped-up" flat for the average, nor the costly apartment house for the rich, nor the squalid tenement for the poor, but "American Homes and Gardens" for all; let the cost be what it may, regulated by the income or financial ability, yet with every possible comfort, every convenience, and the best decoration.

Scientific knowledge of new methods and plans for construction, hints for the exterior and interior illustrations, charming in reality and helpful in suggestion, besides articles upon current topics of the most comprehensive character, as perfectly described in your editorial, present an almost unlimited province for thought, investigation, and practical enterprise.

Years ago, we wondered why the Building Monthly did not develop into such a magazine, which now gives every promise of realization in fact of all that the projectors have formulated theoretically.

MRS. EDWARD P. FOSTER.

Cincinnati, Ohio, July 3, 1905.

THE SIXTH INTERNATIONAL AUTOMOBILE RACE FOR THE BENNETT TROPHY.

On July 5, for the fourth time, the Bennett trophy was won by a French machine. Not only this, but, what is more notable still, by a machine almost identical in construction to that which won it last year, and driven by the same successful chauffeur, Leon Théry. The race this year was over the same course that the French eliminating trials were held upon three weeks before—a circular course 85.35 miles in length, known as the Auvergne circuit. The course had more sharp turns, steep pitches, and narrow stretches than any on which the race has been run heretofore, and that an average speed of over 47½ miles an hour was maintained by the winner in traversing it four times speaks well for his driving and for the car. That familiarity with the course has considerable to do with winning a race is shown by the fact that in this, the second race he has won upon it, Théry increased his average from 45½ to 47.63 miles an hour.

Eighteen machines were entered in the race this year, the following six countries being represented: England by two horizontal-cylinder Wolseley machines and a Napier; France by two Richard-Brazier cars and a De Dietrich; Germany by three Mercedes; Austria, ditto; Italy, three Fiats; and America, two Pope-Toledos and a Locomobile. With the exception of the Wolseley machines, all had four-cylinder vertical gasoline engines capable of developing something like 100 horse-power. The two Pope-Toledo machines were the lowest-powered of the lot, they being only 50 horse-power each.

The start was made at Laschamps at 6 A. M., Théry on his Richard-Brazier being the first to get away. The other cars followed at five-minute intervals, the 140-horse-power Locomobile driven by Tracy being the last machine to be dispatched (at 7.25 A. M.). Only 15 minutes later Théry reappeared, he having made the first round in 1 h. 41 m. Car No. 6—Lancia's Fiat—made the fastest time on its first round, viz., 1 h. 35 m., which is equivalent to a speed of 53.9 miles an hour. The machine dropped out in the second round, however, owing to a stone hitting the radiator and breaking it, so that the water leaked out. After this accident to the Italian car, Théry had no formidable rival. His machine ran like clockwork, and owing to its being equipped with improved Michelin tires, the tire trouble which he experienced was comparatively slight and new tires were quickly obtained. That any tires can be built to stand the strain of taking such sharp corners as that shown in one of our illustrations at speed, seems marvelous; but when such corners have to be rounded every few minutes in the course of a seven hours' run, much depends on the judgment and skill of the driver as to whether the tires will last. Let him not slacken his pace properly in making the turn and the result is almost certain to be a burst tire. Even Théry is said to have had the shoes of his car replaced twice, besides having to repair several punctures on the road. Upon pulling up at a tire station, four men quickly jacked up the machine, while others removed the old tires and put on new ones, which were almost instantly inflated by compressed air stored in reservoirs for the purpose. Only 5½ minutes were required in which to change all four tires. The race may be said to have been a race of tires; and it is at any rate partly owing to the extensive preparations for their renewal that the victory went to a French car.

On a course of this nature, one would naturally expect the machines having the greatest horse-power to make the fastest time, on account of their more rapid acceleration. Such is not always the case, however; and a long-distance automobile road race bears a resemblance to the fabled race of the hare and the tortoise, in that the ability to go and keep going, even if the speed is not of the highest, often gains a machine a prominent place. A case in point is that of the 50-horse-power Pope-Toledo driven by Lytle. A stone flew up and struck the main oil pipe of this machine in the early part of the race, but the mechanic managed to hold the pipe together, and the race was finished in this manner, the car obtaining twelfth place, although the engine received scarcely any oil. The Locomobile racer broke a chain in the first round, and later developed trouble with the clutch-shifting collar, such that it was obliged to drop out of the race on the second round. It may be recalled that Lytle is the driver who finished in the Vanderbilt race last year after many mishaps. In both events he has shown great perseverance and, although driving a low-powered car, has managed to finish in spite of all difficulties. He is to be rewarded, we understand, by being placed at the wheel of a powerful six-cylinder Pope-Toledo racer now building for the Vanderbilt race on Long Island on October 14.

As the race progressed, it was seen that Théry was in the lead, and he was anxiously awaited at the starting point at each successive lap. He finally came around for the fourth time at 1.10 P. M., having won the race in 7 hours and 10 minutes. Cagno, on a 120-horse-power Fiat, got second place in 7:26, and Nazzaro, on another Fiat, third in 7:27. Fourth place went to Callois on the second Richard-Brazier, his time being 7 hours and 29 minutes. Earp, on an 80-horse-power Napier machine, was fifth in 8 h. 30 min., while an Austrian Mercedes driven by Braun came in sixth. None of the other Mercedes machines made a favorable showing. Next to the French the Italians did the best. That their running was very uniform is shown by their finishing only one minute apart. It is significant that the first four cars to finish within 19 minutes were equipped with Truffault-Hartford shock absorbers.

SOME NEW AUTOMOBILE TRACK RECORDS.

In America track racing is more in vogue this year than ever before, and meets in the vicinity of New York are being held almost weekly throughout the season. At one of these, held on July 3 and 4, a new mile record of 48 4-5 seconds was made by a White steam racer, and a new Christie machine with a motor incorporated in both front and rear axles made its appearance. One of the photos (page 49) shows the rear motor of this peculiar car. The front driving equipment was described in our last Automobile Number. Mr. Christie has built a motor in at the rear of his car in a similar manner, and with the two he gets about 120 horse-power on a straight course, although on a track the car has nearer 100 horse-power available. The rear engine has four 5 x 5¾ cylinders, while the front one has four 6¼ x 6¾. The car has 28-inch wheels in the rear, and 30-inch wheels in the front. The contact boxes of the two motors are connected, so as to advance the spark uniformly for each, but this is the only connection between the two. The front motor is started with a crank as heretofore, but the rear one is set going after the car is in motion, by letting in the clutches. When making the turns on the track, the rear motor is shut off by pressing a button in the steering wheel, which cuts off the ignition current. The cone clutches on the outer face of the motor flywheel are fitted with band brakes on their outside. It was due to the expansion of these clutches from heat developed by a sudden application of the brakes, and the consequent failure of the clutches to hold, that Mr. Christie lost the final heat of the match race between the Chicago Automobile Club and the Automobile Club of America for the Thomas trophy, on July 4. One of the photos shows Webb Jay on the White "Rocket" passing Christie on the last turn, and winning the 5.56-mile race in 5:28 1-5. Christie's time in the previous heat (which he won by 150 yards, although making the last mile on a flat tire) was 5:14 4-5, and his fastest mile 50 1-5 seconds. Another photograph which we reproduce shows Jay making the new track record and going at the rate of 73.77 miles an hour. This is the first time a steam machine of the heavy-weight type has made a world's record on the track, and it is interesting to note that the White racer is built on the same lines as the regular touring car, and is fitted with the same size compound engine, although a larger generator is used, and a pressure of 600 pounds per square inch is carried, or double that used in the ordinary White machine. The racer has a shaft drive with a disconnecting clutch, so that the engine can be run and warmed while the machine is at rest. The frame is hung below the axles, and clears the ground by but 4 inches, which accounts for the great cloud of dust raised by the suction. The weight of the machine is 1,700 pounds.

A new record for middle-weight cars was made by a 24-horse-power Fiat machine, that was specially constructed for track racing. This was a mile in 55 4-5 seconds.

These records were made on the Morris Park race track, which is a long track with a wide unbanked turn at one end and a short, insufficiently-banked curve at the other. A complete circuit of the course equals 1.39 miles. There were several accidents, owing to cars running through the fence at the sharp turn, but fortunately the drivers escaped serious injury.

PEARY'S ARCTIC SHIP, THE "ROOSEVELT."

The new Arctic ship "Roosevelt," which has been built by the Peary Arctic Club to enable Commander Peary to make another attempt to reach the North Pole, is now at New York, taking on stores and equipment for the trip. She is 160 feet long on the load waterline; 184 feet in length over all; with a beam at the waterline of 32 feet, and over the guard-strake of 35 feet 6 inches. She has a depth of 16 feet 6 inches, and at full load has a displacement of about 1,500 tons. The form of the ship and its construction have been designed to meet the severe conditions of the service for which she is built. Her cross section and her diagonals show a model that is very round below the waterline, and indeed, from the guard-strake her sections narrow down to a broad easy bilge, to which there is a very sharp dead rise from the keel. This form is chosen to enable the ship to rise when she is being nipped by the ice, pressure upon her wedge-shaped hull tending to lift her bodily upward. In construction she is certainly the strongest wooden ship, or ship of any kind, ever built; for in addition to her heavy frames, and triple planking and sheathing, she is strutted and trussed from end to end with massive horizontal and diagonal timbers. The stem, sternpost, keel, keelsons, frames, planksheer, and garboard strake are all of selected white oak, all bolted and drift-bolted with more than usual thoroughness. The frames are molded to 16 inches at the heel and 10 inches at the head, and they are placed only 2 feet apart from center to center. To give longitudinal strength, a lattice-work of diagonal straps of steel is laid for the full length of the ship, the distance from strap to strap being about 6 feet. The straps are rabbeted down flush into the outside face of the frames. The skin of the ship consists of two courses of 5-inch planking, the inner course of yellow pine and the outer of white oak. Between the two courses is laid a sheathing of tarred canvas. On the inside the frames are covered with 3-inch white oak ceiling, and it can be seen at once that these four layers of planking and waterproof material will render the ship not only water-tight and stiff, but warm in cold weather. The beams of the main deck are spaced 4 feet apart center to center, and the lower beams are immediately below the deck beams. A system of diagonal struts is worked in between the beams, the whole being thoroughly tied with through-bolts. The system of trussing is completed by a central line of tie-rod stanchions, the tie-rods running down inside the wrought-iron piping. These stanchions are constructed so that they can be tightened up at any time in the same way as the truss rods of the old wooden Howe truss bridges were, that did such good service on our early railroads.

The "Roosevelt" is protected against the grinding of passing ice by special protection at the bow, stern, and waterline. At the bow, an extra thickness of 2½-inch greenheart ice sheathing is worked on from the stem well back onto the body of the ship, and extending to the keel. A belt of the same sheathing, 5 feet wide, reaches at the waterline from stem to stern. The stem and forefoot are protected by a heavy steel strap extending down the cutwater and for a considerable distance aft below the keel. The stern, which is built of white oak, is of great massiveness, and has a similar protection of ¾-inch steel plating and 1-inch strap worked on. It extends from the keel over to the sternpost, and gives great strength to this part of the structure.

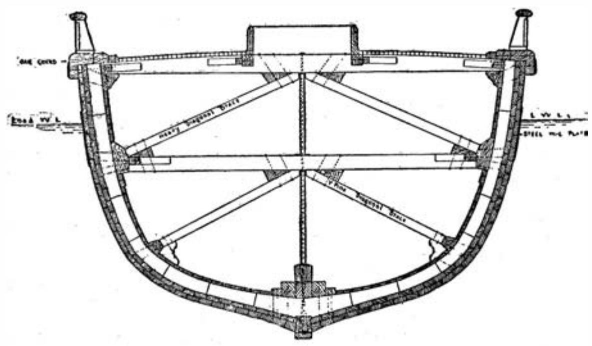
The vessel is provided with two deckhouses; the forward one is portable, and it has been made of sufficient size to accommodate Commander Peary and the officers of the ship. When the "Roosevelt" has been pushed as far north as it is possible to drive her, the plan is to carry the house ashore to serve as winter quarters. The crew are housed in the forward deckhouse, and Commander Peary and his staff have their quarters in the after deckhouse. The ship is heated by steam and lighted both by electricity and oil lamps. The motive power consists of a single, inverted, compound engine, driving a 10-foot four-bladed propeller. Steam is supplied by two water-tube boilers, and, under trial, the "Roosevelt" made about 12 knots. She is expected to have a sustained sea speed of about 11 knots an hour. She will be driven north at about 7 or 8 knots to save fuel. The coal capacity is 500 tons. The ship has a peculiar-looking rig, but one that is designed for the special work she has to do. She is rigged as a three-masted fore-and-aft schooner, and spreads sufficient canvas to enable her to make a fair speed under sail alone.

Two of our photographs show the construction by which it is possible to unship the rudder and the propeller blades while the vessel is at sea. For the rudder a large open well reaching through to the main deck is provided, of sufficient size to enable the massive rudder to be drawn up and hoisted on deck. To do away with the necessity of sending a diver down to release the gudgeons, the latter work in a vertical groove worked into the after end of the sternpost. The pintles are attached to the rudder post by heavy straps, and, in unshipping the rudder, the gudgeons, sliding in the rudder-post groove, come up with the rudder itself. The four propeller blades which, by the way, are of large sectional area and made particularly massive and strong, can also be unshipped by sending a diver down to withdraw the bolts which hold them to the boss. They are drawn up through a well which opens into the body of the ship. By this arrangement the propeller and the rudder can be removed entirely out of harm's way when the ship is in the embrace of the ice pack.

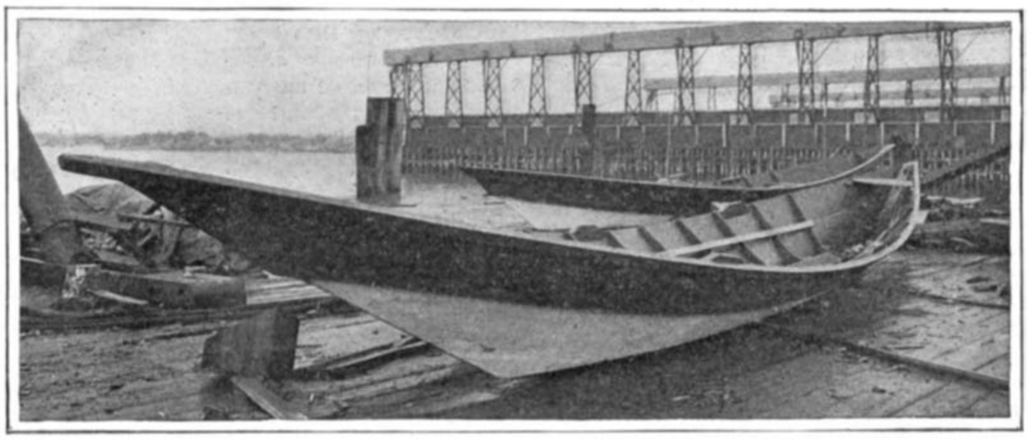
The curious boats shown in one of our illustrations are sealing canoes, which are taken along for the use of the Eskimos in hunting game. Their peculiar sheer and long overhanging bow render them particularly suitable for this work. They are dragged over the ice where it is necessary, and launched whenever open water is reached. The Eskimos propel them with their native paddles, and they are found to be admirably adapted for this work. The total cost of the ship was about $100,000.

From a very early period steam has been used expansively in marine engines, and indeed sometimes to a ridiculous extent. Some engineers as late as the civil war hardly seemed to realize that there was any limit to expansion, although Isherwood's famous experiments on the "Michigan" in 1861 had demonstrated conclusively that, with low pressures, only a very moderate expansion is permissible, beyond which any further expansion is attended by an economic loss. As pressures increased it was natural and correct that a higher range of expansion should be used, and this made practicable the compound engine, where the expansion occurs in two stages, the high pressure steam from the boiler being limited to a small cylinder from which, in turn, the steam of lower pressure is exhausted to a larger cylinder. The compound engine was invented almost as early as Watt's separate condenser, Hornblower's patent dating back to 1771, and Wolff's patent for a two-cylinder engine dating back to 1804. With the low pressures prevalent at that time the compound engine was actually at a disadvantage compared with the simple one. When pressures had gotten up to about 60 pounds, however, the compound engine began to assert itself, the pioneer in that respect being John Elder, of the firm of Randolph & Elder, which is now known as the Fairfield Engine Works. It is interesting to note that the Allan Line of steamers, which is now the pioneer in introducing the steam turbine for an ocean-going steamer, made the last scientific stand against the compound engine, going so far as to take duplicate vessels, and engine one with compound and the other with simple engines of the same power. The actual experience with these two vessels where the simple engine with the high ratio of expansion was constantly in trouble from breaking down, was a convincing proof that high ratios of expansion in a single cylinder were impracticable.

Up to 1840, there were no iron bridges in this country, except suspension bridges, in which iron links were used in the cables and suspenders, the floor-system being of wood. The first bridge in America consisting of iron throughout was built in 1840 by Earl Trumbull over the Erie Canal, in the village of Frankfort, N. Y.

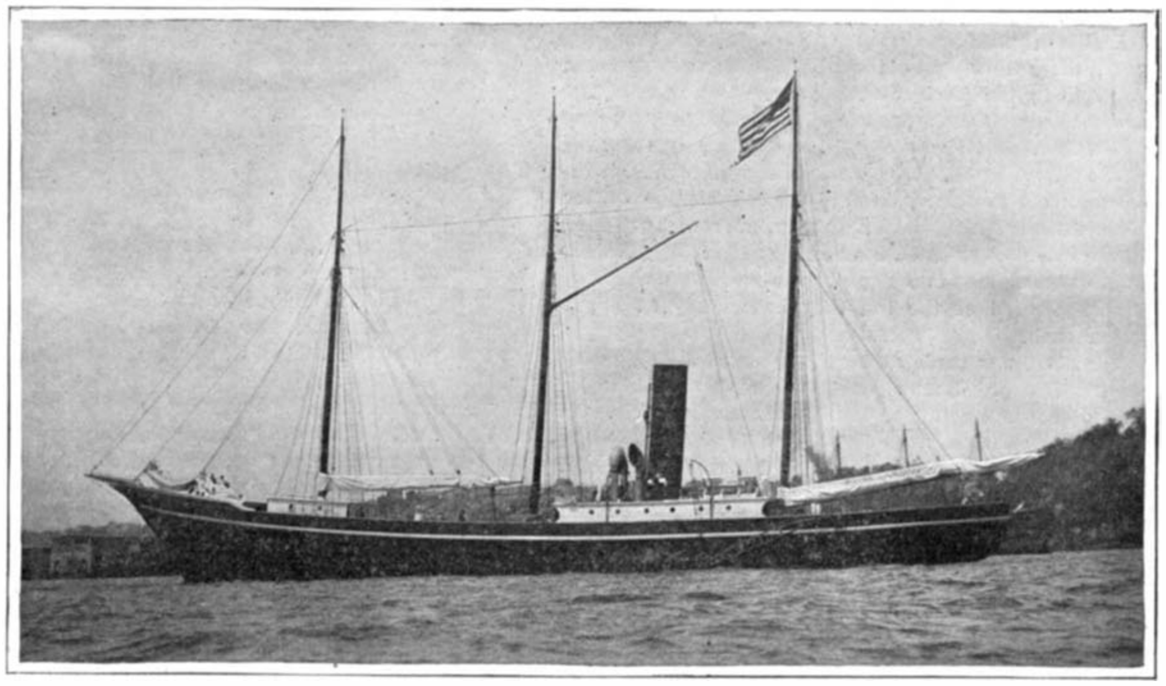


Cross-Section Showing the Strong Construction of the "Roosevelt."

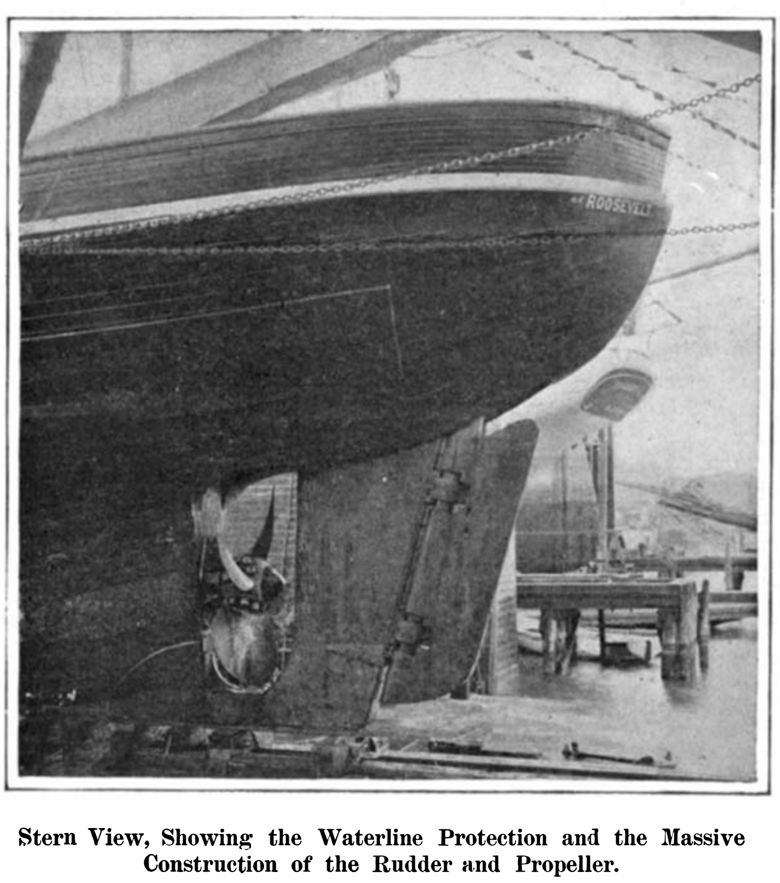


Sealing Canoes for the Eskimo Hunters.

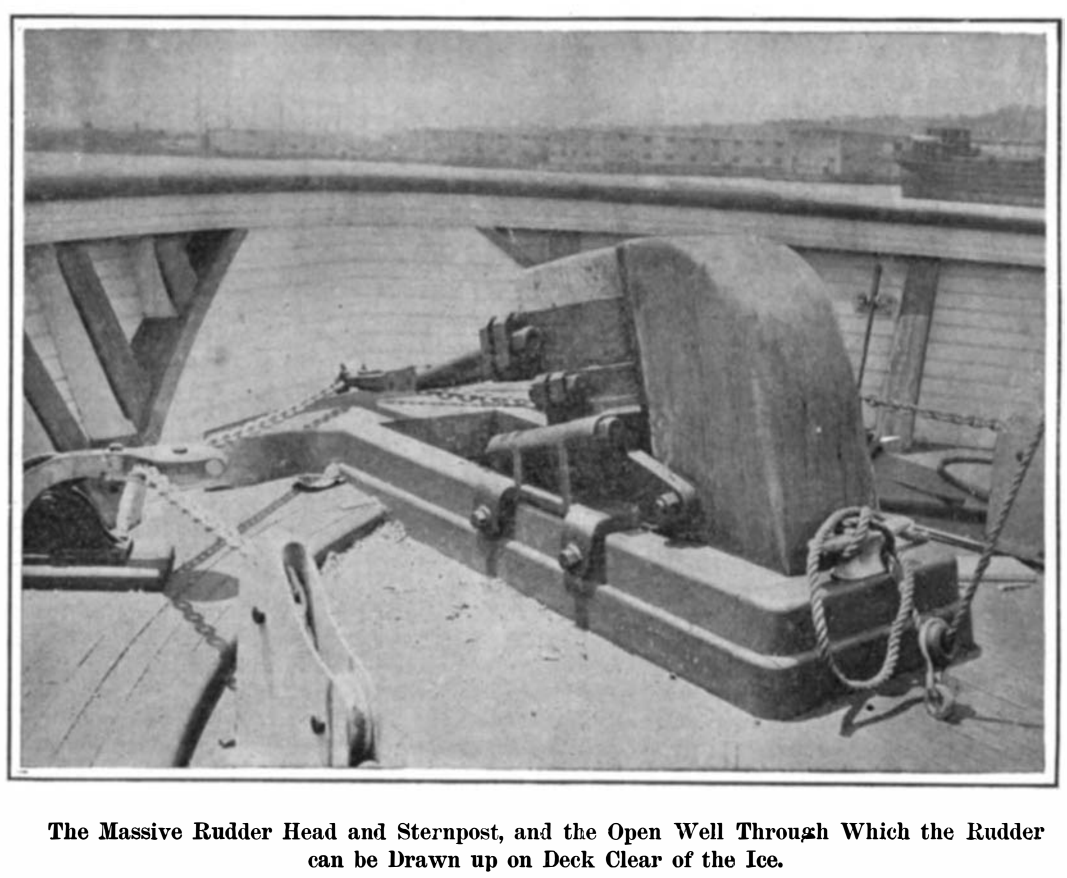
View Showing the Lofty Bow.



The "Roosevelt" Afloat in the Hudson River.

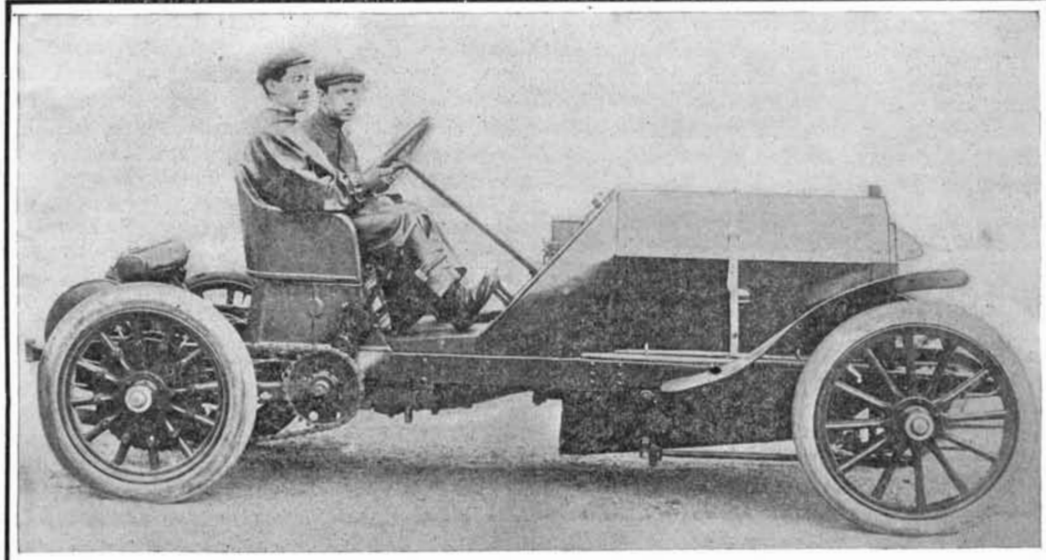


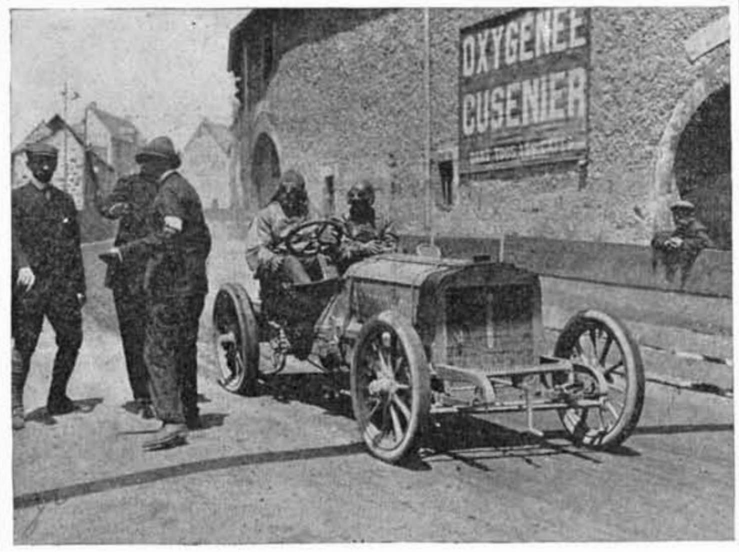
Stern View, Showing the Waterline Protection and the Massive Construction of the Rudder and Propeller.

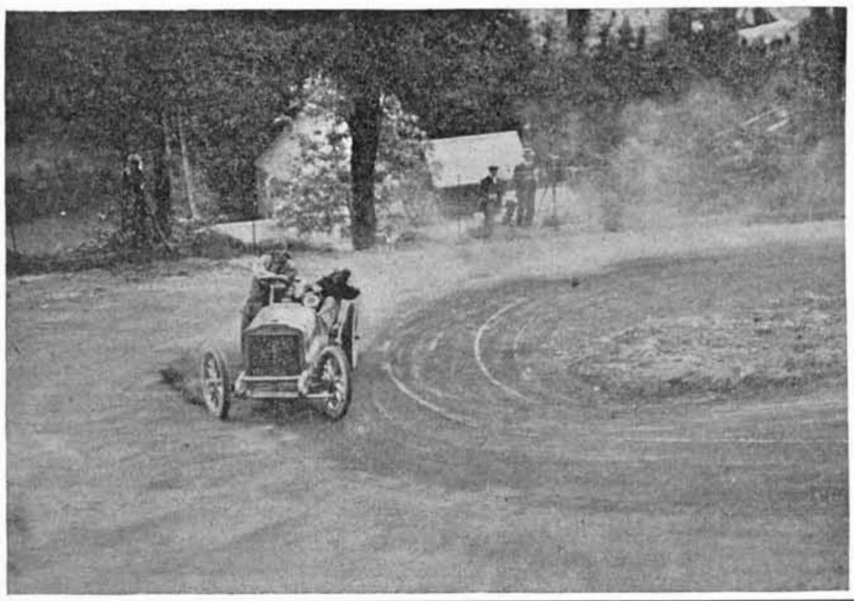


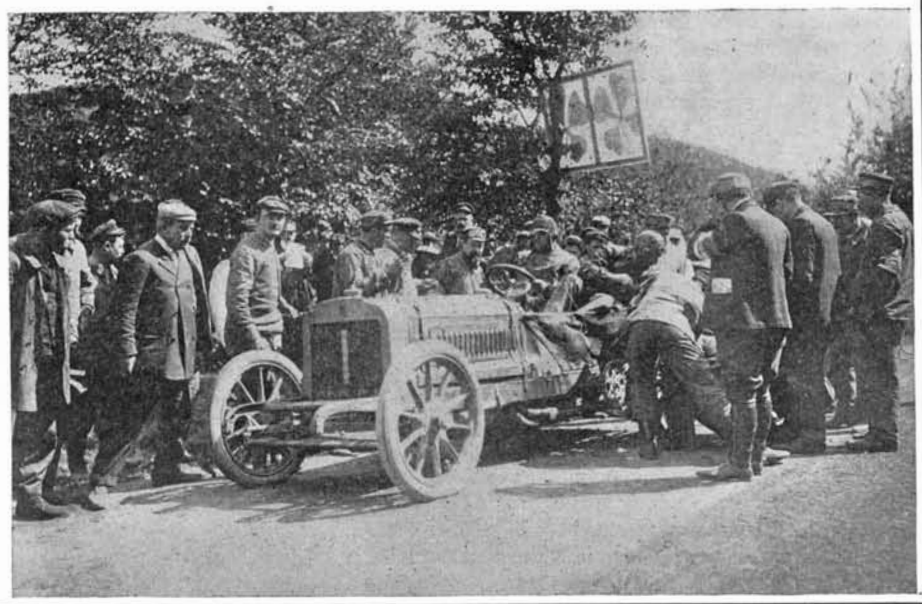
The Massive Rudder Head and Sternpost, and the Open Well Through Which the Rudder can be Drawn up on Deck Clear of the Ice.

COMMANDER PEARY'S NEW ARCTIC SHIP "ROOSEVELT," FOR THE DISCOVERY OF THE NORTH POLE.









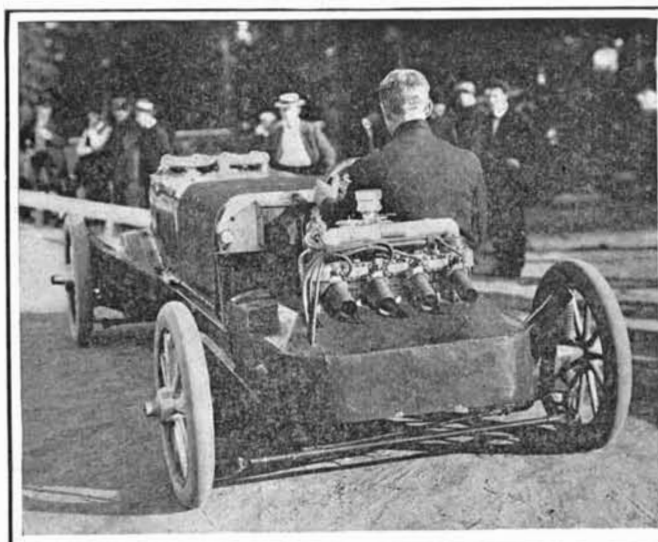
Cagno on his 120-horse-power Fiat which gained second place in 7 hours, 27 minutes.

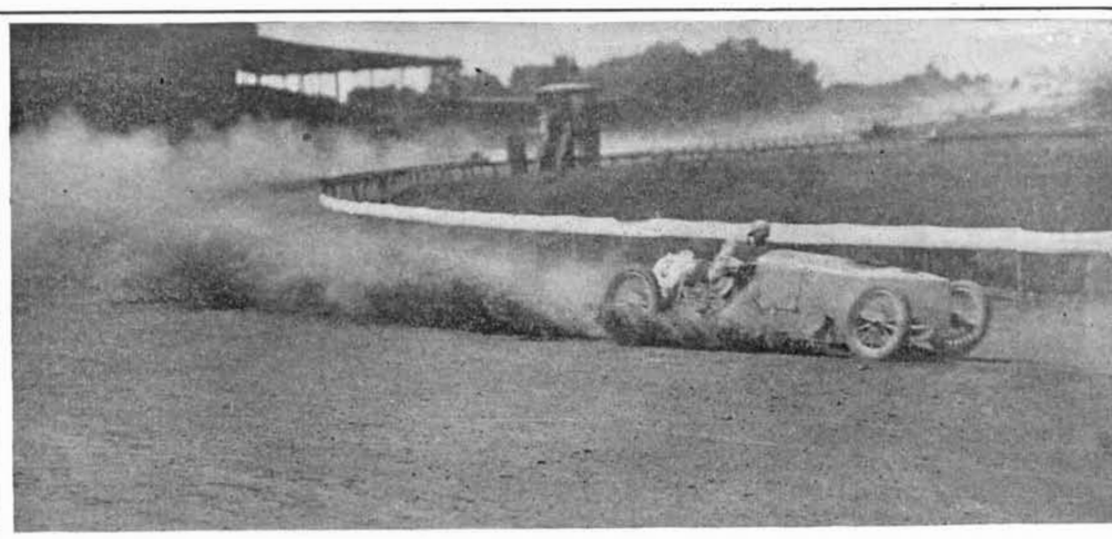
Théry, the winner, on his 96-horse-power Richard-Brazier. Time for the 341 miles : 7 hours, 10 minutes, or an average speed of 47.63 miles an hour.

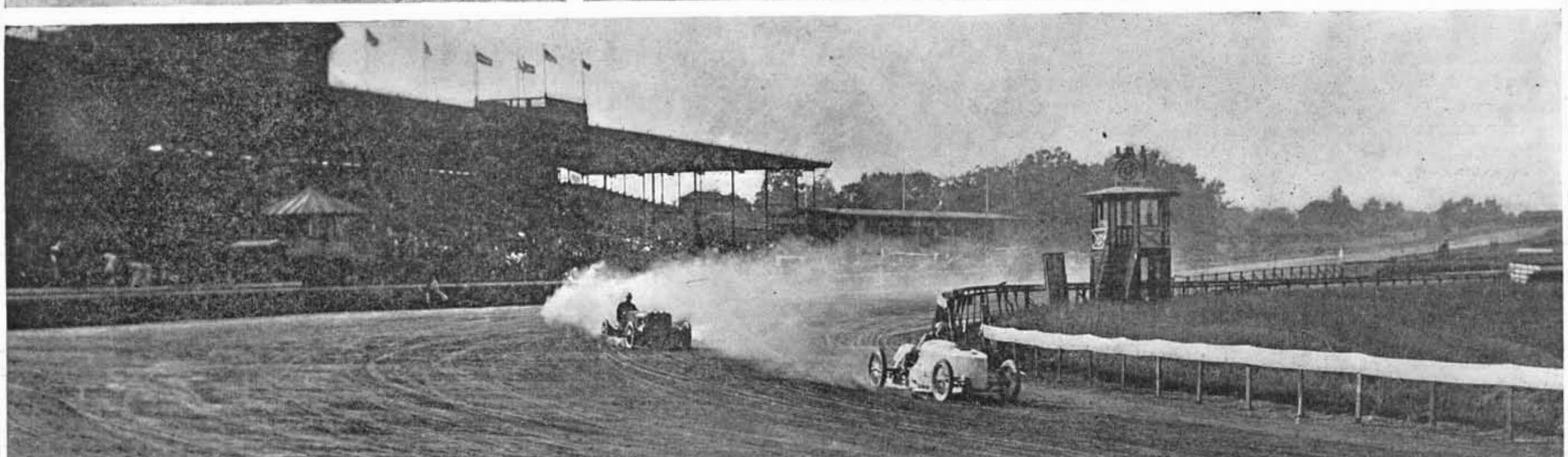
Théry making a sharp turn at speed near the village of Rochefort.

Changing a tire on Théry's machine at a tire repair station.

The Winning Cars in the Sixth International Race for the Bennett Trophy.







The Christie 120-horse-power four-wheel drive racer, showing the four-cylinder motor forming the rear axle and driving the wheels direct. A similar motor drives the front wheels.

Webb Jay traveling 73.77 miles an hour on his 20-horse-power White steam car "Rocket." The machine made a mile in $48\frac{4}{5}$ seconds, which was $3\frac{2}{5}$ seconds less than the best previous record.

The White steam machine passing the Christie racer and winning the Thomas trophy in the final heat of race. Time for the 5.56 miles, $5{:}28\frac{1}{5}$. Christie's time in previous heat was $5{:}14\frac{4}{5}$.

American Racing Cars Making Records on the Morris Park Track.

AUTOMOBILE RACES ON ROAD AND TRACK IN FRANCE AND AMERICA.—[See page 47.]

AN ELECTRICALLY-OPERATED GYROSCOPE.

A NEWLY-DISCOVERED MOTION.

BY EDWARD DURANT.

This specially-constructed gyroscope for use in the College of the City of New York, made by Charles Dressler, from suggestions by Prof. Alfred Compton, is quite new, in that it produces its own motion through the medium of electricity. Within the stationary ring mounted on the stand are carried the conducting wires, which convey the current from the binding posts to mercury cups located at the gimbal pivots of the two movable rings, and thence to the magnetic field ring and the armature brushes. One movable ring is pivoted to rotate in a vertical plane. The magnetic wire-wound field ring is gimbaled to rotate in a horizontal plane, while the armature, composed of a large disk encasing within the armature wires, is pivoted vertically in the field ring, and is in line with the vertical axis of the outer movable ring. In the illustration the brushes will be seen above the armature disk. Below is a special swinging weight, made to move to and from the armature disk by a crank-pin wheel operated by a worm screw on the armature shaft meshing with teeth on the crank wheel. The shaft of the motor is in the nature of a pendulum having the movable weight at the bottom. When set in motion electrically it has the function of a gyroscope, and if it is placed by hand in a position at right angles to the normal, or, in other words, in a horizontal position, while spinning, it will describe an orbital circuit like a planet or satellite, and revolve in a plane parallel with, or tangential to, the earth's surface.

The armature shaft supporting the pendulum weight then becomes a rotating radius vector, and the pendulum weight or armature disk becomes a miniature spinning, planetary mass, revolving in orbit with mutual affection between itself, the earth, and other planets.

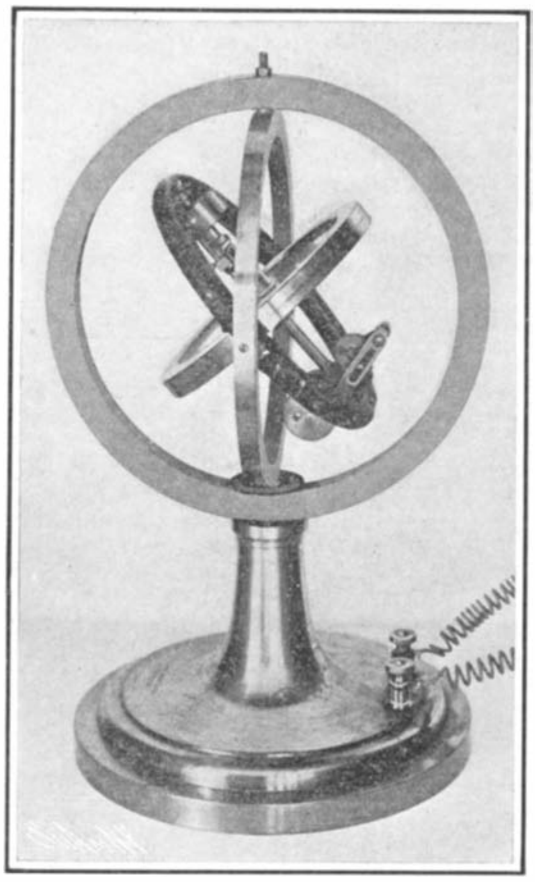
The gyroscope has a constant angular velocity, and a constant orbital time. The separate nutation device attached, consisting of a relatively light weight, oscillated radially by means of the worm gear on the radial shaft, through a small space above the theoretic supporting pivot, brings about the most marvelous mechanical movement yet discovered. The pendulum begins to rise to a horizontal position, as before, but by Nature's influence only; and after it reaches the horizontal position or planetary plane it performs the astronomical nutation phenomenon by gradually stopping and slowly starting again.

What we conceive of as weight or gravitational influence, passes out of the spinning mass to the imaginary supporting point or center of orbit.

When both the supporting rings or gimbals are in the same vertical plane, and the gyroscope wheel is rotating on axis at maximum speed, it will be observed that the gimbals cannot be moved freely by hand, except in the direction of rotation, and a very appreciable resistance is offered when an attempt is made to move the gimbals by hand in the reverse direction.

If the outer gimbal is forced by hand to move in the direction of this phenomenal resistance, the inner gimbal immediately inverts before permitting the outer gimbal to move freely in this same direction it was at first forced.

When the model is at rest the heavy pendulum weight is by no means balanced by the very light oscillating weight.



AN ELECTRICAL GYROSCOPE.

Up to about 1860 the jet condenser was the one usually employed on board ship, which meant, of course, that the boilers were constantly fed with salt water; and this, in turn, meant the deposition of great quantities of sulphate of lime scale on the heating surface. With the low pressure then prevalent this did not greatly affect the economy of the boilers, except that, as "blowing off" to keep the density of the water down was a continuous practice, there was a certain loss of heat, and of course there was the necessity for frequent scaling of the heating surfaces. However, they were effectually protected against corrosion. About 1860 the use of surface condensation became general, and as this greatly reduced the amount of scale formed, it was practicable and safe to increase steam pressures, which accordingly resulted with a consequent reduction in the weight of machinery per unit of power.

THE "WHIRLPOOL" ILLUSION.

We illustrate herewith "The Great Whirlpool," the invention of Mr. Joseph A. Bruce, of Brooklyn, N. Y. This appears to be the latest thriller in the amusement line, and its novelty should appeal to the amusement-loving public.

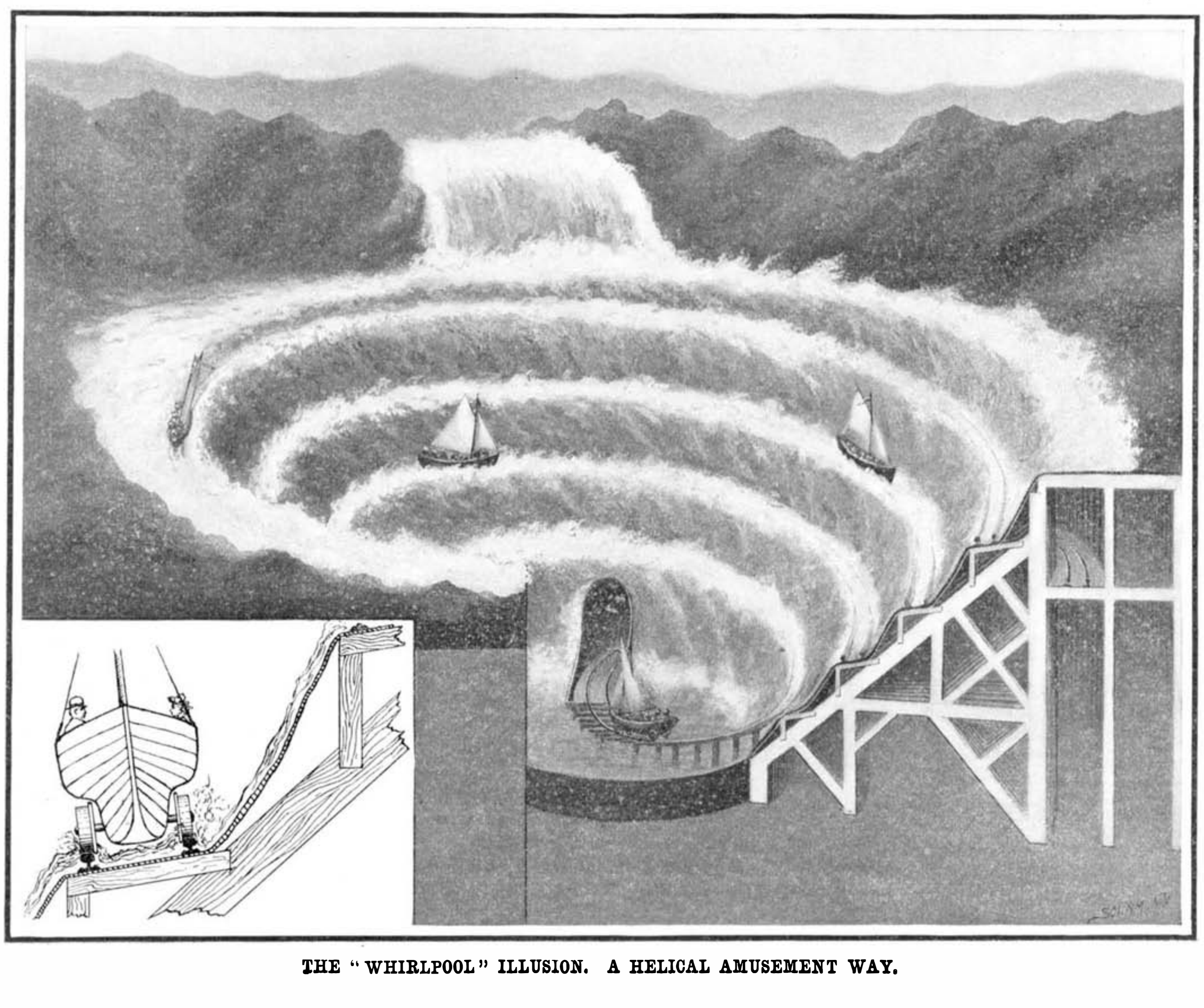
A building over fifty feet high and one hundred feet square is built inside to simulate a monster whirlpool. The passengers who are seeking the sensation ascend in boats by an endless chain from a lobby to the upper interior. As the boats come up, the passengers are confronted by a tremendous waterfall, the water falling from a great height, while the whirlpool proper is at their feet, ninety feet in diameter, the depth being fifty feet. By optical illusions the depth is made apparently much deeper, the waters dashing, jumping, and gyrating to the vortex below, from which the spray ascends. The roar of the mad waters is heard, and the boat starts down an inclined plane or spiral road, going by gravity on tracks at ever-increasing speed until through an opening it disappears at the bottom, apparently sucked into the insatiable depths below. Passing through dark tunnels over many bumps, the boat dashes into the foyer to sunlight and safety.

The building is inclosed, and with the liberal use of electric effects an artistic, realistic, and ingenious exhibition is given.

Our sketch from model shows the interior as the passenger views it when he reaches the top in the boat car; the lower cut gives an idea of the mechanical construction. As shown in the illustration, the interior of the whirlpool, being built as an inverted cone, shelves down with considerable pitch from the top toward the lower center. The shelves contain tracks upon which the boat cars run. From the base of the waterfall there runs all around the building a trough, which carries the water from the falls, and overflowing, it runs down the whirlpool and around the roadway.

The interior is covered with canvas to represent water, and with the electrical effects the whirlpool seems indeed to be a live, mad body of water, restless, hungry, and pitiless. The water descends to a tank at the bottom of the whirlpool, over which is built a bridge upon which the boats pass to make their exit, and from this tank the water is pumped to the top of the building to feed the jumping, spurting, wild, and troubled waterfall. The boats having sails set on the rear side, the passengers are protected from the spray.

Each car is in charge of a man, and as the cars are equipped with safety brakes and are run on signal, all danger of accident is eliminated.



THE "WHIRLPOOL" ILLUSION. A HELICAL AMUSEMENT WAY.

IMPROVED METHODS IN HIGH-SPEED CHRONO-PHOTOGRAPHY.

BY DR. ALFRED GRADENWITZ.

Instantaneous photography, and especially the chronophotography of a moving object, have enabled us to recognize the true nature of some animal motions of which we have had but very hazy conceptions. The operation of the cinematographic camera consists essentially in moving a sensitized film behind a photographic objective, and stopping it for a moment at regular intervals while an exposure is made. For ordinary purposes a rate of ten to twenty views per second is quite sufficient to photograph the different phases of motion. On viewing in a similar intermittently working outfit the series of photographs taken, the impression of a continuous motion is produced. For more rapid movements, however, the rate mentioned proves insufficient, and the late Prof. Marey, of Paris, who paid especial attention to the phenomena of motion, designed some ingenious means of abridging the time of exposure, and thus increasing the number of photographs taken in a second. By intercepting the beam of light with an interlocking disk fitted with narrow slits and rotating at a high speed, he was able to obtain photographs of flying insects in 1-25,000 second. The same process was subsequently made use of by Lendenfeld, who succeeded in reducing the time of exposure to 1-42,000 sec. He was the first who succeeded in employing a continuously moving instead of an intermittently moving film for the dissociation of the images by means of his high frequencies. By employing a rapidly oscillating mirror he produced on a fixed plate images which were separated by intervals of 1-2,150 of a second.

The series of images obtained by this method are

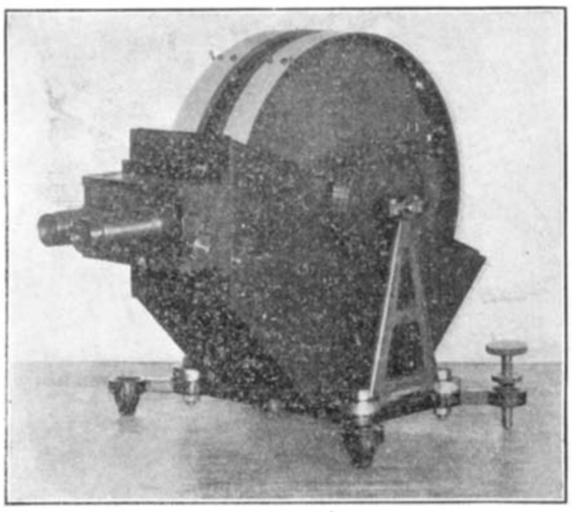


Fig. 1.—Bull Chronophotographic Camera with Cover Removed.

rather short and hardly adapted for a synthetic reproduction of motion. Moreover, they are somewhat blurred owing to the time of illumination, which despite the rapidity of exposure, is still too great as compared with the speed of displacement of the image.

Now, Mr. Lucien Bull, of Paris, the collaborator of Prof. Marey, further developed Marey's ideas. By using the electric spark as a source of light he was

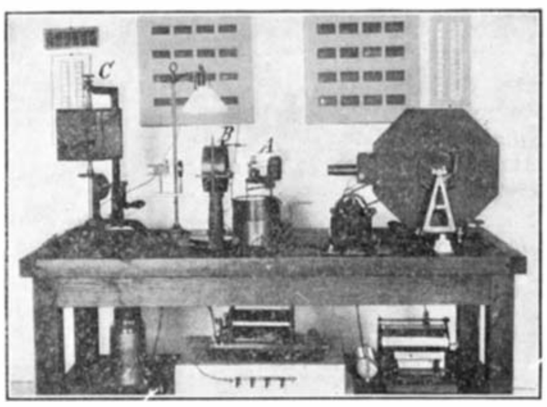


Fig. 2.—The Bull Chronophotographic Apparatus.

able to effect dissociation of extraordinary rapidity without losing definition.

In order to obtain a series of images at constant distances, which is a necessary condition for effecting the synthesis of the analyzed motion, Mr. Bull produces the electric sparks at intervals corresponding to equal displacements of a film.

The outfit used by him is represented diagrammatically in Fig. 4. In a camera box, *A*, a cylinder, *B*, is mounted on a horizontal shaft. To the same shaft is fitted outside of the camera a rotary current interrupter, which is connected with the primary winding of an induction coil, *D*. The induced current is allowed to flow to a Leyden jar condenser, *F*, the spark passing at *E* between two magnesium electrodes in front of the lens, *G*, which concentrates the rays on to the objective, *O*, in the focus of which the cylinder rotates. This cylinder carries a sensitized film and is rapidly turned. At each revolution a number of sparks corresponding with the number of contacts on the interrupter passes at *E*. The shutter is thereupon opened during one rotation to obtain a series of images at constant distances apart of an object placed beween the lens, *G*, and the objective. The shutter is a double shutter and is opened at the given moment by a cam on the edge of the cylinder. The closing of the shutter is effected automatically at the next revolution by the same cam.

Fig. 1 is a photograph of the apparatus, with the cover removed. There are two objectives and two films, so that the apparatus is adapted for taking stereoscopic views.

The cylinder is 35 centimeters in diameter and 10½ centimeters in breadth. There are 54 contacts on the interrupter, thus breaking the current fifty-four times for each revolution of the cylinders. Consequently fifty-four photographs are taken in one revolution. The images are focused by means of a finder comprising a mirror inclined at an angle of 45 degrees, and located immediately behind the objective. Before making an exposure this mirror is lowered by means of a button seen to the right of the finder in Fig. 1.

In Fig. 2 the entire outfit is shown ready for use. Below the objective is placed the electric motor driving the cylinder of the apparatus. At *A* a tuning fork is mounted, performing fifty double vibrations per second, and serving to register the time of each exposure. For this purpose the ends of the prongs are photographed while in vibration, together with the objects experimented on. The different positions of the prongs indicate the time as shown in Fig. 2*a* and in Fig. 8. From *a'* to *b'*, that is, from one coincidence of the two branches to the other, a half vibration is performed, corresponding with 100th of a second. By counting the number of images between two such coincidences, the frequency at which the views are taken is obtained.

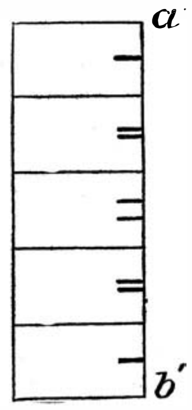


Fig. 2a.—Marks Made by Tuning Fork and Indicating Time of Exposure.

At *B* (Fig. 2)

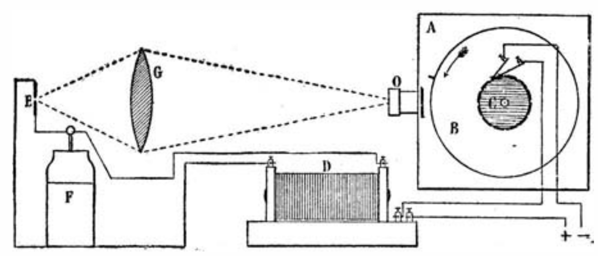


Fig. 4.

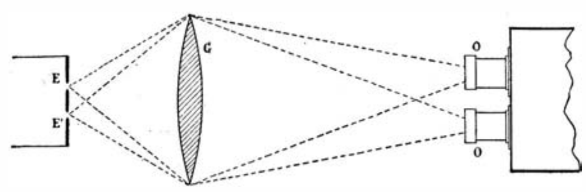


Fig. 5.—Apparatus Arranged for Stereoscopic Photography.

is seen an optical condenser, which is shown separately in Fig. 3. This condenser constitutes the luminous field on which the object comes out clearly. In the same figure are shown the two magnesium spark gaps.

At *C* (Fig. 2) is a rotating mirror, which, though not indispensable, proves useful for ascertaining whether the sparks succeed one another at regular intervals. On the table are further represented the induction coil, placed on a condenser of great surface, a Leyden jar, and the electrical resistances. In Fig. 5 is a diagram showing the apparatus as used for stereoscopic views. Two sparks are produced in the same circuit, giving two distinct beams of light directed toward the corresponding objective. *E E'* are the spark-

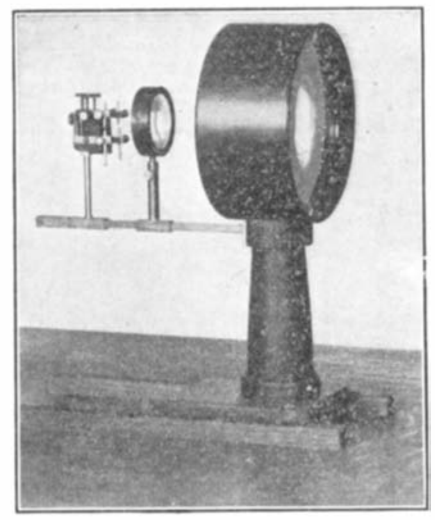


Fig. 3.—Optical Condenser Used with the Bull Chronophotographic Camera.

gaps, *G* the optical condenser, and *O O'* the objective of the apparatus.

Fig. 6 shows a series of images of a soap bubble which is traversed by a paper projectile thrown by a spring. In Fig. 7 is seen an ordinary fly in stereoscopic

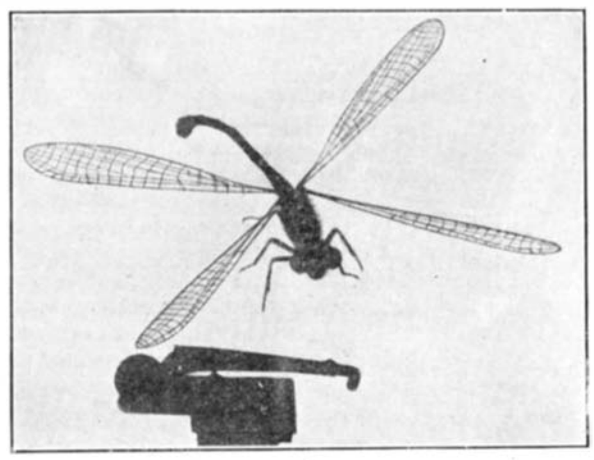


Fig. 10.—An Enlarged Picture Taken by the Bull Apparatus.

views (*a* and *a'*). To the right is shown a millimetric scale, by means of which the displacement of the object is measured, and the tuning fork prongs giving the speed at which the images are obtained. These views were taken at the rate of 1,100 per second, whereas the bee represented in Fig. 8 in horizontal flight was photographed at the rate of 1,200 images per second. In Fig. 9 is seen a *libellule* (*Agrion puella*) on starting. These images were obtained at the relatively moderate speed of 600 images per second. One of the images composing this series is magnified in Fig. 10. The highest speeds so far obtained are more than 2,000 views per second, but Mr. Bull is of opinion that with specially constructed induction coils far greater frequencies can be obtained.

It should be remembered that the aggregate time of exposure is quite inappreciable as compared with the intermediate intervals of darkness. In fact, the duration of each spark has been calculated to be only about the 2,000,000th part of a second. As the distance traversed by the film during this minimum interval is quite inappreciable, the image is as sharp as may be desired.

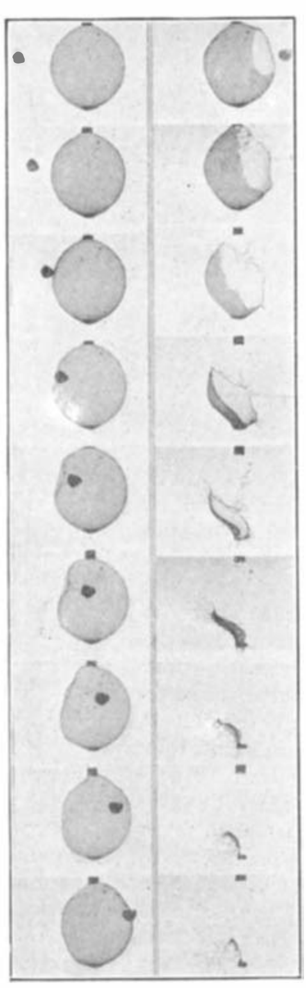


Fig. 6.

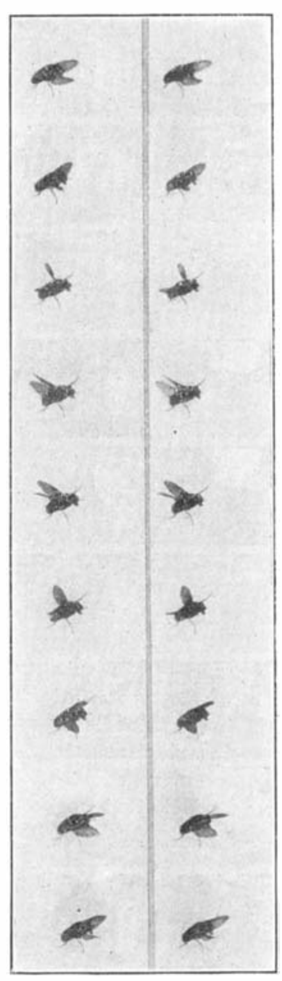


Fig. 7.

Fig. 8.

Fig. 9.

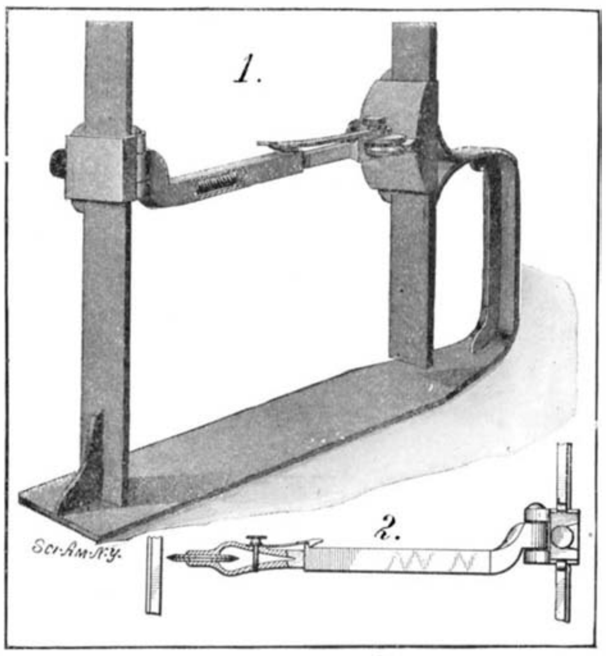
IMPROVED METHODS IN HIGH-SPEED CHRONOPHOTOGRAPHY.

A London dentist named Whitehouse is the inventor of a scheme for overcoming the motion of a vessel on the sea, which was recently given a trial on one of the boats making regular trips across the English Channel. Many of the world's most distinguished scientists and inventors have taken a trial at this problem without success, but the present inventor says that it was never possible until electricity became available for the purpose. The berth designed by him is swinging, and supported by four cords. By means of electric motors these cords are automatically operated to counteract the motion of the boat, in which it is said to be very successful.

Patent Department

GAGE AND MARKER FOR GARMENTS.

Adjusting the hem at the bottom of the skirt so that the garment will hang evenly, that is, at a uniform

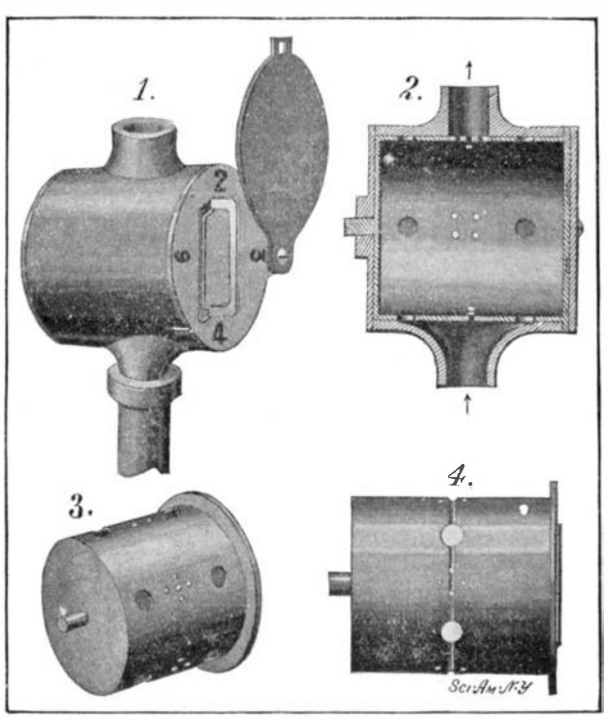


GAGE AND MARKER FOR GARMENTS.

distance from the floor all around, is a task that tailors and dressmakers find very tedious. Ordinarily, the work is done by pinning up a narrower or deeper hem, according to the amount that appears necessary to the eye, and the result is often far from accurate. A recent invention provides a device which marks the skirt at an absolutely uniform height above the floor. As shown in the accompanying drawing, this device consists of two standards firmly secured to a flat base. Each standard is provided with a slide movable thereon, but adapted to be set at any desired position by tightening a thumbscrew. Hinged to one of the slides is a hollow arm, within which the marking rod is fitted. Two rods are provided, one adapted to carry a piece of marking soap, and the other a grooved wheel by which the skirt may be marked with a crease. The groove is adapted to bear against a creasing rib formed on the opposite slide. The wheel is pressed against this rib by a spring in the hollow arm. A spring catch fastened to the marking rod and hooking over a lug on the arm keeps the rod in its socket. In use the bottom of the skirt is placed on the model, who stands stationary while the operator moves the device around the bottom of the skirt. The slides are first adjusted to the proper height, as indicated by a scale on one of the standards. The bottom of the skirt is then caught between the marking rod and the opposite slide, and the marking is done by swinging the marking arm laterally against this slide. For light fabric, such as lawns, etc., the creasing wheel may be preferably used. The device may also be found useful for marking tucks, ruffles, and the like. A patent on this device has been procured by George W. Sensbach and Margaret J. Sensbach, of Ronceverte, W. Va.

A GAS-SAVING DEVICE.

The amount of light given by a gas burner depends,

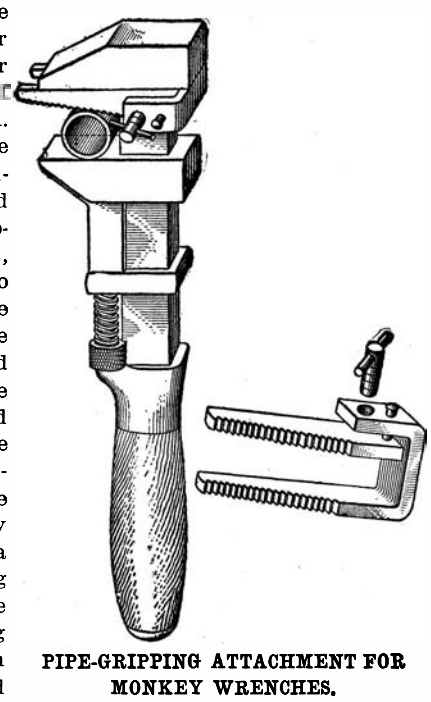


A GAS-SAVING DEVICE.

not on the quantity of gas consumed, but on the character of the flame produced. A gas flame comprises a central dark area and an outer bright yellow spread, the latter, of course, giving the light. As the pressure is increased, the area of the dark part increases more rapidly than the yellow part, until a degree is reached beyond which the dark area increases at the expense of the light-giving part. Under such pressure, one can increase the brilliance of the jet by partly turning off the gas. While the ordinary gas cock thus provides means for regulating the pressure to the proper degree, the average man does not care to be bothered with it, and prefers rather to turn on the full flow of gas, even though it results in less light. For the benefit of the careless man, a device has recently been invented which may be applied to the gas pipe near the meter, to regulate the pressure at all the burners in the house. As shown in the accompanying engraving, the device comprises a casing interposed between the meter and the burners. A hollow plug of the form shown in Fig. 3 fits snugly into the casing. This plug is formed with groups of small perforations, which vary in number corresponding with the numerals printed on the end of the casing as indicated in Fig. 1. A number of large openings are also provided to admit gas into the plug. A handle is hinged to one end of the plug, by which the latter may be moved to bring any of the groups of perforations into line with the outlet pipe above, and thus govern the pressure of the gas as it passes out of the plug to the burners. A socket is provided in the end wall of the plug, in which the handle may be folded, so that it will lie flush therewith, permitting the cover piece to be swung down. The latter is held closed by snapping it over a lug. In Fig. 4 we show a modification of the plug, in which a central groove is formed to provide a certain amount of gas to flow constantly, no matter in what position the plug is turned. We are informed that in a recent test of this gas check a saving of forty per cent was effected without diminishing the amount of light given. The flame produced was steady, and the flickering and noise which are commonly indicative of an uneconomical use of gas were entirely avoided. A patent on this gas-saving device has been secured by the Standard Development Company, 714 Union Street, New Orleans, La.

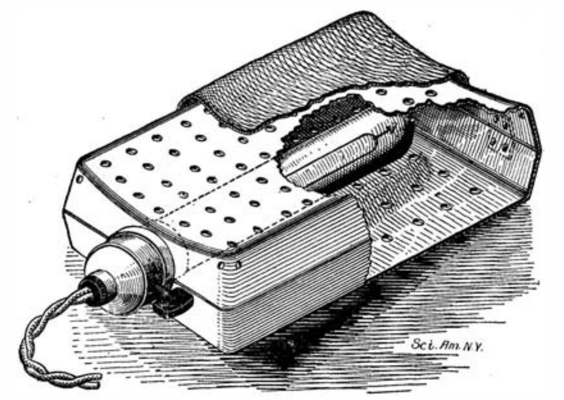
ODDITIES IN INVENTIONS.

Pipe-Gripping Attachment for Monkey Wrenches.—A recent patent provides a very simple means for converting an ordinary monkey wrench into a pipe wrench. It consists of a pair of toothed members, adapted to be fitted under the upper or fixed jaw of the wrench. One of the toothed members is formed with a U-shaped body, adapted to embrace the stock of the wrench and overlap the other toothed member. The device is clamped to the wrench by means of a clamping screw in the overlapping end, which may be turned to press the adjustable member against the stock. The adjustable member carries a guide pin, which extends through the overlapping portion. At the top of the pin a head is formed which holds the two parts together, thus preventing one or the other being mislaid or lost. The advantages of this invention should be apparent to any mechanic.



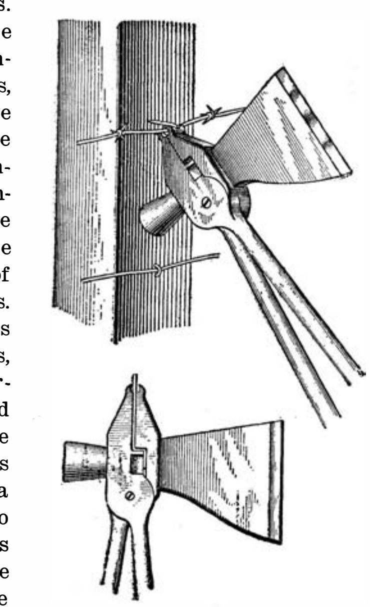
PIPE-GRIPPING ATTACHMENT FOR MONKEY WRENCHES.

Electric Heater.—As a substitute for a hot-water bag, a resident of Napoleon, Ohio, has devised the electrically-heated bag, which is illustrated herewith. It consists of an incandescent electric lamp inclosed by a perforated metal casing. The device may be connected to any electric lamp socket, and when the current is turned on the lamp will heat the casing. Over the latter a bag of soft fabric is placed, to prevent direct contact of the metal with the body. One side of the casing is made slightly concave, in order that it shall conform to the body when hot applications are made. The casing is made detachable, so that it may be removed when the lamp burns out, to permit of renewal. The advantage offered by this heater over the ordinary hot-water bag is that it will remain hot continuously and at a constant temperature, whereas a hot-water bag will rapidly become cooler as the water loses its heat.



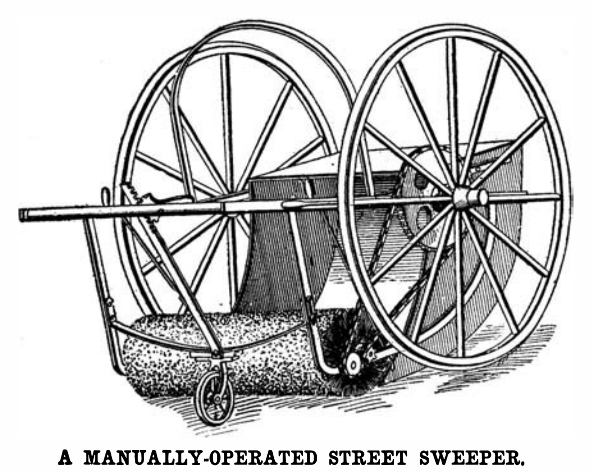
ELECTRIC HEATER.

Combination Tool.—The combination tool illustrated herewith will be found of value in building and repairing wire fences. It comprises in one instrument a hammer, hatchet, pliers, wire cutters, wire benders, and staple pullers. The hammer head is attached to one, and the hatchet blade to the other of a pair of hinged plier jaws. Just below the pliers are the wire cutters, consisting of tapering blades, formed on the opposite jaws. When it is desired to bend a wire, preparatory to making a loop, it is seized between the plier jaws, in the manner indicated by our side view of the tool, when the lower end will be bent at right angles by the lug projecting above one of the cutter blades. Each jaw carries at its upper end a pair of claws, which will be found useful for removing staples, etc.



COMBINATION TOOL FOR FENCE BUILDING.

Street Sweeper.—A manually-propelled street sweeper has just been invented, which operates somewhat on the carpet sweeper principle. The machine comprises a dirt receptacle, and a cylindrical brush or broom which is adapted to be rotated by chain-and-sprocket connection, with the main wheels on which the sweeper is supported, so that as the apparatus is pushed along the street, the wheels in rotating will



A MANUALLY-OPERATED STREET SWEEPER.

operate the broom, sweeping up the dirt into the receptacle. Ratchet clutches are provided between the main wheels and their axle, so that the broom will revolve only when the machine is moved forward. The frame which carries the broom is supported at the rear by a small wheel or castor, and provision is made for regulating the height of the frame thereon to adjust the pressure of the broom on the street paving. The dirt receptacle is carried on an auxiliary frame, which is hinged to the main frame. This facilitates dumping the contents of the receptacle when desired.

Among the recent deaths reported is that of R. G. Armstrong, formerly a resident of Wichita, Kans., where he was a member of the fire department. While residing in that city he invented the harness snap which is now in use in the fire department of every large city in this country. The business of manufacturing these snaps grew to such proportions that Mr. Armstrong was compelled to move to Chicago, where he engaged in their manufacture on a large scale.

RECENTLY PATENTED INVENTIONS.

Of General Interest.

FILTER.—L. QUIMBY, Youngstown, Ohio. This device cleans oil, such as that collected from machine-bearings, thus enabling its reuse. A primarily-acting strainer removes coarse foreign matter and delivers the oil through a valve controlled passage to a washer-chamber containing cleaning liquid. The dirty oil is passed through water in the washer-chamber, is partly cleansed and then discharged into a heater-chamber where any sediment is precipitated. A third chamber receives the oil from the heating-chamber from which upper portions of the filtered oil is drawn, leaving sediment at the bottom. All chambers have means for tapping off sediment from their bottoms. Washer-chamber siphons off mixtures of impure oil and water.

GAME APPARATUS.—R. D. MARTIN, Tampa, Fla. In playing the game the person takes hold of the ball, which is connected by a cord to a wire head, and throws it laterally with the necessary force to cause it to swing around the post, the head turning on the pivot pin. As propelling force diminishes the ball swings nearer the peripheral face of the base, to finally drop into one of the pockets or stalls. Instead of throwing, the ball may be struck by a bat, racket, or the like to cause it to spin around the post and drop into a stall which is numbered. Other games may be played.

FRAUD-DETECTING BOTTLE.—H. METZINGER, New York, N. Y. As is well known, in selling liquids of various kinds from bottles which have been partially emptied ample opportunity is afforded for fraud upon a purchaser, because the bottle bearing the name of a superior brand may be continually replenished with an inferior substitute to all appearances the genuine article. By the practice of the present invention it is hoped to prevent such perpetrations of fraud.

GUN.—C. D. LOUTSENHIZER, Cameron, Mo. This improvement has reference to ordnance, and its object is to provide a gun having improved breech mechanism, with a view to effecting a rapid loading, firing, and sighting. While the parts are simple in construction and arrangement, the operating of the gun is largely automatic, which is a very desirable feature. Intended especially for use in the navy, it still is readily adapted for use as a field-gun.

MINING-TOOL.—W. J. FURBEE, Watson, W. Va. This invention is an improved tool for miners' use, and has for its object to provide in one implement a pick, scraper, and tamping-iron all arranged for convenient and effective use separately. Heretofore these implements have been separate and, with a cartridge-inserting stick, as well as an ax and a shovel, form a miners' kit, which is a bulky assemblage of tools to take care of and have ready.

COMB.—M. ERSTLING, New York, N. Y. In the present patent the improvement relates to toilet-combs; and the inventors' object is to produce a simple comb of a construction especially adapted to facilitate the cleaning of the teeth of the comb and the insertion of new teeth in the case of breakage. The comb normally presents substantially the same appearance as an ordinary comb; but its parts may be quickly disconnected.

EYE-MASSAGE MACHINE.—F. H. MAY, Birmingham, Ala. Mr. May's invention is in the nature of a machine in which mechanical vibrations are imparted to the eye through an electrically-operated vibrator and which is so constructed also as to permit the direct application of either primary or Faradaic currents to the eye. It is intended to relieve catarrhal troubles of the eye and eyelid and for muscular and nerve weakness.

ROOF-FRAMING CHART.—E. E. WHITE, Fertile, Iowa. Primarily this inventor has in view as an object the provision of a chart the surface of which is so graduated or marked that the lengths, cuts, or bevels of common hip and valley and jack rafters will be readily indicated to the ordinary mechanic or builder. Further, to provide a chart which when used in conjunction with the common steel square will assist the beginner in cutting rafters, roof-boards, cornice-boards, and molding.

BUILDING-BLOCK MOLD.—J. McL. PETTYJOHN, Terre Haute, Ind. The inventor's object is to provide a mold for the manufacture of artificial-stone blocks involving certain features of novelty whereby it is rendered better adapted for molding purposes generally, and particularly for molding hollow and also rough building-blocks. In practice he employs a mold having sides and ends made laterally adjustable through peculiar framing and novel connecting means. Minor features are also employed.

PROCESS OF EXTRACTING OILS, GREASE, ETC., FROM SEEDS, WOOL, ETC.—J. McMAHON, New York, N. Y. The object of the invention is the provision of certain improvements in the extraction of oils from seeds, grease from wool, etc., by the use of a volatile solvent in a very economical manner and whereby the solvent is recovered for reuse and protected against an admixture of air to avoid the danger of an explosion.

REFLEX CAMERA.—C. A. MULLER, New York, N. Y. One purpose is to provide in this case a camera-box containing a reflex focusing attachment which when folded will occupy a minimum amount of room, and, further, to so construct the box that any form of shutter or type of lens can be employed and so that when the camera is not in use the lens may be swung into a compartment adapted especially for it and the compartment closed by the lens-board, thus protecting the lens and enabling the front portion of the camera to be without projections.

PACKING-RING.—J. J. McDONALD, New York, N. Y. The invention has reference to improvements in packing-rings particularly adapted for forming a tight and waterproof connection beneath the base of a closet-bowl and a flooring; although it may be used for packing cylinder-heads or the like, the object being to provide a ring strong and durable and that will retain a suitable plasticity.

IGNITER.—J. KELLERMANN, 13 Neue-Jacobstrasse, Berlin, Germany. As the cover is opened air flows into the receptacle, a mixture of the combustible vapors and air is formed, and after a very short time a flame issues from the receptacle top. This flame may be used for igniting purposes. As the cover is again placed on the receptacle and air excluded the ignition process is interrupted and the flame extinguished, so that the igniting body or pill is not worn to any great extent, and long duration of life for the same is insured.

APPARATUS FOR FILLING BOTTLES OR OTHER RECEPTACLES.—H. L. HORNUNG, New York, N. Y. While the apparatus may be used with many kinds of liquids it is very well adapted to those which are carbonated and therefore foam upon being drawn into a receptacle; it is particularly adapted for the filling of bottles with beer. The object is to provide for drawing beer and other carbonated liquids directly from the faucet and while in a live or carbonated condition without formation of foam.

Household Utilities.

SCRUBBING DEVICE.—F. E. WHITNEY, Syracuse, N. Y. The improvement refers to scrubbing-brushes, mops, and the like, and is used as follows: The lever-handle is pushed downwardly and away from the mop-handle. Arms provided with concave face with channels at their ends are inserted within the V-shaped recess or another somewhat similar as the case may be, and the spring portion is placed in notches before restoring the handle to position. Then this handle is pressed back against the mop-handle, bringing strain upon the spring member, whereby the latter is held securely in the notches, and by its elasticity holds the arms firmly in either V-shaped recess.

Machines and Mechanical Devices.

BRICK-CUTTING APPARATUS.—C. M. STEELE and A. P. STEELE, Statesville, N. C. The invention is an improvement in that class of apparatus which are adapted to divide a continuous clay bar into brick lengths; and is an improvement upon the former patent of A. P. Steele, in which a pair of toothed gears were employed to transmit motion to the reel or clay-bar cutter, the construction and coaction of gears being such that the radius of the driving-gear decreases while the radius of the driven increases in relative proportion, so that the bar was cut or divided upon vertical lines.

SPLIT GUIDE-BOX FOR STAMP-MILLS.—W. N. NOLAN, El Oro, Estado de Mexico, Mexico. Mr. Nolan's invention has reference to guide-boxes and admits of general use, but is particularly applicable to guide-boxes employed in stamp-mills for guiding the vertical stems of the ore-stamps. The invention refers more particularly to a type of guide-boxes made in two parts. The mechanism combines practically all the advantages of an integral structure, and a composite structure.

SWAGE FOR INSERTED SAW-TEETH.—W. L. NEWELL and U. STALEY, Buckeye, Wash. The principal object of the invention is the construction of a machine which while simple and comparatively inexpensive in construction will be thoroughly efficient in operation, which may be readily adapted for operation upon saw-teeth of different patterns, and which may be adjusted to compensate for wear both upon the teeth of the machine and upon the saw-teeth operated upon.

MORTISING-MACHINE.—O. C. WYSONG, Greensboro, N. C. Mr. Wysong employs a series of augers and hollow chisels arranged horizontally and mounted in frames adjusted toward and from each other on the horizontal top of main frame. Stuff to be mortised is fed regularly and automatically to augers and chisels, it being supported upon a bed reciprocated automatically and regularly and provided with a "fence," adapted for adjustment to accommodate work of different thicknesses or mortises of different depths. The bed is supported upon brackets adapted to be raised and lowered by screens, according to thickness of stuff or location of mortises therein. Power is applied by treadle.

STUFFING-BOX.—R. L. MOSSMAN, Newcastle, Pa. Ordinarily if throttle-stem packing blows out it is necessary to draw the fire and blow off steam before the stem can be repacked. Former devices were open to the objection that the throttle had to be open while packing, consequently the valve-rod had to be disconnected and the ports covered. Even with the ports covered the opening of the throttle is risky when steam is on, and it requires manipulation and time. The invention overcomes all these objections, as the stem can be packed while the throttle is shut.

BRUSHING OR POLISHING MACHINE.—A. C. JOHNSON, Baker City, Ore. The device is capable of general use and is especially adapted for cleaning and polishing shoes, as well as for brushing clothing, hats, and the like. It may by means of a flexible shaft be applied in any desired position or angle, and operated with a small amount of power.

ELECTRICALLY-OPERATED HYDRAULIC VALVE.—C. ENGBERG, St. Joseph, Mich. In the present patent the improvement has reference to valves, the inventor's more particular object being to enable large and unwieldly valve-gates to be readily controlled, especially from a distance, and to apprise the operator of the condition of the valve.

CARBURETER.—H. BRASIER, 36 Rue Molitor, Paris, France. This invention is a carbureter in which the volatile liquid fuel is introduced into the air current in two diverging jets which meet to increase the atomizing effect of the carbureter, and in which provision is made for auxiliary air supply active upon an increased suction through the carbureter, this supply being controlled by a spring-seated valve lifted more or less according to the force of the suction exerted. Tension of the spring on the auxiliary valve may be regulated at will so as to place the portion of the air and fuel forming the carbureter mixture under control of the operator.

SPRING-MOTOR ATTACHMENT FOR ENGINE-SHAFTS.—W. J. BELL, Los Angeles, Cal. Mr. Bell's invention is an improved means for starting an engine or other rotatable shaft or adding power to such shaft at any period of its rotation. An improved attachment is available for starting an engine or starting the rotation of any shaft to which it may be applied or for energizing—that is, maintaining or increasing the rotation of—the shaft at any juncture.

Railways and Their Accessories.

RAILWAY SAFETY DEVICE.—W. H. CLING, Charleston, S. C. The invention relates particularly to improvements in devices for preventing head-on or rear-end collisions of two trains moving on the same track, the object being to provide a simple means for providing the setting of emergency-brakes of a train or trains should two trains be moving in the same block, thus bringing a train or trains to a full stop in time to prevent accident.

CAR-AXLE.—F. M. THOMPSON, East Liverpool, Ohio. Mr. Thompson's invention is an improvement in car-axles. In the use of this improvement the inventor avoids any dragging or grinding of the wheels and the consequent wear thereon and on the rails on rounding curves by permitting the opposite wheels to turn independently and secures this result by a simple construction which permits the ready connection and disconnection of the opposite axle-sections.

Pertaining to Recreation.

CARD-RECEPTACLE FOR DUPLICATE CRIBBAGE.—L. C. WILLIAMS, New York, N. Y. The object of this invention is to provide a cribbage board with a series of receptacles so arranged as to receive the several hands and the trumps in order to provide for playing of duplicate cribbage. The board proper is mounted at the top of the receptacle and below it are arranged in the front and end walls two series of horizontal recesses for the hands and trumps. The former are alternately numbered from front and ends so that their numerals serve to designate the trump recesses. Receptacles are provided for packs left after dealing. Designed for two players, but four can be accommodated.

AMUSEMENT DEVICE.—H. S. THOMAS and J. J. KIRKPATRICK, JR., New York, N. Y. This invention pertains to improvements in devices of the character in which passenger-carrying cars are movable along a track, the object being to provide a means for starting the cars and also to provide movable scenic devices along portions of the track that will give the impression of traveling a long distance at high speed, while, in fact, the car is moving a comparatively short distance at slow speed.

Pertaining to Vehicles.

HARNESS.—R. WEEKS, Carmel, New York. The object in this case is to minimize the parts of the harness without lessening its efficiency for the purpose specified, thereby not only simplifying the rig, but lightening the load on the horse and permitting the animal greater freedom of movement. The invention relates particularly to "track-harness"—that is harness intended for light or racing vehicles. Mr. Weeks has invented another harness especially for use with light vehicles in track or speedway driving, but applicable to various other conditions. It provides for the use of a breast-collar, enabling the horse to draw heavier loads than with the draft from the saddle or belly-band alone, as in this inventor's copending case formerly filed, and he also provides means for supporting hopples for pacers and other attachments to the hind quarters of a horse.

WHEEL-RIM CLAMP.—W. L. BLISS, South Egremont, Mass. The present invention refers to a clamp for the rims of wheels, and has particular application to a device for perfecting the joints of the rims of vehicle-wheels. The principal object is to provide an article which may be readily, easily, and conveniently adjusted to the rim of a vehicle-wheel for the purpose of perfecting the joint of said rim when the latter is being placed upon the spokes, such device assisting in the final cutting of the rim.

VEHICLE-TIRE.—J. C. RAYMOND, New York, N. Y. In this tire a rim plate is provided along the side edges of which are circumferential channels. At the outer edge of each channel there are inwardly projecting lugs formed at their inner sides with enlargements or ribs. In connection with the channels and lugs, edged sections are employed on the rim and are formed in their outer edges with sockets to receive the tire edges. The sections are also provided with inwardly projecting hook portions having enlarged heads for engagement with lugs of the rim plate, and springs are arranged within the channels to secure the engaging parts of lugs and hook portions of rim plate and sections.

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 the paper.

Business and Personal Wants.

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

MUNN & CO.

Inquiry No. 7026.—For manufacturers of cellulose from cornstalks.

Inquiry No. 7027.—For manufacturers of beads out of soft stone.

Inquiry No. 7028.—For manufacturers of condensers for telephone or wireless telegraph.

Inquiry No. 7029.—For manufacturers of glass tubing having 1-16 inch inside diameter, for making wireless telegraph coherers.

Inquiry No. 7030.—For parties who can furnish raw hide.

Inquiry No. 7031.—For manufacturers of wire musical instrument strings.

Inquiry No. 7032.—For manufacturers of advertising novelties.

Inquiry No. 7033.—For manufacturers of capsules of carbon dioxide gas; also siphon for charging water.

Inquiry No. 7034.—For parties selling sheet aluminium and a soldering flux for soldering aluminium.

Inquiry No. 7035.—For manufacturers of machinery for making banana into fine flour.

Inquiry No. 7036.—For manufacturers of brass band instruments.

Inquiry No. 7037.—For manufacturers of springs wound by a key and run for five or ten minutes.

Inquiry No. 7038.—For parties who print colored pictures on paper in one continuous piece of about 6 inches wide and 12 feet long.

Inquiry No. 7039.—For manufacturers of telescoping steel flag poles.

Inquiry No. 7040.—For manufacturers of cast iron porch posts.

Inquiry No. 7041.—For manufacturers of fishing hooks and lines; also the manufacturer of the original Limerick hooks.

Inquiry No. 7042.—For manufacturers of mechanical stokers.

Inquiry No. 7043.—For manufacturers of self-propelled invalid chairs.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(9680) C. H. C. says: Can you inform me of the philosophy of the curving of a tennis ball when struck with a "cut," and why some balls, with a forward twist, drop, and others, with a reverse twist, carry a long way without dropping? Is the cause gyroscopic action, or the result of the climbing motion of the ball against the air, or what? A. The curving of a tennis ball is probably due to the same cause as that of a base ball. The rotation of the ball is such that the air pressure is greater on the side toward which the ball rotates, pushing the ball in the opposite direction. See Scientific American, July 16, 1904, for a discussion of this question. This explains upward and downward motions of balls, as well as sideways motions. There is no gyroscopic action, so far as we can see.

(9681) L. S. says: Several times I observed in your valued paper that one *thousand* millions is called one *billion*. So (issue of February 18, 1905, page 146) Mr. Edgar L. Larkin says that 500,000,000x64 = thirty-two *billion*. As far as I know, it is only thirty-two *thousand* millions; or thirty-two millions = 32,000,000, while thirty-two billions = 32,000,000,000,000. Please tell me in your notes and queries who is right. A. What is a billion? In Great Britain it is a million million—1,000,000,000,000; but in America a billion is a thousand million—1,000,000,000. We of course print numbers as they are expressed in America. Both ways are right; but one should know the custom of the country in which he is, to know what is meant. The American follows the French method of notation of numbers, three figures in one period.

(9682) M. E. G. says: I would like to know how long the longest railroad and street car rails are made nowadays. A. The usual length of railroad and street car rails is 30 feet, and they are furnished this length unless otherwise specified. They may be, however, rolled longer than this when especially ordered.

(9683) D. B. says: Will steam at a pressure of 110 to 120 pounds (not superheated) set fire to woodwork? The dry house in our factory gets so hot that our thermometers fail to register, as they are only marked to 125 degrees. A. The temperature of steam at a pressure of 120 pounds per square inch is 350 degrees Fahr. This is not hot enough to set fire to wood, but is hot enough to char it, and wood should not be allowed to come closer than two inches to such steam pipes without being protected with asbestos or other suitable covering. Thermometers may be purchased which will register up to this temperature, or if desired considerably higher.

(9684) C. E. D. asks: In your reply to query 9606, you state that daylight is gone after the sun is 18 deg. vertically below the horizon. It seems to the writer that this is an error. On almost any clear night in the latter part of June, the sun's light can be traced, decreasing as the hours pass by, farther and farther north until the North Pole is passed, when it begins increasing until dawn. If this is not daylight, what is it? It is a well-known fact that the nights in summer are not so dark as in winter, and this must be because the daylight is not so fully excluded. A. You are quite right in supposing that the light seen in the sky after the sun sets is sunlight. It is reflected from the dust particles in the upper air. This is twilight, not daylight, since daylight implies the seeing of objects distinctly, while twilight implies a dim, indistinct vision. *Twi* here means *between*, that is, neither light nor darkness. The twilight zone is about 1,500 miles broad, to the east and west of the sunset line. At different times in the year a different time is required for the sun to reach an altitude of 18 deg. below the horizon. In our latitude this is more than two hours in midsummer, and the shortest possible duration of twilight in the torrid zone is one hour twelve minutes, all the year round. The writer has lived there, and seen the night fall almost as soon as the sun sets. Twilight is not reckoned upon for working in the torrid zone, as it is here in the summer. The twilight illumination of the sky swings around toward the north as the sun itself does, and in the most northern portions of the United States the twilight zone does not dip below the horizon, even at midnight. Above latitude 48 deg. twilight of morning meets evening twilight at the north. Even in Montreal or Edinburgh the evenings of summer are very long, and the streets are filled with people much later in summer than with us. But wherever on the earth the sun is 18 deg. below the horizon, it is night, and no light of the sun is to be seen above the horizon. Another fact in this connection, is that the sky is never dark. This, however, is not due to the sun, but to the stars. The Milky Way is above the horizon in summer in our latitude, and it gives a great deal of light by night, enough to make the night sky of that time brighter than when it is not a part of our night sky, as is the case in winter. Then, too, the stars which cannot be seen by the unaided eye give us much light. The stars which are not visible to the eye give more light than those which are visible. We quote Todd's "New Astronomy," p. 424, on this point: "Accepting a sixth-magnitude star as the standard, and expressing in terms of it the light of all the lucid stars registered by Argelander (a catalogue of 324,000 stars to the 9½ magnitude), they give an amount of light equivalent to 7,300 sixth-magnitude stars. But calculation proves that the telescopic stars of this extensive catalogue yield more than *three times* as much light as the lucid ones do. The stars, then, we cannot see with the naked eye, give more light than those we can, because of their vastly greater numbers." In the whole heavens the stars give about 1-80 as much light as the full moon. There is good reason for the fact that the sky is light all the night.

(9685) A. C. asks: In constructing some storage batteries I run across the term "sponge lead," which is used in the active material. I would like information as to what this sponge lead is, and how it is made. A. In the charging and forming of the plates of a storage cell, the lead oxide or the lead plates are reduced to a spongy condition, a porous condition in which the acid solution penetrates to the interior to an extent. This lead is not put into the plates, but results from the action of the charging current upon the lead oxide, which is used as a paste in the making of the plates.

(9686) F. R. Co. asks: We wish to know if it is generally considered practical to connect a motor and incandescent lighting service to one meter, and if said meter will accurately measure the current consumed by each. If a meter is calibrated for motor service, which is usually rather irregular and which requires much more power than light service, will this meter register one or two incandescent lights just as accurately as if it were originally calibrated and intended for a lighting circuit? We note that in most cases companies run two distinct services for lighting and power, and same metered on different meters. A. In general, electrical meters register independently of the use to which the current is to be put after it gets past the meter. It may be that a meter which was sensitive to a single incandescent lamp would not be as sensitive to a 100-horse-power motor, or 1,000 lamps. But other than this we do not see that motor service differs at all from lighting service. We do not expect that hay scales will also weigh diamonds or medicine. And a meter for large currents cannot be equally sensitive to small currents. Probably the reason for using different meters for light and power is that frequently companies have different rates of tariff for the two different services.

(9687) M. D. S. asks: I desire to secure the formula of the solution for making blue prints; how to apply it to the paper, and how to develop and finish it, after printed. Can you inform me of any book treating on the matter and where to procure it? A. To make solution for blue-print paper, make a solution of potassium ferricyanide, 1 ounce to 5 ounces of water; also a second solution of 1 ounce of citrate of iron and ammonia to 5 ounces of water. These two solutions will keep indefinitely in separate bottles. To prepare the paper, take equal parts of each solution and mix them. The mixture is sensitive to light, and the rest of the work must be done in a feeble light. With a swab dipped in the solution cover the paper by passing across in parallel lines, and afterward crosswise of these, so as to have an even layer of liquid all over the paper and yet not enough to flow or drip. The paper is hung by a pin in the dark to dry. It is then ready for printing. After printing in bright sunlight, the picture is developed by putting it under water. Wash thoroughly till the white parts of the picture are clear.

(9688) E. C. B. asks: To extract the square root of any number between 100 and 9,999 with close approximation: Divide the number by a multiple of 10 whose square would be the nearest number exceeding the number the square root of which is desired; carry the division to at least one decimal place. Take one-half of the sum of the quotient found, and multiple of 10 used as divisor. In event of number being less than 100, simply divide it by its nearest square root; add this divisor to quotient found, and take one-half. Above may not be new, but having never run across it, thought it might be useful. A. This method of finding an approximation to the square root of certain numbers will be a help to those who need only an approximate square root. But it would seem better to be able to find the exact root to the desired number of decimal places by the usual process. Several numbers which we have tried yielded their roots with scarcely more work than is required in finding an approximation by the method given above. We printed the process of taking the square root of a number fully worked out in answer to Query 8196, Vol. 84, No. 22, Scientific American, which we send for ten cents. The process is easily learned and quickly applied. There would seem to be no need of approximate processes.

(9689) G. C. K. asks: 1. Where can I buy porous cups 1¼ inches outside diameter? A. For small porous cups address the dealers in electrical supplies who advertise in our columns. They can supply the size you name if they can be had. 2. Can the field of the motor described in Scientific American Supplement No. 1195 be divided so as to make four fields in place of two, and how many turns will I have to put on so as to have the same horse-power described? I want to make it so I can run some small machinery. A. There is no reason why you should not divide the field winding of the motor into four parts as you propose. The result will be the same as if the field were in two coils when the armature has completed one revolution. Nor do we see that you will gain anything by making the change. The power will be the same as in the present design. It will drive small machinery just as well as it is. 3. Could I get Chapter XIX. of "Experimental Science," on a one-quarter horse-power electric motor, without buying the entire volume? If so, what will be the charge? I mean the one-quarter horse-power electric motor which may be enlarged or reduced. A. No, we have not published the one-quarter horse-power motor you refer to in the Scientific American or Supplement.

(9690) B. T. asks: Will you please inform me why a gravity battery will not run a small electric motor which will run on a single cell of dry battery? A. One gravity cell will not take the place of one dry cell. The voltage of a dry cell is 1.4, while a gravity cell is usually not above 1.07 volts. Two gravity cells must be used in place of one dry cell. They will run the motor much longer and stronger than a dry cell. A dry cell is not adapted to a motor. It being an open-circuit cell, it should have a rest after working, as it does in ringing bells. A gravity cell is a closed-circuit cell, and should be kept at work. On an open circuit it does as poorly as a dry cell does on a closed circuit. You cannot use the same cell on both closed and open circuit work.

(9691) L. B. G. asks: Will you kindly give a rule for finding the velocity that steam is capable of attaining at all pressures, when the back pressure is known, and when expanding into the atmosphere? A. The rule most commonly used for determining the velocity of steam as it escapes from an orifice is:

$$G \; A \times \frac{P1}{70}$$

Where $P1$ is the pressure per square inch in the reservoir, A is the area of the orifice, G is the flow through the orifice per second in pounds. This rule only holds good where the pressure inside the orifice is at least 1.66 times the pressure of the atmosphere into which the steam is escaping. After finding the number of pounds of steam that flows through the orifice from the above formula, you can readily find the velocity corresponding by looking up the volume of one pound of steam corresponding to the pressure in any given case in steam tables, and from this calculate the velocity of flow.

(9692) E. H. W. asks: 1. What month and day of the month was Easter Sunday, 1863? A. In the year 1863 Easter fell on April 5. 2. Easter Sunday for any given year? A. Easter Sunday is calculated by the assistance of tables which may be found in the Episcopal Book of Common Prayer. It is kept on the Sunday which falls next after the first full moon following the 21st of March, or the vernal equinox. If a full moon falls on that day, the next full moon is the Paschal moon; and if the Paschal moon falls on Sunday, the next Sunday is Easter day. The moon referred to is not the real moon, but a fictitious moon which moves uniformly in the celestial equator in exactly the same time as the real moon moves in its orbit. Any attempt to locate Easter by the motions of the real moon as given in an almanac will frequently fail. The best way is to go to the Prayer Book and get the dates, which in some books are given for a couple of centuries.

(9693) F. L. asks: Will you kindly inform me through your columns if a bullet dropped from the muzzle of a rifle would reach the ground quicker than one fired from the rifle at the same elevation with the rifle held perfectly horizontal. I think that it would not. Am I right? A. A bullet dropped from the muzzle of a gun and one shot horizontally from the gun at the same instant are both acted on by gravity in exactly the same manner. Both fall toward the earth with the same velocity and both will keep all the time in the same horizontal plane. So both will strike the earth at the same distance below at the same instant. It is on this principle that the sights of a rifle are adjusted and all cannon aimed. Were not this true it would not be possible to hit a target at all. The science of gunnery teaches how to elevate the gun so that the ball will fall as it flies just enough to hit the target after one second or any other time of flight.

(9694) C. L. W. asks: In the Scientific American for February 18, 1905, I read a very interesting piece on the subject "Velocity Potential of the Universe." In this the writer states that "if a hole be through the earth, passing through its center, and a stone be let fall into it, the stone will move to the opposite side and return to the starting point; and if the air could be removed, it would oscillate to and fro so long as the earth endures. It would be a pendulum." I claim that the ball would stop at the center of the earth. The basis of my claim is Newton's laws of motion and weight given in all school physics. Would not the weight of the stone at the center be zero, and if its weight were zero, would it not stop? Please tell me who is right, and if I am wrong, how about the laws of gravitation? A. Your opinion that a ball dropped into a hole through the center of the earth will stop at the earth's center is the opposite of the belief held by mathematicians upon this point. We are not able to accept your view of the case. A falling body will have its motion accelerated as long as the minutest force acts upon it to draw it downward. This will be the case until it reaches the center of the earth. It will at that moment be moving with its highest velocity, and will pass to the region where the acceleration becomes negative, and tends to reduce the velocity. The center of the earth is but a point, and the momentum of the ball acquired during its fall will carry it past the center and forward as far as it fell to acquire that momentum, that is, to the surface on the opposite side.

(9695) H. M. says: 1. About what size and length is the wire wound on an induction coil in a long-distance telephone? A. There are many kinds of induction coils in use in telephone practice. An average coil may perhaps have ½ ohm of No. 24 wire in the primary and 250 ohms of No. 35 wire in the secondary. 2. What size and length is the wire that is used in a telephone receiver? A. A receiver may be wound with 100 ohms of No. 36 wire. 3. Would not the sending distance of the wireless telegraph instruments (described in the papers herewith sent) be increased by increasing the height of the aerial wire say by kite or balloon? A. The sending distance of a wireless telegraph depends upon the height of its aerials and the spark length of its induction coil. A kite and a balloon have both been used for raising the aerial wire, but the kite drags away so obliquely on the wind that little is gained by using a kite. So also does a captive balloon. 4. Why is it that a telegraph sounder of low resistance, say 5 ohms, is not suited for a line of much length, and a sounder of 20 ohms can be worked on a line up to 15 miles in length? A. The resistance of a sounder is only a mode of stating the number of turns of wire it has in it, and therefore the magnetic force it can exert. The more turns, the farther it can work. A 20-ohm sounder can work farther than one of lower resistance, since its greater number of turns of wire can produce more magnetism by a weak current, than a sounder of low resistance can produce with a weak current. 5. We have a mutual telephone line in our neighborhood. It runs very close to W. U. T. Co.'s line for about three-quarters of a mile. It crosses over the telegraph line in two places. At certain times, usually late in the evening, the line is bothered with so much noise that persons can hardly be heard talking over the line. The line is a party line with one wire, and cannot be transposed. Do you think the noise is caused by the two lines so close together? Can it be eliminated any other way than by using metallic circuits? A. The difficulty with your telephone line is its nearness to the other line. This can only be remedied by removing it from the neigh[illegible] the disturbing line or by mak[illegible]sed metallic circuit.

(9696) G. W. C. asks: 1. What is a cycle, in connection with gas or gasoline engines? A. A "cycle" in connection with any engine refers to the series of events which takes place from any point until the engine does precisely the same thing again it was doing at the start. Thus the "cycle" of an ordinary gas engine is as follows: A charge of air and gas is admitted during a forward stroke; the admission valve closes, and it is compressed during a return stroke; it is ignited during the return stroke; it expands during a forward stroke; the burnt gases are expelled through the exhaust during a return stroke; the engine is then at the point where we started, ready to take a fresh charge of gas and air, and the "cycle" is now complete. 2. Should one say an engine with single cylinder makes one or two strokes in one revolution? A. An engine with a single cylinder makes two strokes per revolution. 3. What is a "stroke cycle"? A. A "stroke cycle" would be the series of operations that an engine goes through during a single stroke. Thus, during the forward stroke of a steam engine, steam enters the cylinder; the admission valve closes; the steam expands; the release valve opens. This is not a common term and is not one of special value, because the "cycle" is not complete. 4. Must a two-cycle engine have two cylinders? A. No.

(9697) C. S. J. asks: 1. Do two objects, for example a ball of lead 4 inches in diameter and a cork ball 4 inches in diameter (thus presenting an equal surface for the air to act upon), fall to the earth in the same space of time if dropped from the same height at the same moment, under atmospheric resistance? A. A ball of lead falls faster through the air than a ball of cork of the same size, since it has more momentum for overcoming the resistance of the air. This is easily observed. If you watch motes floating in the air, or a feather, you will see the effect of the resistance of the air to the downward motion of light bodies. They lack weight for pushing the air out of their way. 2. Would the result be changed if the cork ball be, say, 8 inches in diameter and the lead ball 1 inch in diameter? A. The result will be the same if the cork ball is made larger, for the surface presented to the air increases as the square of the radius of the ball, while the weight increases as the cube of the radius. The ability to overcome the air varies as the radius. 3. Or would it make any difference in the time of descent if the cork be, say, only 1 inch in diameter and the lead ball 8 inches in diameter if dropped from the same height at the same time, under normal conditions of the air? A. You cannot make a cork ball fall as fast as a lead ball by any proportions whatever, so long as the densities of the two are so different. Compress the cork and it will fall faster. 4. In pumping water from a well with a common suction pump, does the person pumping by means of the pump-handle raise the *water* out of the well or does he lift a column of air of the same diameter as the well tube, thus letting the atmosphere outside of the tube press the water up into, and out of the tube? A. The piston of a suction pump removes the pressure of the air from the surface of the water in the barrel of the pump. The pressure of the atmosphere in the well forces the water up into the barrel of the pump. The person pumping lifts the air in the barrel of the pump. If the area of the barrel is 5 square inches he must lift 75 pounds of air. This has no relation to the size of the well.

(9698) F. L. J. asks: 1. Are the polished parts of a bicycle nickel plated, or are they polished with an acid, as I have been told? A. The parts of a bicycle which have a silvery luster are nickel-plated. 2. Why is it that people do not receive shocks from a trolley rail? If you could touch the overhead wire, without touching the ground, would you get a shock? I have seen birds do this last, and think the reason they can do it, is that they are not in contact with the ground. Am I right or wrong? A. If by a trolley rail you mean the rail of the track upon which the car wheels run, there is no reason why a person should receive a shock from it. It is at the same potential as the earth. If one could catch a trolley wire while in the air he would receive little shock because the potential of his body would soon be the same as the wire, which is at a low voltage, only about 550 volts. No current would flow through him since he is not in a complete circuit. 3. When electric cars jump the track, I have seen the motormen place the switch iron from the rail to the trucks to complete the circuit. Is this necessary? The wheels are in good contact with the ground, and I have heard that the current returned to the station through the ground as well as the rails. A. When electric cars jump the track, it is necessary to provide a better contact than that of the dirt for the current to flow from the motor to the rails. Dry earth is not a conductor nor is pulverized earth. When the current returns through the earth to the power house it must find a better path than either of these if any considerable current is to make a swift return. A poor conductor will take a small amount of current by leakage. 4. I have asked several persons why they build roofs over their porches, and have been told it was to keep the rain and dew [illegible]ing on the porch. Is there a[illegible]w part of this answer? I have learned that dew does not fall, but is moisture in the air which was condensed by contact with cold objects. How can a roof protect a person from dew? A. Most certainly there is good sense in the "dew part" of the answer to the question why piazzas have roofs. Dew forms on a body exposed to radiation, so that its temperature can fall below that of surrounding objects, that is, below that of the air. Under a roof or under a tree the heat which is radiated upward is arrested by the roof or the tree and prevented from easily escaping to the sky, with the result that the space underneath the roof or tree is warmer than in the open air. You can verify this by moving your chair out from under a roofed piazza on almost any quiet clear evening. You will find it colder than under the roof, and dew forms more quickly. Clouds act in the same manner to screen the earth, and there is rarely dew on a cloudy night.

NEW BOOKS, ETC.

MANUAL OF TERREOHMETRY. By Ethan Scheidler. South Pasadena, Cal.: Ethan Scheidler, 1905. 16mo.; pp. 44. Price, $2.

This little manual has been written as an aid to mining men, for the purpose of showing how ores may be located scientifically by electrical tests. The science of terreohmetry, as it is called, has received a large amount of study and original investigation by the author, who has incorporated in his manual the results of many lessons learned from practical experience in making mining surveys throughout this country, Canada, and Mexico. A clear description of all the necessary apparatus is given, and full directions will also be found as to the method of using the same in locating ore.

MODERN IRON FOUNDRY PRACTICE. Part II. By George R. Bale, Assoc. M. Inst. C.E. London: The Technical Publishing Company, Ltd., 1905. 12mo.; pp. 194. Price, $1.40.

This part of the work on iron foundry practice deals with Machine Molding and Molding Machines; Physical Tests of Cast Iron; Methods of Cleaning Castings; Foundry Accounting, etc. The machines illustrated and described are typical ones, and besides these descriptions the reader will find a very exhaustive account of the physical tests of cast iron which, on account of the exacting demands of the modern engineer, has now generally to be very thoroughly tested before being put into use. The book is completed with an index, and will be found most helpful to all connected with the iron industry.

HENDRICKS' COMMERCIAL REGISTER OF THE UNITED STATES. New York: Samuel E. Hendricks Company, 1905. 4to.; pp. 1,279. Price, $7.

This is the fourteenth annual edition of this valuable reference book, which forms a complete and reliable index, containing over 350,000 names, addresses, and business classifications, of the architectural, mechanical, engineering, contracting, electrical, railroad, iron, steel, mining, mill, quarrying, and kindred industries. The book also contains a full list of the manufacturers of and dealers in everything employed in the manufacture of material, machinery, and apparatus used in these great industries, from the raw material to the manufactured article, and from the producer to the consumer. The book will be found extremely valuable as a buyers' reference book, for all engaged in any way in the trades above mentioned.

PROBLEMS OF THE PANAMA CANAL. Including Climatology of the Isthmus, Physics and Hydraulics of the River Chagres, Cut at the Continental Divide, and Discussion of Plans for the Waterway. By Brig.-Gen. Henry L. Abbot, Consulting Engineer, New Panama Canal Company. New York: The Macmillan Company, 1905. 12mo.; pp. 248. Price, $1.50.

This work, which is from the pen of one of the most qualified and lucid writers on the problem of the Panama canal, appears at an exceedingly opportune time. The American public, after being treated to successive reports by expert commissions, each giving a series of recommendations differing, more or less, from the others, will welcome this book, which gives a complete but not over-elaborated statement of the various phases of the Panama canal question. Gen. Abbot was at one time a member of the celebrated Comité Technique which, at the request of the new Panama Canal Company, made an exhaustive examination of the vast amount of technical data gathered by the engineers of the company. His pen was one of the most potent influences in leading the United States government, and the American public at large, to see the superior claims of the Panama to the Nicaragua canal route, and the present work embodies much data that have been presented in the various articles written to this end during the past few years by Gen. Abbot. The work opens with a historical *resume* of the history of the canal, and then takes up the subject of the rival routes and the physical conditions existing on the isthmus. A whole chapter is devoted to the once-formidable and supposedly-insurmountable problem of the Chagres River. Then in logical sequence there follows a chapter on the ultimate disposal of rainfall in the basin above Bohio. The last chapter considers, in considerable detail, the projects for the construction of the canal. To all of those who desire something more than a superficial knowledge of this great national problem, we cordially recommend this work.

THE MECHANICAL HANDLING OF MATERIAL. By George Frederick Zimmer, A.M. Inst. of C. E. New York: D. Van Nostrand Company, 1905. 4to.; pp. 521; 550 illustrations. Price, $10.

This work forms the first complete and connected treatise on the Mechanical Handling of Material, in any language. Its author has had over twenty years' experience in the designing and installing of machinery designed to handle material in the substitution of or supplemental to hand labor, and all such machinery is described in full in the present volume. The book is divided into three main sections dealing with the Continuous Handling of Material; the Intermittent Handling of Material; Unloading and Loading Appliances; and Miscellaneous Handling Apparatus, such as automatic weighers; apparatus for coaling locomotives; coal-handling plants for gas works; power stations, boiler houses, etc.; floor and silo warehouses for grain and seeds; and high-level or cantilever cranes. Section I. deals largely with all kinds of elevators and conveyors, and Section II. with endless chain and rope haulage, ropeways, and aerial cableways. Section III. deals with the loading and unloading of vessels, cars, etc., and describes all modern machinery of this sort. The book is printed on fine paper, and is very completely illustrated with a large number of half-tones and numerous line cuts, showing details of machinery. It will no doubt be welcomed by all engineers, and will be found a most useful handbook.

FARM GRASSES OF THE UNITED STATES. By William Jasper Spillman. New York: Orange Judd Company, 1905. 12mo.; pp. 248. Price, $1.

This volume presents, in connected form, the main facts concerning grasses grown on American farms. Actual practice in grass growing has been set forth wherever information concerning this is available. The country has been divided into four regions, each of which presents a different set of problems. The problems of growing grass in the South and the semi-arid lands of the West are discussed, and full information given concerning them. The book forms a practical treatise on the grass crop, seeding and management of meadows and pastures, descriptions of the best varieties, the seed and its impurities, grasses for special conditions, etc.

BUILDING MATERIALS. Their Nature, Properties, and Manufacture. By G. A. T. Middleton. New York: William T. Comstock, 1905. 8vo.; pp. 420. Price, $4.

This book is one of the most recent and complete works on the subject of building materials which has come to our notice. It is prefaced by a geological introduction, describing the formations in which British building materials occur, and by a second introductory chapter dealing with the chemistry and physics of building material. After citing the various stones and their classification, these are all described in detail, a chapter being devoted to each. Other building material, such as lime, plaster, cement, bricks, terra cotta, artificial sand and stone, and their methods of manufacture, are described in detail and illustrated by photographic views. Several chapters are devoted to timber, the various woods and their method of seasoning and preservation being described. The main varieties of iron, their impurities, strength, and test, are also considered in detail. Steel, copper, zinc, and lead are also treated of, and the book even goes into the description of special paints, enamels, and iron and stone preservatives, giving full directions for mixing and using the same. Varnishing, polishing, enameling, and lacquering are also described in the latter portion of the work. Glass and wall and ceiling papers, besides stamped metal linings, etc., are among the sundry materials of lesser importance which will be found described. The work is a complete textbook for students and others engaged in the building trades.

THE POCKET BOOK OF REFRIGERATION AND ICE-MAKING. Edited by A. J. Wallis-Thayer, C.E. New York: The Norman W. Henley Publishing Company, 1905. 16mo.; pp. 184. Price, $1.50.

This volume contains in a handy form such formulæ, data, tables, and memoranda as are constantly required by persons engaged in the refrigeration and cold-storage industries. It is a very reliable handbook, giving full information on all subjects of refrigeration, such as Cold Storage; Ice-Making and the Storage of Ice; Insulation; the Testing and Management of Refrigerating Machinery, etc. The book has a large number of general tables and memoranda, and is completed by an index, which makes all its information readily accessible.

KNOTTING AND SPLICING ROPES AND CORDAGE. By Paul N. Hasluck. Philadelphia: David McKay, 1905. 16mo.; pp. 160. Price, 50 cents.

This small handbook, which is fully illustrated with numerous engravings and diagrams, was compiled by the author for everyday use. It consists of a comprehensive digest of information on this subject, obtained from the columns of Work. Among the different kinds of knots described are eye knots, ring knots, and fancy knots. Rope formation, shortening, and splicing are also described. One chapter is devoted to "Working Cordage," another to "Lashings and Ties for Scaffolding," and a third to "Splicing and Socketing Wire Ropes." Two of the most useful chapters are on "Simple and Useful Knots" and "Hitches and Bends." The book is provided with an index, which makes the information it contains readily available.

CEMENT AND CONCRETE. By Louis Carlton Sabin, B.S., C.E. New York: McGraw Publishing Company, 1905. 8vo.; pp. 507. Price, $5.

This volume is one of the most complete we have seen on cement and its properties and uses. It is divided into four parts, which deal respectively with the Classification and Manufacture of Cement; the Properties of Cements and Methods of Testing Them; the Preparation and Properties of Mortar and Concrete; and the Use of Mortar and Concrete. The author has produced a work which, although not going into the subject as deeply as some others, still gives all the information essential to the young engineer of to-day, to whom we heartily recommend the work as a most helpful reference book.

ELECTRIC LAUNCH MOTOR. — THE design in this paper is for a motor of unusual simplicity of construction, which can easily be built by an amateur at small cost. It is intended for a boat of about 24 feet over all and 4 feet 6 inches beam, drawing 18 inches, and is capable of propelling such craft at a speed of 7 miles per hour. Illustrated with 21 cuts. See SCIENTIFIC AMERICAN SUPPLEMENT, No. **1202.** Price 10 cents by mail, from this office, and from all newsdealers.

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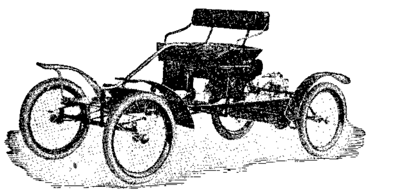

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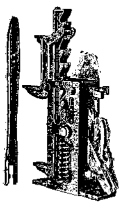

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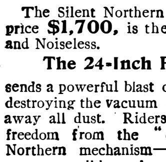

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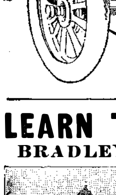

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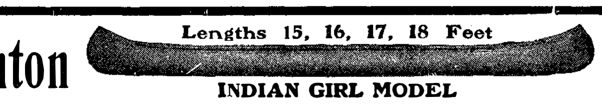

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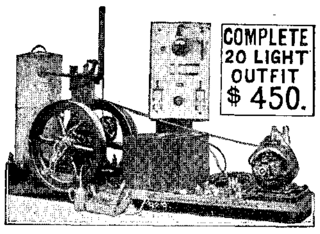

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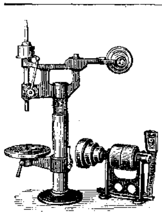

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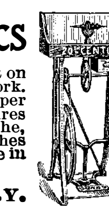

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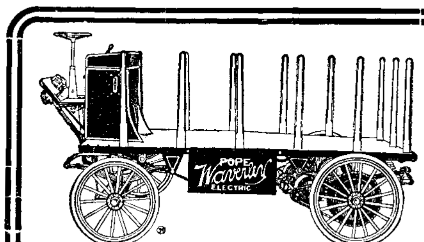

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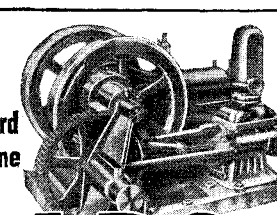

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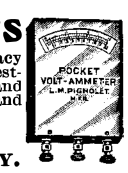

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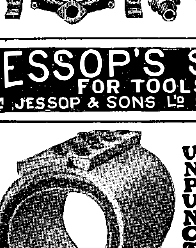

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