SCIENTIFIC AMERICAN

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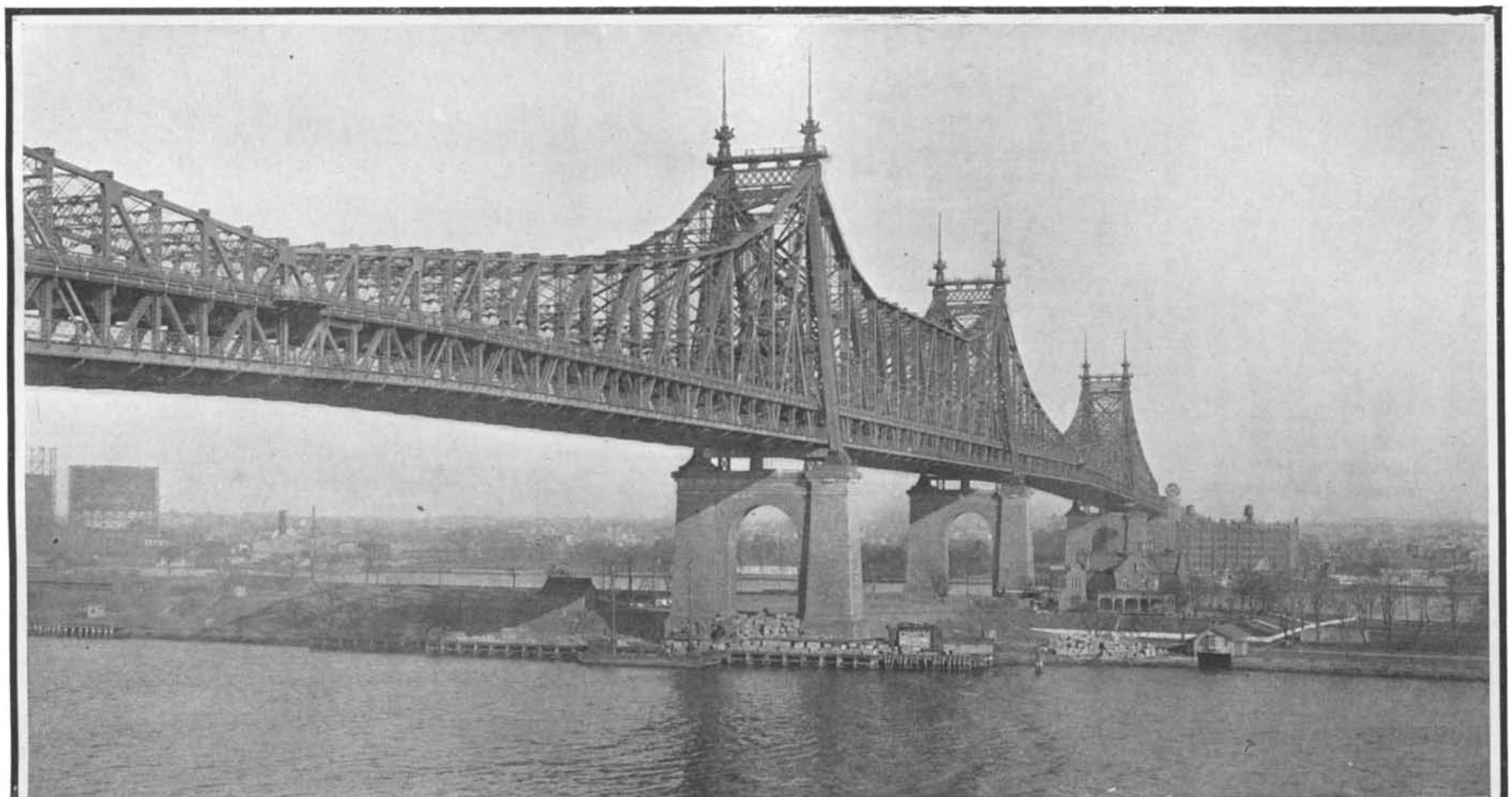
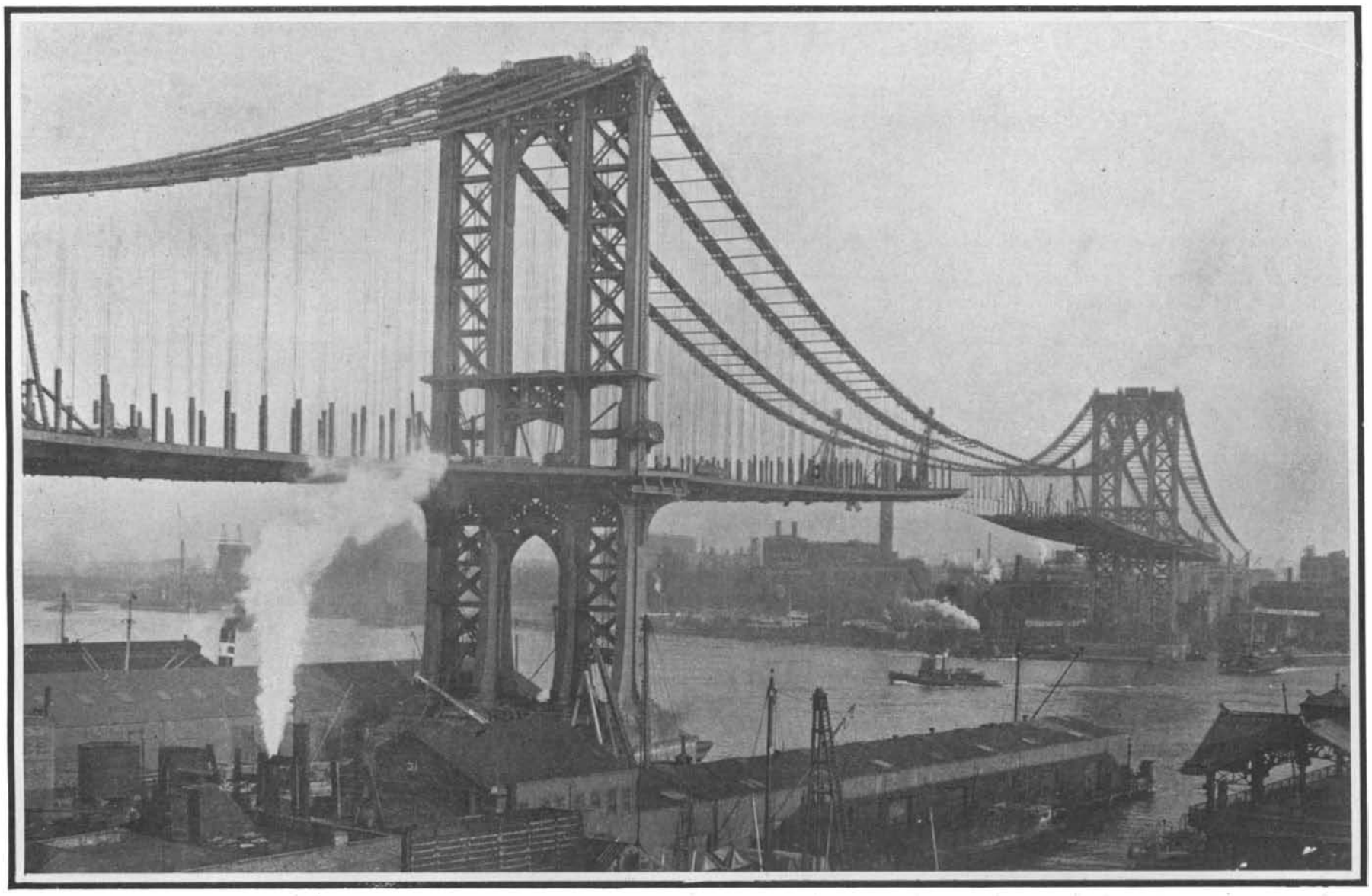


Total length, 8,600 feet. Total weight of cantilevers, 52,000 tons. Contains two main spans of 1,182 and 984 feet. Cost, $20,000,000.

The Queensboro cantilever bridge, opened for service March 30th, 1909.



The upward curve of the completed roadway is due to the partial loading of the cables, which are depressed near the towers and raised at the center. When the floor is completed it will lie in a true curve.

Building the suspended roadway of the Manhattan bridge.

THE QUEENSBORO AND MANHATTAN BRIDGES ACROSS THE EAST RIVER.—[See page 281.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, APRIL 10th, 1909.

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.

THE NEW HUDSON RIVER STEAMER "ROBERT FULTON."

The year 1909 being the centennial celebration of the inauguration of passenger steamboat service on the Hudson River, and also the three hundredth anniversary of the discovery of the river, it is fitting that the name "Robert Fulton" should be given to the handsome steamer, illustrated in the current issue of the SUPPLEMENT, which will form the latest addition to the fleet of the Hudson River Day Line. There is considerable interest, moreover, in the historical coincidence that, while the new "Robert Fulton" is under construction, work should also be progressing upon a facsimile of the "Claremont," the first boat to make the passage under steam up the Hudson. After careful search, sufficient data have been secured to make it possible to build a close facsimile of Robert Fulton's famous craft, and the contract for its construction has been let to the Staten Island Shipbuilding Company. The original "Claremont" was 150 feet long; 13 feet wide, and had 7 feet depth of hold. She was able to make from 4 to 6 miles an hour. In the forthcoming celebration, the 1909 reproduction of the "Claremont," in company with a facsimile of Henry Hudson's "Half Moon," which is being built by the Dutch in Holland, will form the most interesting feature of the great naval parade up the historic river.

THE RENAISSANCE OF THE SPANISH NAVY.

No little interest attaches to the fact that the Spanish nation has at length determined upon a scheme for the systematic upbuilding of her navy. In view of the brilliant records of her medieval naval history, there is no reason why, under her young and exceedingly popular King, the Spanish flag should not fly over a modern navy that in everything but size will compare favorably with those of the leading maritime peoples. The scheme of reconstruction contemplates the building at Ferrol of three battleships of about the size of our own "Connecticut," and the construction at the same place of what will be, in effect, an entirely new naval yard. A similar reconstruction is to be undertaken at Carthagena, where four 800-ton gunboats, three 350-ton destroyers, and twenty-four 180-ton torpedo boats are to be built. The construction of the new docks and of the ships themselves will be undertaken by three leading British firms, and the total outlay will be between $35,000,000 and $40,000,000. The most important part of the new programme is three big-gun battleships which, although they are to be of only about 15,000 tons displacement, will have in some respects greater gun power than the 18,000-ton British "Dreadnoughts." Each ship will mount eight 50-caliber 12-inch guns of 52,000 foot-tons muzzle energy. Two of these will be forward on the center line, two aft, and one on each beam. The two last-named pair of guns, placed *en echelon*, will be capable of firing across the deck, and therefore will command either broadside. This will give a concentration of six guns ahead or astern, and eight on each broadside, which provides an all-round fire equal, in the number of guns engaged, to that of the "Dreadnought," and, because of the more modern character of the guns, considerably more powerful. The ships will carry a 9-inch belt with 7-inch side armor above the belt. The barbettes will be protected by 10 inches of armor, and the battery of torpedo-defense guns will everywhere be protected by 7-inch armor. As a protection to the machinery and magazines against torpedo attack, interior armored bulkheads are to be built into the ship. The ships will stow sufficient coal for a radius of 5,000 miles at cruising speed, and they are required to show 19½ knots speed on trial.

The Spanish authorities are to be congratulated upon securing so much fighting power on so relatively small an expenditure of money, for these three ships will mount among them no less than twenty-four 12-inch guns of the most modern type, every one of which will be available on either broadside. Moreover, in an engagement these guns will be contained within a battle line not over two-thirds of a mile in length; and these three little battleships will thus secure those advantages of big-gun concentration, which our own Capt. Simms has shown to be such an important factor in winning the line-of-battle engagements of the future.

CENTER VERSUS SIDE DOOR CARS.

It is surprising that so much conservatism should exist in the planning and operation of great public utilities, and particularly those having to do with city and suburban transportation. Although it has long been recognized that the speed with which large bodies of people can be kept moving is determined by the least area of the passageways, entrances, and exits, through which they must pass, it is only recently that the railroads have begun to act upon this principle, which so vitally affects the passenger-carrying capacity of their systems. If we but take a comprehensive view of the problem of city transportation, it appears nothing less than amazing that our railroad men should have been satisfied for so many years, to cut down the capacity on certain congested roads, fully twenty-five to thirty per cent, by the foolish expedient of providing only a single narrow door at each end of the cars for loading and unloading passengers. It has been known for years that the total traffic that can be carried over a given stretch of road is determined by the number of trains that can pass over that road in a given time. It has also been well understood that it is not so much the speed of the train, as the length of the stops at stations, which determines the frequency of the trains; and lastly, it is well known that the length of the stops at stations is determined by the length of time which it takes to get people into and out of the cars.

The quickest and cheapest way to loosen up congestion on a railroad is to remove obstructions to the transfer of passengers between the station platforms and the cars. We have known this for years. The Illinois Central Railroad, during the World's Fair at Chicago, introduced the European practice of providing a side door at the end of every pair of seats; and they proved that the quick and easy handling of vast crowds at stations is, other things being equal, directly proportional to the number of side entrances provided on the cars. Conservatism, however, proved to possess an inertia which not even this notable lesson of the Chicago Fair could overcome; and the absolutely stupid practice of building big cars of large seating capacity with single end-doors lives and flourishes in our midst to-day.

The Public Service Commission recently made a commendable attempt to loosen up the congestion of our crowded subways by putting on an eight-car express train, in which two side doors were provided at each end of the car. The device showed its value in the few days of its operation, in spite of the fact that the officials of the Interborough Road seem to have done everything they could to hinder its success. These officials, however, claim that they are not opposed to improvements looking to the expediting of traffic, and they have announced their intention to place some fifty cars in service, which will be provided with single end-doors for the incoming, and central doors for the outgoing passengers.

This raises the question of the relative merit of the Public Service Commission system and that proposed by the operating company. Judging from the success which has attended the use of center door cars, when they are so operated as to produce an uninterrupted flow of passengers, we are inclined to think that the solution of the problem may be found rather in the use of the single center door than in the provision of double end-doors. If the end-doors are reserved for incoming and the center doors for outgoing passengers, the stream of traffic is kept flowing in one direction, and all collision is avoided. Should the Interborough Company be really building a train of center-door cars, there will be presented an excellent opportunity to try out the two systems under exactly identical conditions. We may look for an early settlement of the question, to be followed by a complete equipment of the whole Subway system, and an increase in its capacity by fully twenty-five per cent.

RECENT FLIGHTS OF GERMANY'S FIRST ZEPPELIN MILITARY AIRSHIP.

The "Zeppelin III." airship, which was reconstructed and experimented with by Count Zeppelin last fall after the demolishment of the "No. IV.," was purchased by the German government and renamed the "Zeppelin I." During the past month the army officers have been making flights and tests of various kinds with their first rigid-type airship, while the Count has been pushing the construction of his fifth vessel, which is also being built for the government and which, when completed this month, will be called the "Zeppelin II."

During the first day's tests by the military authorities, three flights were made. In the second flight, which was a speed test, the airship went from its shed to Lindau and back, a distance of about 24 miles, in 40 minutes, which is equivalent to a speed of some 36 miles an hour, thus demonstrating that it has lost none of its former speed through the use of 2-bladed propellers in place of the 3-bladed ones that have always been used heretofore. During the greater part of last month experiments and flights were made almost daily, and on March 16th it for the first time made a successful landing upon the ground instead of upon the surface of the lake. This successful demonstration of ability to land on *terra firma*—a feat which critics of the Zeppelin type of rigid airship have always claimed it could not accomplish—encouraged the officers in charge, and a few days later, on March 20th, the airship is reported to have made a 150-mile flight in 4 hours with 26 men on board. On the 29th ultimo a record for height of 6,000 feet was made.

On April 1st, at 4 A. M., the airship, with Count Zeppelin at the helm, left Friedrichshafen for Munich, a distance of a little over 100 miles. Shortly before 9 it appeared over the city, and afterward attempted to land in a nearby field. The wind against which it had battled all the morning increased in velocity, however, and it was found dangerous to attempt to land in it. The rear motor gave out, and with but half power available, the airship could no longer make headway. It drifted about 70 miles, and was finally brought to earth successfully at Dingolfing, where it was moored in a field over night. The motor was repaired, and the next morning, at 11:15, the huge vessel reascended in a moderate wind, and returned quickly to Munich in 2¼ hours. A successful landing was made on the parade ground outside of the city. Count Zeppelin was decorated with a gold medal by the Prince Regent of Bavaria and was given an ovation. At 3:30 P. M. a start was made for Friedrichshafen, and the 100 miles were covered without incident in 4½ hours.

This long-distance trip of Germany's first aerial cruiser gives one an idea of what is yet to come in the line of aerial transport for pleasure and business purposes. The main point brought out was the uncertainty of the gasoline motor. The 4-cylinder 85-horse-power engines used are the best that the Daimler Company can produce; they are fitted with three separate ignition systems, to make them perfectly reliable; and yet, at a crucial moment, one of them failed to operate, thus leaving the airship at the mercy of the wind for a period of several hours. After sending the vessel to a higher elevation in an effort to find calmer air, it was finally brought to earth without damage in a wind having a reported velocity of over 30 miles an hour. Furthermore, it was moored all night in the open, despite the strong wind which did not abate until 10 A. M. the following day.

The successful landing and mooring of this huge air craft under such extremely unfavorable conditions show it to be by all odds the most practical type of airship that has thus far been developed.

THE FOURTH DIMENSION ESSAYS.

The Fourth Dimension competition was definitely closed on April 1 in accordance with the rules. All told no less than two hundred and forty-five essays were received, from almost every civilized country. If we needed any proof of the world-wide interest which this prize competition excited we would surely find it in the fact that the competitors are residents of England, Germany, Austria, France, Turkey, South America, Holland, India, Australia and South Africa, as well as the United States and Canada. The task of carefully reading two hundred and forty-five essays and of selecting that which is worthy of the prize is no light one, for which reason it is doubtful if the judges will reach a decision before June or July.

Many workers who employ artificial lighting largely at their work prefer the gas incandescent light, finding it softer and less trying to the eye than the light of the carbon filament. The light of the carbon filament is certainly rich in red rays, and to these some authorities ascribe in part the tiring effects. On the other hand, the light of the gas mantle is rich in actinic rays. The introduction, however, of the metalic filament changed the character of the light of the incandescent electric lamp and rendered its radiations of much the same quality as those given off by the rare-earth gas mantle. It remains to be determined whether the metallic filament is better or worse than the carbon filament so far as the action of its light on the human eye is concerned.

ENGINEERING.

Armored concrete continues to enlarge the field of its application, and he would be the bold prophet who ventured to state the limits of its usefulness. We understand that the experimental concrete telegraph poles erected by the Pennsylvania Railroad have proved so successful that the company has decided to extend their use gradually over its western lines.

We understand that M. Turpin, the inventor of melinite, the first of the high-explosive shell fillers, has invented a new powder which he has offered to the French government. The new explosive is more stable than that now used by the government, and the inventor claims that the number of accidents will be greatly reduced by its introduction into the army and navy.

Following the lead of Brazil, the Argentine Republic is undertaking an ambitious programme of naval reconstruction. The principal feature is the construction of two battleships of the "Dreadnought" type, six destroyers, and a considerable number of torpedo boats. According to advices the battleships are to be of 20,000 tons trial displacement; and it is expressly provided that there shall be a secondary battery of sufficient size and power for torpedo defense.

A special train on the New York Central system recently made a run from New York to Chicago which is worthy of being placed on record. Leaving New York at midnight, eastern time, or eleven o'clock central time, Buffalo was reached at 6:39 in the morning, Cleveland at 9:27, Toledo at 11:23, Elkhart at 1:23, and Chicago at 3.07, the total distance of 965 miles being covered in 967 minutes. The train consisted of three empty cars and one private car, and six changes of engines were made on the trip.

The Long Island Railroad Company has asked for bids on 120 steel passenger motor cars, which will cost together about $2,000,000. They are intended for service through the Pennsylvania tunnels leading beneath the East River into the New York city terminal. It has been definitely decided that steel cars only are to be operated in the tunnel system, and the Long Island Railroad, by this order, is bringing its equipment up to the required standard.

The decision of the United States Geological Survey to establish rescue stations in the leading coal fields of this country is prompted by humanitarian considerations which will meet with universal approval. The stations will be located in centers where the most fatal accidents have occurred; complete plant for the rescue of miners will be provided; and a board of experts will instruct both the officials and the miners in its use. The instruction corps will consist of thoroughly competent mining engineers, who will hold themselves at all times ready for emergency work.

With a view to avoiding the passage around the dangerous Cape Cod coast, a provision was inserted in the River and Harbor bill recently passed, under which the government engineers are empowered to make a preliminary survey of what is known as the "inside" route. The line of the proposed canal extends from Narragansett Bay, by way of Taunton River to Taunton. It follows a tributary of this river to the divide, and reaches Boston by way of Weymouth, Fore River. The length of the canal, from the 25 feet depth of water in Taunton River to the same depth in Boston harbor, is about 41 miles. The estimated cost is $12,000,000.

The work of reconstructing the late Admiral Sampson's flagship, the armored cruiser "New York," is about completed. The ship now carries new and modern armored turrets, fighting tower, and gunfire directing and control systems. The new turrets are of the same design as those being installed on the new "Dreadnoughts." They have automatic shutters in the ammunition hoists; and everything relating to the handling of the ammunition and the firing of the guns is thoroughly up-to-date. The "New York" now carries four of the new 50-caliber 8-inch rifles in her two turrets; and a broadside battery of 5-inch guns will probably replace the old and comparatively feeble 4-inch guns. The latest water-tube type of boilers is to be installed. Altogether the ship will be modernized.

The first official statement of plans for the great bridge across Hell Gate, New York, which will serve to connect the system of the New Haven Railroad Company with that of the Pennsylvania Railroad Company on Long Island, was recently given out. The bridge, including its steel approaches, will be about a mile and a half in length, with a central span above Hell Gate 1,000 feet in length, having 135 feet headway above the water. It will be a braced arched structure, the total height of the arch above the suspended roadway being 140 feet. The crown of the arch will be 277 feet above the water. The structure will provide four railroad tracks, capable of carrying the heaviest load of locomotives and freight trains upon all four tracks at the same time. This will be the heaviest span, per foot of its length, of any of the existing long-span bridges of the world.

ELECTRICITY.

A company has been incorporated in Canada to develop the water power of the Conchos River in Chihuahua, Northern Mexico. It has been estimated that 25,000 horse-power can be developed, but at the start only 15,000 horse-power will be used. The current generated will be employed for light and power purposes in the surrounding towns and cities of the state, and also in neighboring mines. Many large and important mines are located within fifty miles of the plant.

It is customary to test a storage battery on open current by applying a voltmeter across the terminals of the battery. It has been pointed out that this is not a true measure of the condition of the battery when discharging at normal current. In order to make the proper test an instrument has recently been devised in which is embodied a resistor, adapted to be connected in parallel with the battery and the voltmeter. The resistor is such as to permit momentarily a normal discharge of the battery.

Some of the electric lighting companies in Germany charge their customers for a certain maximum current consumption for which the customer agrees to pay. This does away with the necessity of using current meters and simplifies the keeping of accounts. However, to protect the companies against an over-use of current an instrument is provided on each circuit which is arranged to break the circuit whenever the current consumption exceeds the amount agreed upon. The current limiter is provided with a solenoid which is set to operate at the predetermined current value and thus interrupt the flow of current. The device operates with two-pole magnets for three-wire systems, and has been made with three-pole magnets for polyphase currents.

A relay has been devised for use with the telephone receivers of wireless telegraph systems. It is customary to read wireless telegrams by means of a telephone receiver. The relay consists of a step-down transformer coil, the fine wire of which is connected with the electrolytic detector, while heavy wire is connected to the telephone receiver. The fine wire is wound to 450 ohms, while the thick wire coil is wound to 3 ohms. A carbon rod rests on the diaphragm of the telephone receiver, while the opposite end engages a carbon block, thus forming a microphone. The second telephone is placed in circuit with this microphone and a battery. The second telephone thus reproduces the "wireless" signals so loudly as to be heard throughout a large room.

An electric furnace has been put on the market for tempering and hardening tool steel, in which it is claimed that a more constant and uniform temperature is maintained than is possible with the ordinary coal and gas furnaces now used. As a bath for this furnace barium chloride and potassium chloride are recommended. These metallic salts have no effect on the composition of the steel and thus have an advantage over the lead bath or cyanide process. Furthermore, they give off no dangerous fumes. The outer wall of the furnace, even when the temperature of the bath is 1,300 deg. C., is not so hot as to be uncomfortable to the hand. Hence the cooling bath may be placed close to the furnace, reducing to a minimum the time required to transfer the material from one bath to the other.

In a paper recently presented by Prof. S. P. Thompson and Mr. E. W. Morse before the Physical Society, England, some interesting facts about the demagnetization of bar magnets were brought out. They showed that every bar magnet has a self-demagnetizing action, the value of which at the middle of the bar depends for a given intensity of magnetization on the ratio of the length of the bar to its cross section, on the permeability and on the surface distribution of the magnetism. It was found that for equal values of the dimension ratio the factor for rectangular bars having a sectional ratio of 2 to 1 was about 93 per cent of that for bars of square section, while for flat bars having a sectional ratio of 10 to 1 the factor was 75 per cent of that for bars of square section.

The value of ozone as a disinfectant is well known, and many apparatus have been designed for the production of this gas. The most familiar method of generating ozone is by means of the silent or brush discharge, and this requires a transformer using an alternating current or an interrupted direct current. A new method of making ozone has just been devised, in which a continuous current is used, and the transformer is eliminated. It consists of a tube provided with a small fan, adapted to draw the air therethrough. In the center of the tube is a Nernst rod. The rod is first heated to the proper degree by a heating coil, after which the coil is disconnected in the usual manner and the current passes directly through the rod, which is thus rendered incandescent. At the same time the fan is automatically started. Ozone is produced by the contact of the air with the incandescent Nernst rod.

SCIENCE.

A new radio-active product of the uranium series has been discovered by Mr. Jacques Danne, of Paris. While engaged in the laboratory of Mme. Curie at the university in separating and concentrating the uranium X contained in 60 pounds of uranium nitrate, he was led to observe the new substance which appears as closely related to uranium X. He has decided to call this body radio-uranium.

The prairie dog has become such a pest in the national forests of Arizona and New Mexico, that the United States Forest Service has decided to carry out an active campaign for its extermination. Poisons are used such as strychnine, cyanide of potassium, anise oil, and molasses, the poison being smeared over wheat. The riders carry the wheat in a tin pail supported by a gunny sack slung across the shoulder. One hand is free for the reins. With the other the rider uses a teaspoon to measure out the poison.

Capt. Roald Amundsen has completed arrangements for his drifting expedition in search of the North Pole in Nansen's famous ship, the "Fram." The "Fram" is being overhauled and strengthened, and probably will be ready to leave Christiania early next year. Amundsen will accompany the steamer out of the fiord, but will return and later proceed to America, and thence to Nome, Alaska, where the "Fram," which is to go by way of Cape Horn, will pick him up. From Nome the expedition will enter the Arctic Ocean through Bering Strait.

It is estimated that a fence post, which under ordinary circumstances will last for perhaps two years, will, if given preservative treatment costing about 10 cents, last eighteen years. The service of other timbers, such as railroad ties, telephone poles, and mine props, can be doubled and often trebled by inexpensive preservative treatment. To-day, when the cost of wood is a big item to every farmer, every stockman, every railroad manager—to everyone, in fact, who must use timber where it is likely to decay—this is a fact which should be carefully considered.

A radium institute, of the kind already in process of formation in Vienna, London, and Berlin, is to be opened for work in Heidelberg in the present year. An endowment has been secured, and the Heidelberg Institute will thus be the first of its kind actually to come into existence and to commence work. It is to be known as the Radiologische Institut. The new institute is to be under the same direction as the Physikalische Institut of the University, and will thus secure full benefit from the whole existing resources of the university. The endowment will insure the furnishing of the institute with the best equipment that can be secured, while the spring sediments from the neighboring State of Kreuznach, to be worked up by the government salt department, will provide a source of radio-active material for clinical and scientific investigation.

A peculiar phenomenon attending a total eclipse of the sun is that generally known as the "Shadow Bands," first observed in 1842, and noted in most subsequent eclipses. Ordinarily the phenomenon presents itself as a series of long, dark bands, separated by white spaces, which are seen on the ground or sides of buildings just before and just after the total phase of an eclipse, these bands having a progressive, or undulatory motion. While they are generally admitted to be due to the irregular refraction of the light coming from the narrow crescent of the sun's limb, no conclusive proof has yet been offered and further observations are desirable. Prof. A. Lawrence Rotch has for many years collected such observations. He infers from all the data collected that the shadow bands are produced by the diminishing crescent of light penetrating air-strata differing in their thermal and hygrometric conditions and, consequently, in their refractive power.

Prof. W. H. Pickering recently announced that there might be a possible ultra-Neptunian planet in right ascension 7 h. 47 min., declination + 21 deg. In the December number of the Monthly Notices of the Royal Astronomical Society Prof. George Forbes from a study of the aphelion positions of a number of comets deduces the place of a possible planet for 1908 as longitude 215 deg. 31 min, latitude —33 deg. 53 min. or right ascension 13 h. 12 min., declination —45 deg. For 1914 the predicted place is longitude 217 deg. 21 min.; latitude —32 deg. 15 min, or right ascension 13 h. 24 min., declination —44 deg. The period of the hypothetical planet is given as 1,076 years and the other elements as follows:

Ω	*i*	*e*	π	Mean Distance.	Date of Perihelion Passage.
247° 34′	52° 0′	0.1665	114° 57′	105.1	A.D. 1702.

A remarkable feature of these elements is the great inclination (52 deg.) of the orbit to the plane of the ecliptic, which explains perhaps why it has not been found if it should be bright enough to be readily seen or photographed.

A LIFE-LINE AIR CANNON.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The ordinary rocket as a means of establishing communication between a wrecked ship and the shore in stormy weather has the disadvantage of being severely limited in its range of action, and when discharged in the teeth of a gale the deviation in the line of flight still further reduces the range. The question of establishing a more efficient and longer range system has occupied the attention of the British government for some time past, and a few months ago the department of the Board of Trade established a special committee of experts, for the purpose of examining and thoroughly testing various improved devices for throwing life lines, as well as other contrivances for connecting a wreck with the shore, so that the ordinary breeches buoy may quickly be brought into service for succoring those in distress.

Among the various contrivances investigated was an air cannon invented by Mr. Alexander J. Macleod of West Hartlepool, which attracted particular attention. The rough full-sized model used in these trials is shown in the accompanying illustration. It comprises a cannon mounted on a four-wheeled carriage for convenience of transport. Compressed air is used as the propelling agent for throwing the missile to which the life line is attached. The cannon is elevated through a wide angle by gearing, and mounted on either side is a crank wheel for use in compressing the air to provide the propelling charge. The two cylinders are mounted on the barrel of the gun and fitted with the usual pressure gage, a special valve being used to control the admission of the charge into the breech when desired.

The life line is coiled on a winch mounted in the front part of the carriage beneath the cannon, and fitted with special check action to prevent the line from paying out too rapidly while the projectile is in flight and thus becoming tangled. The barrel of the cannon is 5 feet in length, and the air-compressing mechanism is designed to supply sufficient energy to throw the line a maximum distance of half a mile under its full compression charge. It is not necessary to use the maximum compression charge when effecting communication over a shorter intervening space, the gage being graduated to fulfill various requirements as to range, while in heavy weather where increased resistance to flight is encountered, a greater charge than that which is normally adequate for the distance can be used.

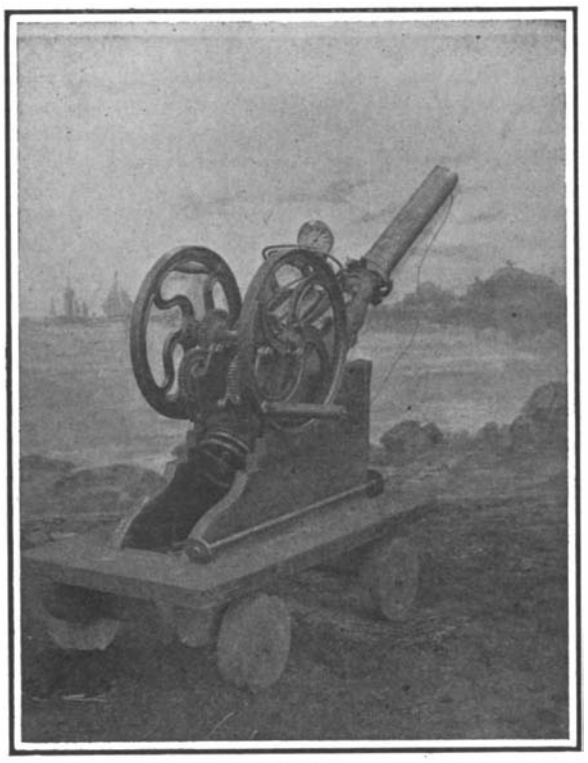
This line-throwing apparatus, unlike the majority of such appliances, is particularly designed for attachment to ships. As is well known, vessels are for the most part unprovided with any line-throwing facilities, albeit that in the majority of instances, the possibilities of establishing communication between the wreck and the shore, from the ship itself, are greater than in the reverse direction, since the land offers a better target for the alighting of the line-carrying missile than the vessel, and the fact that in the majority of wrecks the wind is invariably blowing strongly on shore, so that the very agency which retards the flight of the rocket fired from the beach tangibly assists that thrown from the ship. But the use of a rocket apparatus and similar agencies from a deck is attended with great risk, especially if the ship be carrying an explosive or inflammable cargo. With the Macleod apparatus, owing to compressed air being the propelling agent, the cannon can be discharged in the closest proximity to any combustible cargo with absolute safety.

In the course of the trials at South Shields, where this system was first demonstrated, its safety and long range, combined with its applicability to vessels, attracted the especial attention of the investigating experts, who induced the inventor to repeat his experiments at Dundee, and these proved eminently successful. It is anticipated that this line-throwing appliance may be used on ships, not only for wrecks, but in other emergencies, where it is required to effect a communication over an intervening space under conditions which render the employment of a boat impossible.

Experiments to show the effect of rolling on the magnetic properties of steel were recently carried out in the German Reichsanstalt. It was found that the steel was more efficiently magnetic at right angles to the direction of rolling than parallel to it, and the differences were uniformly quite marked.

THE FILTRATION OF CITY WATER SUPPLY.

Although the customary method of building dams and impounding the water of springs and rivers will secure for a community an abundant supply of drinking water, careful analysis has proved that such a system offers no guarantee as to its purity; for not only will it contain a large amount of vegetable matter which has been carried into it from the surrounding watershed, but in cases where the drainage area is inhabited, it is liable to contain the germs of fatal diseases. Moreover, in localities where the reservoirs are filled by pumping water from an adjoining river, into which the sewage of towns and villages



A COMPRESSED-AIR LIFE-LINE CANNON.

located on the upper reaches of the river has been emptied, analysis shows that the disease-breeding germs may be present in fatally large numbers.

In looking for a suitable means for the purification of drinking water, we find that nature has provided an excellent object lesson in the natural water springs, and the process by which they are brought to their condition of clarity and sweetness. The purity of spring water is due to the slow filtration of the water through the sand, silt, and finely-divided mineral matter of the earth's surface, and the further purification which occurs as it rises to the surface in some distant and less elevated locality. The slow seepage of the water not only strains out the mechanical impurities, but it also assists a certain bacteriological action, which results in the almost complete elimination of harmful bacteria.

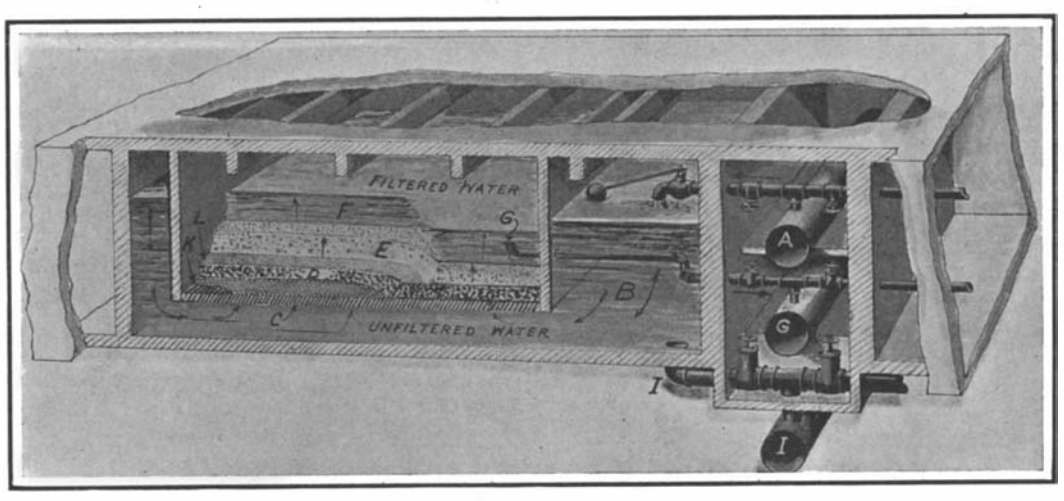
The first attempt to reproduce the processes of nature was made in the year 1839, at the Chelsea Water Works at London, England. Large open basins were constructed, in which was laid a bed of sand several feet in thickness. The water to be filtered was introduced above the bed, and allowed to strain through, the filtered water being collected in pipes laid at the bottom of the sand beds and led away to the distribution mains.

There can be no doubt that the reluctance of many cities to undertake the construction of filtration plants is due to the large first cost, and the subsequent cost of operation. Filtration by the method of allowing the water to strain by its own gravity through a closely-packed bed of fine sand, several feet in thickness, is necessarily a slow process; particularly as the rate of flow decreases with the steady accumulation of the deposited impurities in the upper strata of the sand bed. Consequently, for a given daily supply of water a large area of filters must be constructed. Moreover, in the course of a few months, it becomes necessary to discontinue the use of the sand beds, remove the upper foot or so of sediment-impregnated sand, wash it thoroughly in a special apparatus, wheel it back to the beds, and carefully level it off. This is a slow and costly process, and places the filter beds periodically out of service for a considerable length of time. Dr. William R. Smith, Principal of the Royal Institute of Public Health of Great Britain, evidently recognizes this fact when he sums up an indorsement of slow sand filtration with the following significant sentence: "It therefore obviously becomes a matter of serious consideration whether some other efficient means of filtration can be obtained, which can be relied upon to do satisfactory work on a limited area and at a moderate cost."

With a view to reducing the size of the plants by increasing the rapidity of the filtration, what is known as mechanical filtration is employed. In this process the sand bed is placed in a closed vessel, and the water is forced through it at a pressure of from 20 to 50 pounds to the square inch. To place the impurities in a better condition, a certain amount of alum is often added to the water, to coagulate the contained matter. Although this process serves to remove the mechanical impurities, it fails to eliminate those of a bacteriological nature, with the same thoroughness which marks the gravity sand filter. The difference between the two systems is clearly brought out in the report of a Senate committee made to the Fifty-sixth Congress on the question of the best system of filtration for the city of Washington, in which it is stated that mechanical filters have accomplished very little in the reduction of typhoid fever rates. A comparison is made of five European cities using water from sand filters with five American cities using mechanical filtration, in which the average number of typhoid fever deaths for the year 1895 per one hundred thousand of the population is shown to be 46.8 for the American cities, against 6 for the foreign cities.

Lest this comparison between foreign and domestic cities should be considered unfair, the committee prepared a table showing the average number of deaths from typhoid fever in several American cities before and after filtration, from which it appeared that while slow sand filters accomplished a reduction of 78.5 per cent in the number of deaths from typhoid fever, the reduction accomplished by mechanical filtration amounted to only 26 per cent.

The superior effect of slow sand filtration is due to the fact that both the anaerobic and aerobic bacteria are deposited in the upper layers of the sand bed, where the former destroy the latter. It may be further explained that bacteria are divided by Pasteur into two great classes—anaerobic and aerobic. The aerobic bacteria in water consist of the colon group (of which *B. coli communis* is the chief) typhoid and sewage streptococcus. The anaerobic germs have the power, when existing in quantity, of destroying the aerobic; the anaerobic being caught in the upper layers of the sand and near the surface of the water, where they are held in a favorable condition for this biological action to take place.



The Croton water enters through pipe *A* to outer chamber *B*; passes up through slots *C*, iron mesh *K*, charcoal bed *D*, copper mesh *L*, and bed of sand *E*, finally collecting at *F*, whence the purified water is drawn off by pipe *G* For cleaning, water *B* is drawn off through pipe *I*, and filtered water, *F*, rushing through the filtration bed, washes it clear of impurities.

SECTIONAL VIEW OF FILTRATION PLANT AT JEROME PARK RESERVOIR.

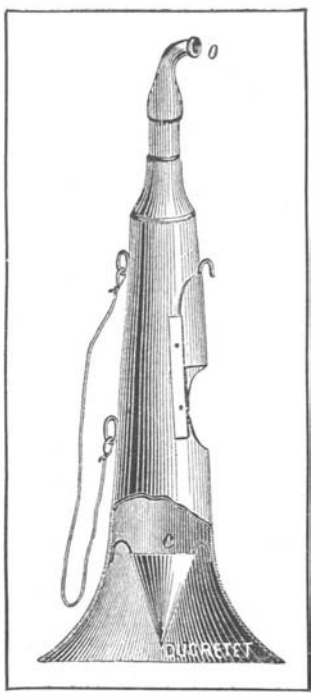
The accompanying illustration shows the general principle of a system of filtration designed to secure all the germ-destroying action of the slow sand filter together with the advantage of sedimentation and consequent increase in capacity. A demonstration plant with a capacity of one hundred thousand gallons per day has been erected by the Municipal Filtration Company in the easterly half of Jerome Park reservoir. It consists of an outer chamber *B*, which contains the unfiltered water, and inner chamber *F*, in which the water collects after being filtered. Pipes *A* and *G* connect respectively with the chambers *B* and *F*, for feeding in the raw water and drawing off the filtered water. The water in chamber *B* is maintained at a slightly higher level, usually less than eight inches, than the level of the filtered water in the chamber *F*. This head insures a constant flow of the water up through the sand filter bed *E*. At the bottom of the chamber *F* is a series of slats *C*, placed at an angle of 45 degrees; above this is a floor,

(*Continued on page 278.*)

DETECTING UNDERGROUND STREAMS WITH AN EAR-TRUMPET.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A new apparatus was presented to the Académie des Sciences during a recent meeting, by Messrs. Diénert, Guillerd, and Marrec, which is adapted to detect underground flowing water. The apparatus, which is shown in the accompanying views, is based on the principle of the "acoustele" or sound trumpet invented by Daguin, and it has now been modified and utilized in the researches for underground water which were made not long since by M. Diénert, engineer of the Paris water supply department. It consists of a large ear trumpet which is set mouth downward upon the ground and has in the interior at the lower part an inverted metal cone *C*. The cone is centrally placed so as to leave an annular space between the upper edge of the reversed cone and the sides of the trumpet. The instrument is surrounded by a box stuffed with sound insulating material to prevent the noise of the outer air blowing against the instrument from being heard. On the upper end of the trumpet there is a rubber tube *o* terminating in a pair of ear-pieces which the operator puts in his ears.

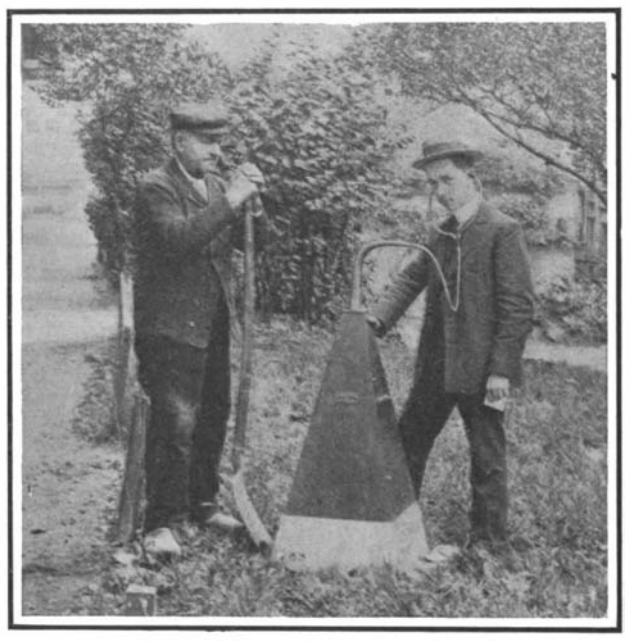


ACOUSTELE BROKEN AWAY TO SHOW THE CONE.

The tests referred to above were made in the suburbs of the city in the neighborhood of the aqueduct which brings the water of the Avre stream into Paris, between Vancresson and Garches, and the presence of the underground water could readily be detected by the noise which was heard in the acoustele. At a point near Vancresson there is an underground reservoir which lies at a depth of 230 feet below the surface of the ground. The reservoir is supplied with water from a spring which furnishes 30 gallons per minute. The water is brought into the reservoir by means of a pipe line which descends along the wall of the latter. The pipe line runs to a point below the water level of the reservoir 2 feet above the bottom. The total fall of the water is about 100 feet. Over this reservoir four different experiments were made, and the presence of the water was indicated by a rumbling noise heard in the instrument, and caused by the water flowing through the piping. The effect was observed even when the instrument was removed to a distance of 530 feet from a spot directly over the flowing water.

A second series of experiments showed the extreme sensitiveness of the instrument. In one case a water reservoir lies at a depth of 145 feet below ground, and it had a pipe line running into it as in the first case, with a total fall of 83 feet. The infiltrations of water from the earth into the reservoir could be perceived in this case, and it was observed that the water dropped from time to time into the basin. This effect was distinguished by the fact that the instrument gave a sound which resembled that of the strokes of a bell heard at a distance. A third test of the acoustele was made at a point near Garches, where the water reservoir lies but 10 feet below the surface. It was interesting to notice in this case that when one of the party descended the shaft leading from the surface of the ground into the reservoir by the aid of a ladder fixed to the side of the shaft, the noise of his feet could be heard in the instrument, and when he whistled, while at the bottom of the shaft, he could clearly be heard through the intervening ground by means of the acoustele.

In all these cases the noise made by the running water was somewhat like that which is produced by the wind in the leaves of trees. To show that the sound was actually caused by the water and not due to any effect coming from the outside, the instrument was taken a much greater distance from the spot, and the noise could no longer be perceived. In order to make use of the apparatus under the best conditions it must be properly placed in the ground, and should be set up in the spots which lie at the lowest level. A hole is dug in the ground about 18 inches square and from 10 to 12 inches in depth, and the surface is well flattened off so that the acoustele can be fitted tightly upon the ground, and it should be placed as flat as possible. The base of the instrument is then sealed with earth to a depth of four inches, but without packing it down. The two tubes are placed in the ears and the observer remains in this position for about five minutes. Should there be a flow of water within a reasonable distance, the observer should hear the sound as described above. The instrument will probably not detect the presence of water when removed to a distance of 800 feet to one side, as was found by the above experiments. When it is desired to explore a piece of ground in order to locate an underground spring for the purpose of boring a well, a series of holes of the kind we just mentioned should be dug at different parts of the ground, and the point which is best for carrying out the boring will be the spot which shows the loudest sound. Should outside noises interfere with such operations, the apparatus as well as the head can be covered by a blanket to deaden the noise. Persons should not walk near the apparatus at the time, nor should the observations be made when near a road except when vehicles are at a great distance. While the above-mentioned experiments were made upon a spot where the presence of the flowing water was known in advance, it will be remarked that the latter was at a considerable depth below the surface, and it is believed that the instrument will be of service in a great number of cases in finding underground water.



ACOUSTELE BOXED AND IN POSITION FOR LOCATING UNDERGROUND WATER FLOW.

PYTHONS AND THEIR PREY.

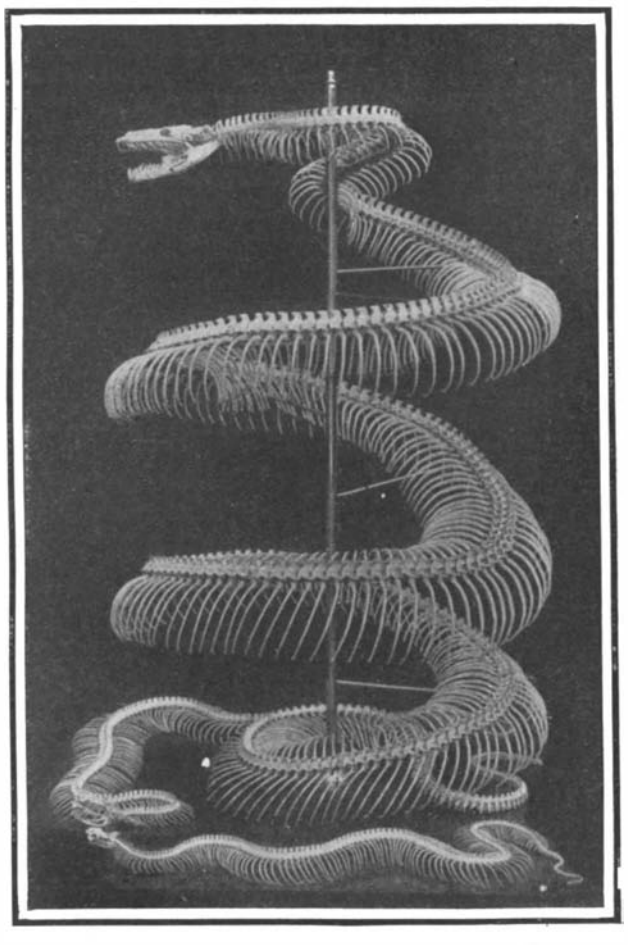
BY W. HENRY SHEAK.

The ability of snakes to perform feats of swallowing their prey is astounding. Recently a small boa, scarcely four feet in length, with a head no larger than a man's thumb, swallowed a full-grown pigeon. We put the pigeon in the cage at night, thinking that an Indian python seven or eight feet long would take it, but a great swelling in the body of the little boa showed what had become of the bird. As no snake chews or rends his prey, we knew that it passed his head and throat entire. The enlargement did not disappear for a week.

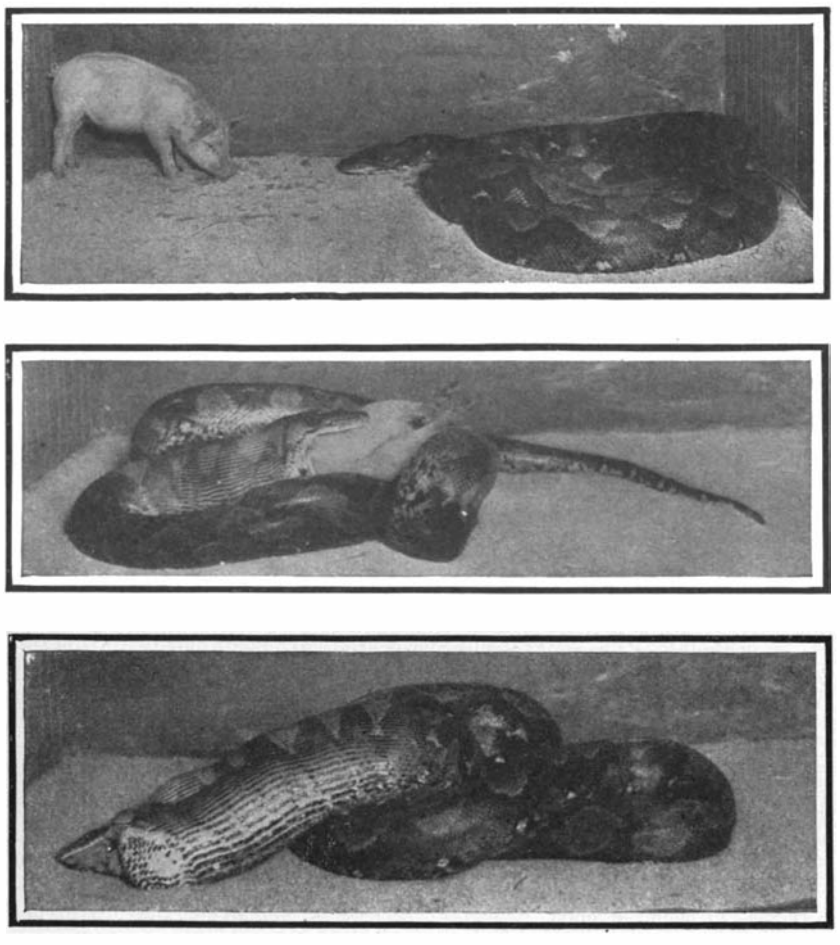
"Long Tom," a giant reticulated python, fed on a pig weighing forty-five pounds. We wanted to get some photographs of the monster reptile taking large prey, so the pig was put in the den alive; but as his prey had been killed for him in captivity, the snake got frightened when the pig began to move about and squeal, and backed away. When the pig was killed and he smelled the blood, he took the animal at once, and in twenty-five minutes it had disappeared. The pig is, however, an easy object to swallow, compared with a dense pelage of fur or feathers.

For two or three days the stomach was enlarged to almost the size of a beer keg, but on the third day the swelling began to diminish, and by the end of the fifth the body had returned to its normal diameter. Contrary to common belief, these big snakes will generally soon learn to take their prey after it has been killed. We usually feed them chickens or rabbits, killed, but while still warm. We have, however, fed them with cold-storage rabbits that were killed in Australia. Miss Grace Clark, the snake charmer, says that she once had a snake that would take a chicken after it was dressed and cut into pieces, receiving the pieces one at a time. A few months ago we wanted to feed a very large pigeon to a very small Indian python. In order to save him the trouble of working over the shoulders, we cut off the wings. After gorging the bird, we offered him the wings, which he took and swallowed.

The python which swallowed the pig was received from Carl Hagenbeck of Hamburg, Germany, in July, 1907. He has a photograph of it in the act of swallowing an Indian antelope weighing over ninety pounds. He had another reticulated python, which swallowed a ninety-seven pound ibex. A python in the Cincinnati zoological gardens swallowed a goat weighing forty-two pounds. All of



Skeleton of python reticulatus. Skeletons of a rattlesnake and a moccasin on the base.



The pig is in the python's throat.

PYTHONS AND THEIR PREY.

the goat that passed intact were the horns, the hoofs, and a piece of sash rope four feet long attached to his neck.

We recently had a big reticulated python, which passed the hoofs of a pig. They were shown to Dr. W. T. Hornaday, the director of the New York Zoological Park, who identified them as the hoofs of the Bornean wild pig, of about forty pounds weight. A ship's captain, in bringing over a large reticulated python, found in the excrement the quills of a Javan porcupine, lying in the same relative position they occupied on the animal's body. The reptile must have begun with the head, extending the coils backward over the body, and pressing the quills down horizontally in their natural state of rest. Evidently, this is a species of prey a snake could not disgorge.

Our small snakes feed largely on frogs, toads, and fish; the anacondas feed extensively on fish; king snakes and king cobras eat other species of snakes; but I have never known a boa or python to take a cold-blooded animal. We often keep small snakes and iguanas with the boas and pythons, but they never take any notice of them. In a state of nature their prey consists largely of small deer and antelopes, lambs, kids, pigs, other mammals weighing less than a hundred pounds, and any bird that may be large enough to attract their attention. That their prey does not always submit without a fight is shown from the number of broken ribs that are found in the skeletons.

We have an artificially mounted skeleton of a twenty-two foot reticulated python, in which there are thirty-seven ribs that show well-marked fractures, and a number of others that show indications of fracture. Some of them have been broken two and even three times. In one, the ends have slipped past each other for about a half inch, and the two sides are knitted together. In one place there are five fractured ribs in succession. A peculiar feature about these broken ribs is that they always occur toward the posterior quarters of the snake. It is probable that the animal responsible for these fractures is the Bornean wild pig. Doubtless the reptile usually seizes the pig near the head, and throws his coils about the shoulders. The posterior limbs are thus left free, and with these he fights desperately till life is crushed out, frequently, as is plainly evident, doing serious damage to his assailant.

In conformity to their attenuated form, snakes have a large number of vertebræ and ribs. A peculiarity of the skeleton is that there are but two cervical vertebræ. The atlas and axis, or first and second bones of the spinal column, next to the head, bear no ribs, but they start with the third vertebra. Neither are there any lumbar or sacral vertebræ. In the reticulated python there are 361 vertebræ. Of these, 2 are cervical, 37 caudal, and 322 dorsal. The caudal vertebræ all bear transverse processes, the proximal ones long and broad, diminishing gradually toward the tip of the tail, but they do not disappear, even on the last distal vertebra. It may be that these are but ribs ankylosed to the vertebræ. It is sometimes difficult to distinguish just where the ribs end and the transverse processes begin. This is true in the Indian python. As already intimated, there are 322 pairs of ribs. However, it is highly probable that this number will not hold constant. Even in man there may be thirteen, eleven, or as few as nine pairs. At least one human skeleton has been known with twelve ribs on one side and thirteen on the other.

Likewise the teeth of the python are numerous. In the upper jaw there is a row of teeth in the maxillary, and a second row, set at considerable distance inside the first and imbedded in the palatine bones. In the lower jaw there is but one row of teeth, that of the inferior maxillary, but it is really double, as there is a line of tiny teeth just inside the larger ones. The teeth are all acutely conical in form, smooth and with no cavities, depressions, or ridges, and set so that they point toward the back of the mouth. They serve merely for catching and holding the prey. As there are no particles of decaying food on the tooth to be carried into the wound and produce blood poisoning, a bite from one of these monsters usually heals quickly.

In seeking his prey, the python depends much more on his sense of smell than on that of sight. It is always dangerous to go near these big snakes with the smell of any bird or mammal on the hands or clothing. When they are hungry and scent their natural food, they will strike at the first thing they see moving. They will even strike at inanimate objects which have come in touch with their natural prey. One evening we were feeding a big python. For some reason it dropped the prey, and to get him to return to the chicken, a woolen duster was pushed toward his head. Instantly he struck and seized the duster in his teeth. His jaws had to be pried open to make him let go. Under similar circumstances, a python seized and swallowed a blanket. After retaining it for two days, he disgorged the article, rolled into a compact wad.

The sense of taste in the serpents is very keen. If chickens are kept in a dirty box, these reptiles will refuse to feed on them. If a python bites into the crop of a chicken containing bad-tasting matter, he will drop the chicken. To test the sensibilities of the serpents, a black snake was once given a stale egg. This species is very fond of eggs, but no sooner had the shell broken in his stomach than he commenced vomiting, and continued till the stomach was completely evacuated.

It is a common belief that snakes are so plentiful in India, that one can scarcely walk about without stepping on them. This is erroneous. It is possible to live for considerable periods of time in that country without so much as catching a glimpse of a snake. And this is especially true when we confine our references to the big pythons. Dr. Hornaday spent two years hunting in India and Borneo, and yet he declares he never saw but one python, and that was a small one. The pythons are timid and shy, and lie coiled among the foliage of trees or shrubs, or in the dense grass on the ground. They never attack man or the large animals so long as they are unmolested.

THE FILTRATION OF CITY WATER SUPPLY.

(*Continued from page 276.*)

K, of steel wire mesh; then a bed of charcoal *D*, followed by a fine screen, *L*, of fine mesh copper; and above this is laid the bed of sand *E*. It will be seen from the above description that this form is a modification of the slow sand system, with the direction of the flow of the water reversed.

Although, normally, the system operates under a very small head of water (the difference of the water level in the outer and inner chambers), as the sediment accumulates in the filtering medium, the height of water in the outer reservoir increases, and there is an automatic adjustment of conditions to overcome the increased friction in the filter bed, but this in practice does not exceed eight inches. The Jerome Park reservoir filters pass through 15 gallons per hour per square foot of filtering surface, which is about five times as fast as the flow through an ordinary slow sand bed. This means that the total area of filter bed required would be only one-fifth of that necessary by the ordinary gravity system.

The advantages of this system are, first, that the slow flow of the water through the outer chamber permits about 60 per cent of the impurities to be deposited there, leaving the filter bed to deal with the remaining 40 per cent only.

Secondly, most of the remaining suspended matter is deposited at the lower surface of the bed.

Thirdly, whereas in slow sand filtration the suspended matter is forced about two feet down into the bed, in the system being tested at Jerome Park it is found that after fifteen months' continuous operation, the suspended matter penetrates four inches only into the sand bed.

Fourthly, instead of removing the sand with great labor, as is necessary in slow filtration, the outer basin is discharged by opening a valve, and the pure filtered water, rushing through the bed, thoroughly cleanses the same.

Fifthly, the valuable biological action, which characterizes slow sand filtration, is also secured in this system, through the presence of the carbon and the septic stratum of sand which is formed in the lowest portion of the bed.

In conclusion, it may be stated that by a series of analyses made at the Jerome Park plant by Dr. John C. Sparks, the water expert, of the water before and after filtration, it was found that although there was an average of 262 organisms present for each cubic centimeter of the unfiltered Croton water, after it had passed through the filter bed, the total organisms were reduced 99.2 per cent; there was no trace of *B. coli communis;* and the water was free from odor, color, taste, or sediment.

An International Exhibition of Inventions.

An international exhibition of recent inventions will be held at the Michael Manege, St. Petersburg, from April to June, 1909. The exhibition is being organized by the Society of Military, Naval, and Rural Sciences. The object of the exhibition is to bring before the notice of the Russian public the latest inventions pertaining to technical science and national economy.

The inventions exhibited relate to military and naval technics, agricultural science, ways and means of communication, constructive work, new industrial and factory appliances, electricity, household novelties and appliances for the prevention of fires. Inventions pertaining to the fine arts, medicine, chemistry, pharmacy, sport, etc., have also been included.

The minister of finance has given permission for the exhibitors to take advantage of the exemption tariff, No. 163, 1894, that is, free return transport of the goods exhibited.

Foreign exhibits will be admitted duty free on the condition that they be returned abroad within a period of two months of the date of the closing of the exhibition. A deposit equal to the duty payable must be made, which will be refunded when the goods are leaving the country.

Exhibitors must bear all expenses in connection with the delivery of exhibits to, and packing and returning from, the exhibition. They will also be charged for the space allotted to them, as well as for electric light, gas, and water required for the special illumination and working of their exhibits.

All exhibits will be entirely under the care of the exhibitors themselves. The committee will take general precautionary measures against loss and injury, or damage by fire, and will insure the building of the exhibition, but it will not be responsible for the safety of the exhibits, and in consequence invites the exhibitors themselves to insure their exhibits. Should the occasion arise, the committee will undertake to effect such insurances by special agreement.

The judging of the exhibits will be carried out with the utmost care; the experts appointed for the purpose are well known in the various fields of science.

Exhibits should be addressed to the Exhibition Committee of the International Exhibition of Latest Inventions, Nevsky 13, St. Petersburg, Russia.

New Automobile Speed Records in Florida.

At the seventh annual race meet upon the beach at Daytona, Fla., recently a number of new records were established. On the first day, March 23d, David Bruce Brown made a mile in 33 seconds in a Benz 120-horsepower racer, and thereby won the race for the Dewar trophy at a speed of 109.09 miles an hour. Strang, on a 30-horse-power Buick stock car, won the 100-mile race for such machines in 1 hour, 34 minutes, 1 1-5 seconds, at the rate of 63.81 miles an hour. The following day, in the 10-mile free-for-all race, Mr. Brown made considerably faster speed over the longer distance, as he covered the 10 miles in 5 minutes 14 2-5 seconds, at a speed of 114.5 miles an hour. Ralph De Palma on his Fiat "Cyclone," was second in 5:29 2-5. The previous record in this race was 6:15, made in 1905 by McDonald with a Napier machine. In the 5-mile invitation race, the German Benz driven by Robertson, beat De Palma's Italian Fiat. The Benz covered the distance in 2 minutes 45 1-5 seconds, or at the rate of 108.95 miles an hour, and thereby beat Lancia's record of 2:54 3-5, made in 1906 with a Fiat racer.

The last event of the second day was for stock cars of various piston displacements up to 400 cubic inches and over. The distance set for this race was 100 miles. Three of the six starters covered this distance, and one ran 120 miles, when the race was called off on account of rising tide. The 120 miles were covered by De Palma's Fiat, of over 400 cubic inches piston displacement, in 1 hour, 33 minutes, 44 3-5 seconds, at an average speed of 76.8 miles an hour. It covered 100 miles in 1:16:55, while the second car at this point—Strang's Buick—took 1:30:24, which corresponds to an average speed of 65.5 miles an hour. The Benz racer, the third car of the trio having over 400 cubic inches piston displacement, stopped early in the race on account of a seized piston.

On the last day of the meet the Fiat racer had a walkover in a 100-mile race, and thus secured for the third time—and therefore finally—the Minneapolis trophy. This trophy was won twice by Mercedes machines and twice by Napier racers, and its third winning by the Fiat car places Italy ahead of both Germany and England. The Fiat "Cyclone," which won it, is only a 60-horse-power machine, and yet it covered a mile in 36 seconds, as against the 33 seconds scored by the Benz 120-horse-power racer. The new record of 2 minutes 45 1-5 seconds made by the latter machine in the 5-mile race supplants that of 2:47 1-5 made three years ago by Marriott in a special Stanley steam racer.

Bicycles and motorcycles were in evidence more than ever this year at Ormond, and a new mile record of 43 2-5 seconds was made by Robert Stubbs, while 43 4-5 was scored by A. G. Chapple. The best previous record for this event was 45 1-5 seconds. A new kilometer record of 27 4-5 seconds was scored by Walter Goerke, who also won the 69-mile race for amateurs with motorcycles having a piston displacement of not over 61 cubic inches. Goerke's time in this race was 58 minutes 25 4-5 seconds, an average speed of 73.7 miles an hour. The best previous record was 68 miles 1,380 yards in 60 minutes, made on the Brooklands track in England. The 20-mile motor-cycle race was won by A. G. Chapple in 17 minutes and 25 1-5 seconds.

The $500 prize that was offered for a mile flight by an aeroplane was not won. Carl Bates, of Chicago, had a small aeroplane with a 10-horse-power motor at Daytona, but he did not succeed in making any flights, even under the nearly perfect conditions obtaining there.

Correspondence.

THE PROPERTIES OF NUMBERS.

To the Editor of the SCIENTIFIC AMERICAN:

For the past three or four months I have been much interested in the discussions of the curiosity of the properties of numbers. From the fact of the age and absolute truth of mathematics, there cannot be any curious properties in the science of numbers.

The citation of one correspondent of the sum of two prime or odd numbers being even is not curious, for the reason that every odd number is one more than even, and 1 plus 1 being 2, which is even, hence the sum of two odds must be even.

Another correspondent states, if the sum of the nine digits be doubled and the last term deducted, the remainder will be the square of the last term; which is not only true of 9, but of the last term of any like series, for the reason that the sum of the terms of a like series is half the sum of the first and last terms divided by 2 and multiplied by the last term—which, in this case, increases 9 five times—and being doubled ten times, or once more than its square.

Extending the series from 1 to 25, we have the sum of the first and last term as 26, the half of which is 13, and being doubled increases 25 to 26 times, or once more than its square. Or, we can say, the last term multiplied by the sum of the first and last is equal to one more than the square of the last.

Other correspondents, noting that numbers may be expressed by the difference of two squares, apparently manifest surprise, notwithstanding the fact that right triangles are governed by that law, which may be illustrated by the construction of triangles, the formation being primary. By assuming any quantity—odd or even, whole, mixed, or fractional—as either of the short sides, with any number slightly or greatly larger as the sum of the other two sides, as many commensurate right triangles may be formed as numbers can be found to express their sides. Some of the assumptions may involve intricate fractions, but when worked out will be found to comply commensurately with the conditions. One of the governing laws is embodied in the fact: The product of the sum and difference of any two quantities is equal to the difference of their squares. Versus: the difference of the squares of any two numbers divided by their sum is equal to their difference.

Assume 1 as a base with 1¼ as the sum of the other two sides. Dividing 1 squared by 1¼ we have 2/3, the difference of the two sides. Dividing 1¼ into two parts having a difference of 2/3, we obtain 13/12 and 5/12. Squaring and subtracting, we have 1 square.

Assuming 5 as an altitude and 12 as the sum of the other two sides, we have 5 squared divided by 12, which equals 25/12 as the difference; and dividing 12 into two parts having a difference of 25/12 we obtain 169/24 and 119/24 as the two sides. Squaring and subtracting, we have 25, or 5 square.

Assuming 5 as an altitude with 25 as the sum of the other two sides, we have 5 squared divided by 25, which equals 1, and 25 being divided into two parts having a difference of 1, we obtain 13 and 12 for two sides. Squaring and subtracting, we have 25, or 5 squared.

Assuming 12 as a short side and 16 as the sum of the other two, we have 12 squared divided by 16, which equals 9, the difference of the other two sides. Dividing 16 into two parts, we have 12½ and 3½ as the two sides. Squaring and subtracting, we have 144, or 12 square.

Assuming 13 as one of the short sides with 17 as the sum of the other two, we obtain 13 8/17 and 3 5/17 as the other two sides. Squaring, we have 48,841/289 minus 360/289 equals 169, or 13 square.

This may be continued without finding a single exception. Besides, the findings may be proportionately expanded or contracted to any extent with like results.

By permission I can, and will, demonstrate to the satisfaction of the lay mind that right triangles are also governed by the laws of proportion. In any right triangle whose base is equal to 1/3 the sum of the other two sides, then (and only then) 1/3 the sum of all three sides is equal to the altitude, as 3-4-5 and 6-8-10, etc.

Yet the properties of numbers, or the science of mathematics, have neither curiosities nor exceptions to their laws.

Hannibal, Mo. D. M. MORRIS.

THE COMMERCIAL POSSIBILITIES OF THE AEROPLANE.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of February 13th there appeared a letter from Mr. C. A. McCready in which he asks if there is any sound principle underlying these air vessels that is capable of development to the point of commercial success. He then goes on to define what the commercially successful airship of the future will be. While he does not actually say so, yet he intimates that there are better principles for the construction of aeronautic machines than have as yet been tried and that none of the present machines can eventually be commercially successful.

There undoubtedly is a field of usefulness for any practical airship, for exhibition, sporting, and pleasure purposes and as an implement of war. One can never tell to what extent any practical device will be commercially successful. The bicycle, the automobile, and the motor boat have not been used to any extent commercially compared with their use for pleasure purposes, yet the industries built up around them have been amazing. It would therefore look reasonable to suppose that inventors are justified in working along the lines so far disclosed rather than looking for new ones to turn up, like a famous character in Dickens. Especially is this the case when we consider that it is likely that the principal problems met with at present and which are being solved from day to day will probably be embodied in the airship of the future.

However, let us consider what has already been done and see if even in its present crude state the aeroplane does not give promise of commercial success. The Wright machine has demonstrated that it can travel for a couple of hours at a time at the rate of forty miles per hour. It does not seem unreasonable to suppose that this time could be extended to five hours. The distance between Boston and New York by air line is about 190 miles; by railroad it is 233 and by road 243 miles. The motor of the Wright machine consumes about three gallons of gasoline per hour. In other words for the trip between Boston and New York, following the air line, about four hours and forty-five minutes would be consumed and about fifteen gallons of gasoline. This, at the rate of twenty cents per gallon, would mean an expense of $3, and allowing a dollar for lubricating oil, etc., would bring it up to a total of $4. As there are only two five-hour trains per day and the fare on these is $6.65 per passenger and the Wright machine is capable of carrying two, it would look as if, everything considered, from both a time and money standpoint the aeroplane gives at least promise of commercial success, especially when it is considered that an aeroplane can be built at only a fraction of the cost of an automobile of anything like the same horse-power.

Boston, Mass. HAROLD H. BROWN.

A PROBLEM IN MECHANICS.

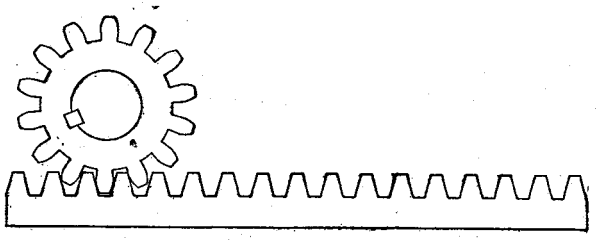
To the Editor of the SCIENTIFIC AMERICAN:

I have been a reader of your valuable paper for many years, and have been in the business of designing machinery of many kinds, some of it very complicated.

Lately there has come up in my work a very interesting problem in practical mechanics. I inclose you a blue-print showing a gear wheel and a rack. The rack is fixed. The gear wheel approaches the rack on a horizontal line parallel with the pitch line of both the gear and rack from right to left at a steady speed of 12 feet per minute. At indeterminate times this gear wheel is standing still; at other times revolving from right to left, and at other times again from left to right always with a speed of 10 revolutions per minute. At the moment, however, when the gear wheel comes in touch with the end of the rack, it may be doing any one of the three things mentioned above, that is, either standing still, revolving from right to left, or from left to right. It is entirely haphazard as to just what position any particular tooth of the gear wheel may occupy when it comes in touch with the rack.

The problem is, to design the teeth on the end of the rack in such a manner that under all of the above-mentioned conditions the gear wheel will engage promptly without any hitch, and in an absolutely certain manner.

In the particular machine I refer to, there are some 500 odd of these gear wheels advancing toward the rack during the entire running time of the machine. The gear wheels have to revolve against a resistance of about 300 pounds; consequently, the engagement must be practical and certain. If any one of the gears



A PROBLEM IN MECHANICS.

should fail to engage, the entire machine would become a wreck.

After a long series of calculations and experiments, I have solved the above problem, and the machine has now been running for three years nearly steadily in an entirely satisfactory manner.

It lately occurred to me that this particular problem in mechanics may be of great interest to your readers; but thinking that possibly it may already be well known to a good many of them, I am writing this in advance, as possibly some of your readers may give another solution to the above problem than the one I worked out. CONSTANTINE SHUMAN.

Philadelphia, Pa.

STEREOSCOPIC ILLUSION.

To the Editor of the SCIENTIFIC AMERICAN:

On page 320, issue of November 7th, 1908, Prof. Michaud begins a stereoscopic essay with "Some stereoscopic relief is usually perceived," etc. This is a fallacy; all that he can see by the devices he explains is a heightened perspective effect, and no wise different in kind, or quality of vision, from what a good pair of eyes, and appreciative training of mind, can see in viewing a fine landscape painting (or photograph) such as Church's "Heart of the Andes."

In the illustration, Fig. 1, there is an illusory effect, simulating stereoscopic, caused by variations and defects in one of the two engravings—particularly in the background, which appears as a plane surface to the rear of the defects. The figure, books, flowers, etc., if the light is sufficiently strong to cut out imagination, are pictured as a plane surface.

I learned when young to make separate use of my eyes, which focus differently; can shoot a rifle well with both eyes open, ignoring the vision of either at pleasure. Can add a long column of figures, begin with one eye at the top, "switch off onto the other" eye on the way down, easily.

I do not need a stereoscope to enjoy stereoscopic views, as I hold the view card before me a little too near, then adjust an eye to each, and carry the card to its due distance. I then have, as it were, three pictures in sight, the middle one made up of two superposed, a clear stereoscopic view, clearer in detail than the others, which are flat surfaced. I can then run my attention, easily, from one to another, note defects, scratches, etc., without losing the clear stereoscopic effect on the central one.

Deland, Fla. ALFRED HOWARD, C.E.

[Prof. Michaud's reply.—Stereoscopic effect is that impression which leads one to believe that the observed relief is *not* produced—as in a drawing—by a combination of lines, lights, and shades, figured on a flat surface, but is the result of the fact that the object occupies the three dimensions of space. Such an impression and the consequent belief are easily produced in observers who look into the stereoscope for the first time, without knowing the real nature of the object. It comes still more readily and is stronger when one looks, through a pinhole, at a distance of one or two inches, on the diagram published in the March 30th, 1907, issue of the SCIENTIFIC AMERICAN. I refer Mr. Howard to that diagram, which he has probably not seen.

Stereoscopic relief is of course less apparent on the figure published in the November 7th, 1908, issue, and the reasons for the decrease (absence of artificial distortion and great distance of photograph from the eye) are fully explained in the May 2nd, 1908, issue; but, while weaker, that stereoscopic relief is no more illusory than that observed in the stereoscope. Mr. Howard believes that it should be attributed to variations and defects in one of the two photographs. The explanation is not plausible, as both photographs were made with one and the same negative, and will bear, from that point of view, the closest scrutiny. Moreover, the same impression of stereoscopic relief can be had with about the same intensity when a *single* photograph is examined through one of the apparatus mentioned in the article.

Few are the observers who can readily produce the parallelism of their optical axis, together with the necessary convexity of their crystalline lenses, while looking directly at a pair of stereoscopic photographs. Those who can, get the impression of stereoscopic relief just as strong as with the stereoscope. Most of those who cannot, will obtain the desired result through the use of the double diaphragm described in the November 7th, 1908, issue of the SCIENTIFIC AMERICAN.]

The Current Supplement.

The opening article of the current SUPPLEMENT, No. 1736, is an illustrated description of the recently-launched Hudson River steamboat "Robert Fulton." An instructive technological article is that which bears the title "Propeller Molding," and in which the amateur molder is informed how he may cast a true screw propeller. The second and concluding installment of the summary of Edison's inventions and their commercial value to the world is presented. A rolling lift bridge across a river in Burma is described and illustrated. The structure is of particular interest, because the bridge was designed by American engineers. The European oxygen industry is passing through a period of most remarkable development. One of the processes which is in use is the invention of Claude, and is fully described and illustrated by our Berlin correspondent. Prof. Harold Wilson's recent discourse on the electrical properties of flames, delivered before the Royal Institution, is summarized. M. Eiden writes on the sinking of the earth's crust, and explains how many of our geological changes have occurred. To the student of marine invertebrate biology, there is perhaps no other group of lowly organisms which presents a greater variety of exquisite forms or affords more bionomic interest than do the hydroid zoophytes with their offspring, the jelly fishes. This family is instructively described and illustrated by Mr. J. E. Bullen. A concise history of the whale industry is given. Dr. Koerner contributes a valuable article on the production of alcohol from cellulose. To look upon the wonderful and varied hues of the flowers that surround us, and not feel the desire to know something of the pigments that produce their colors, is well-nigh impossible. C. M. Broomall writes on the subject.

Official Meteorological Summary, New York, N. Y., March, 1909.

Atmospheric pressure: Highest, 30.45; lowest, 29.06; mean, 29.83. Temperature: Highest, 66; date, 10th; lowest, 21; date, 5th; mean of warmest day, 52; date, 10th; coolest day, 26; date, 5th; mean of maximum for the month, 44.6; mean of minimum, 32.0; absolute mean, 38.3; normal, 37.7; excess compared with mean of 39 years, 0.6. Warmest mean temperature of March, 48, in 1903. Coldest mean, 29, in 1872. Absolute maximum and minimum for this month for 39 years, 75 and 3. Average daily excess since January 1st, 3.2. Precipitation: 3.19; greatest in 24 hours, 1.66; date, 24th and 25th; average of this month for 39 years, 4.01. Deficiency accumulated since January 1st, 0.74. Deficiency compared with average of 39 years, 0.82. Greatest March precipitation, 7.90, in 1876; least, 1.19, in 1885. Snowfall, 4.1. Wind: prevailing direction, west; total movement, 12,344 miles; average velocity, 16.6 miles; maximum velocity, 60 miles per hour. Weather: Clear days, 12; partly cloudy, 10; cloudy, 9. In which 0.01 inch or more of precipitation occurred, 11. Fog (dense), 10th. Thunderstorms, 4th.

Electrolytic Chloroform.

Chloroform is now produced by electrolysis of a solution of 50 parts of crystallized calcium chloride ($CaCl_2$, 6 H_2O) in 100 parts of water, to which 0.6 part of alcohol is added. The electromotive force used is 3 or 4 volts and the current density is ¼ ampere per square inch. The solution is kept at a temperature between 136 and 145 deg. F. The chloroform distills over and is condensed and collected.

NEW TYPE OF SUB-SURFACE TORPEDO BOAT.

When the torpedo boat first made its appearance, it was hailed as likely to produce a complete revolution in the principles of naval warfare. It was so swift, elusive, and deadly that it was supposed to hold the unwieldy warship at its mercy. Appearing as it did in the days of slow-firing guns, when shooting was very inaccurate, it was believed that the torpedo boat would be able, even in the daytime, to make a swift dash through the zone of gun-fire, and deliver the under-water blow before it was put out of action. But the torpedo boat found its answer in the rapid-fire gun and the searchlight. Its old-time terror has vanished, and we now know that its only chance to get in the fatal stroke will be at the close of a hard-fought engagement, when the rapid-fire guns have been dismantled, the personnel crippled, and the big ship is comparatively helpless against attack.

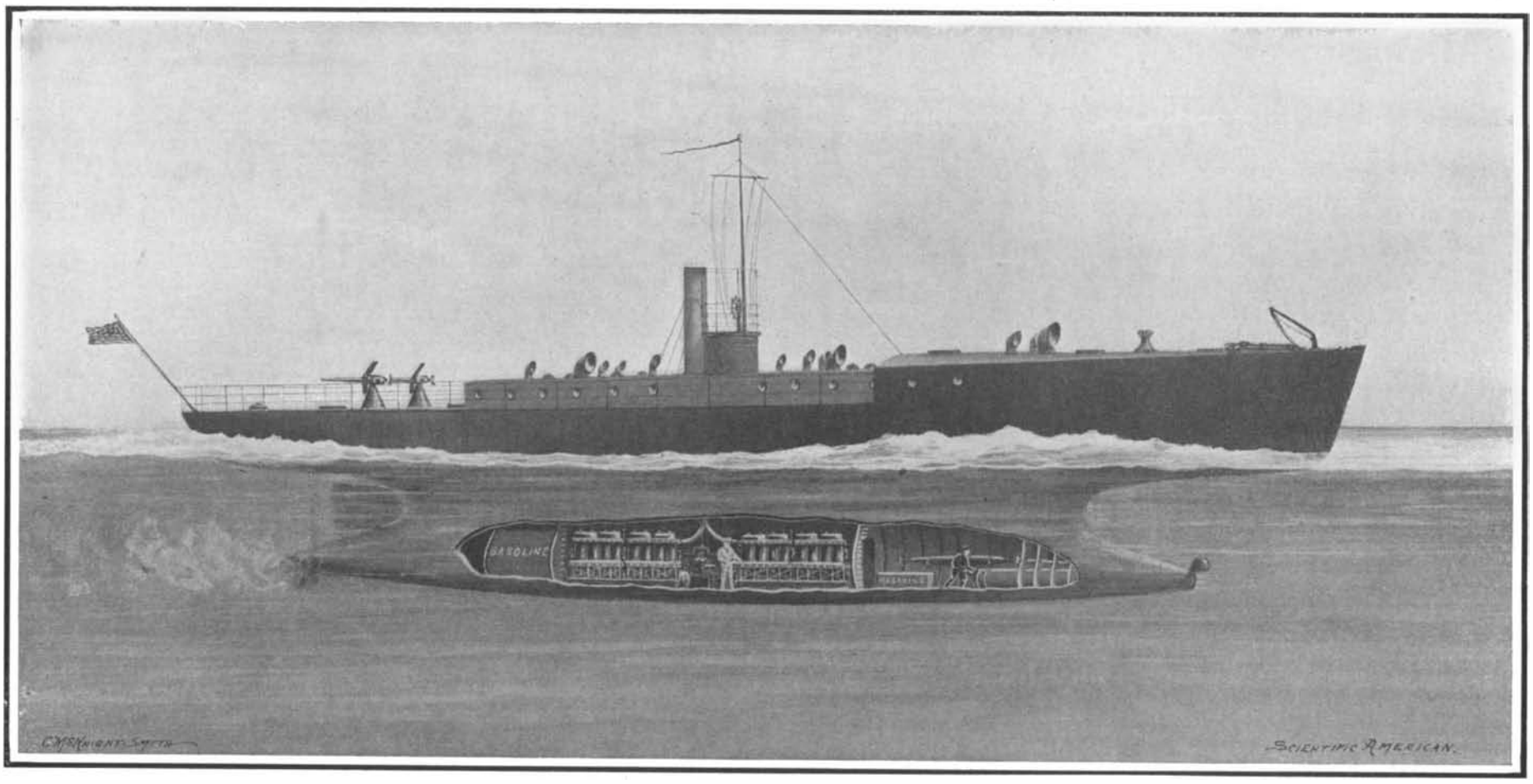
The curious vessel which forms the subject of the accompanying illustration represents an attempt to produce a torpedo boat which can attack in broad daylight and make a dash at the enemy, even after its own presence has been discovered. The vulnerability of the present type of destroyer lies in the fact that it is absolutely without armor protection, and, therefore, can be perforated by the smallest projectiles of the machine and rapid-fire guns of the enemy. A single one-pounder shell, passing through the light plating of the hull, might put a torpedo-boat destroyer out of commission, either by breaking some essential part of the engine or steering gear, or even by severing a tube in the boilers. When we remember that each of a warship's thirty or forty rapid-fire guns, ranging from the 1-pounder to the 6-inch 100-pounder, will be raining shot upon the oncoming torpedo boat at the rate of from ten to twenty a minute, it can be understood that attack by daylight or under the searchlight would be doomed to complete failure.

Hence, the *raison d'etre* of the submarine, in which invisibility is obtained by complete submergence of the boat beneath the surface of the water. That the submarine can torpedo a battleship with considerable accuracy, provided the ship is at anchor or is moving slowly, has been proved in various experimental trials; but the usefulness of the submarine is limited by its want of speed. In these days of battleships of 21 knots speed and armored cruisers of 25 knots speed, a submarine capable of steaming only 9 or 10 knots is of very doubtful value, except under certain conditions of harbor defense. For attack in the open, for use in engagements on the high seas, it is absolutely necessary that the attacking submarine possess speed equal to and superior to that of the warship.

The vessel which we illustrate is designed to combine the under-water protection of the submarine with the speed of the surface torpedo boat. It consists of a surface hull of the general form of a torpedo boat or high-speed motor boat, below which is suspended and rigidly attached (forming, indeed, part of the hull structure) a submerged torpedo-like body containing the torpedoes, the motive power (in this case internal-combustion engines), and the supply of gasoline. The above-water portion of the boat is built on the cellular plan, being subdivided by a number of longitudinal and transverse bulkheads. The whole hull, as thus divided up, is packed with cellulose, which has the quality of swelling up in contact with water and so sealing any perforation which may be made by shells. In making an attack, the boat would be headed direct for the ship and run at full speed. The exposed hull, of course, would be frequently struck and considerably torn up by the enemy's shell fire; but the vitals of the ship, lying deep below the surface of the water, would be comparatively safe from injury. It is expected that the craft would be able to hang together and take what was coming to it, until it got near enough to the ship to fire its torpedo.

Congress has so far taken cognizance of the design, that it has appropriated $22,500 for the purchase of a vessel of this type, if it should prove to be satisfactory on trial. The 25-knot vessel which we illustrate is the invention of Mr. Clarence L. Berger, of the Sub-surface Torpedo-Boat Company. She is a much larger and more powerful vessel than the one contemplated in the government appropriation, to meet which the same company is now having designed and built by Tams, Lemoine & Crane, of this city, a small 45-foot boat, of the same general character. The surface hull of the new boat will be modeled approximately on the lines of the racing motor boats designed by this firm of architects, of which the most famous is "Dixie II," which last year won the Harmsworth cup, and established itself as the fastest boat of its class in the world. Below water the plating of the boat will be carried down to form a sub-surface hull, which will be approximately pear-shaped in cross section; but, otherwise, will be similar in form to the Whitehead torpedo. At the head of this submerged section will be carried the enormously powerful charge of 1,000 pounds of gun-cotton, which is about six or seven times as much as is carried in an ordinary torpedo. Within the hull, back of the warhead, will be the internal combustion engines, tanks, propeller shaft, etc., and suitable connections from the motive power to the hull above. In the surface hull will be a small conning tower, built of ½-inch steel, within which the captain of the boat will have his station. The contract speed is 15 knots an hour; but it is not unlikely that 19 or 20 will be secured on trial. The boat will be its own torpedo; that is to say, no independent torpedo will be fired, but she will herself be run right up to contact with the ship to be attacked. The theory of handling upon which she is designed, is that the operator will remain in the conning tower, steering by hand until he is near enough to the enemy to make sure of a hit, when he will lash the wheel, dive overboard, and leave the torpedo, for such it will be, to cover the last short dash by itself.

Of course, the one or two men who man such a craft will take their lives in their hands; but the history of naval warfare shows that when deeds of daring that promise great results are to be achieved men of desperate courage are always available.



The motive power and torpedoes are contained in the submerged, pear-shaped hull. The surface hull, which is filled with cellulose, may be hit by shells without endangering the stability or stopping the boat.

A smaller, 45-foot boat, of this type is now being built for trial by the government.

TWENTY-FIVE-KNOT SUB-SURFACE TORPEDO BOAT.

New Test to Detect Traces of Moisture.

A new and delicate test for traces of moisture is based on the fact that the nearly colorless lead-potassium iodide is partially decomposed by water, yellow lead iodide being set free. Lead-potassium iodide is precipitated when 4 parts lead nitrate dissolved in 15 parts water are mixed with 15 parts potassium iodide dissolved in 15 parts water. The dried precipitate is dissolved in 15 or 20 parts of acetone, again precipitated by adding water, washed with ether and dried *in vacuo*. The compound iodide, thus prepared, is nearly white, but becomes pale yellow on keeping.

In tests for moisture a 20 per cent solution of the salt in acetone is dropped on filter paper. The paper turns deep yellow rapidly on exposure to moist air, and instantly when breathed upon. Moistening with acetone reproduces the original solution and destroys the color, so that the paper can be used repeatedly. In experiments with air dried by sulphuric acid of various strengths the moisture in air drawn from the outer atmosphere at 64½ deg. F. and passed through 78 per cent sulphuric acid was clearly detected, although it corresponded to a vapor tension of only 0.3 millimeter or little more than 1/100 inch. To detect water in liquids, the test paper is dried in a stream of dry air and the liquid is poured over it. The yellow coloration is produced instantly by commercial ether and "absolute" alcohol, dehydrated by the usual methods. Traces of water can be removed from alcohol by agitating it with solid lead-potassium iodide.

Artificial Camphor.

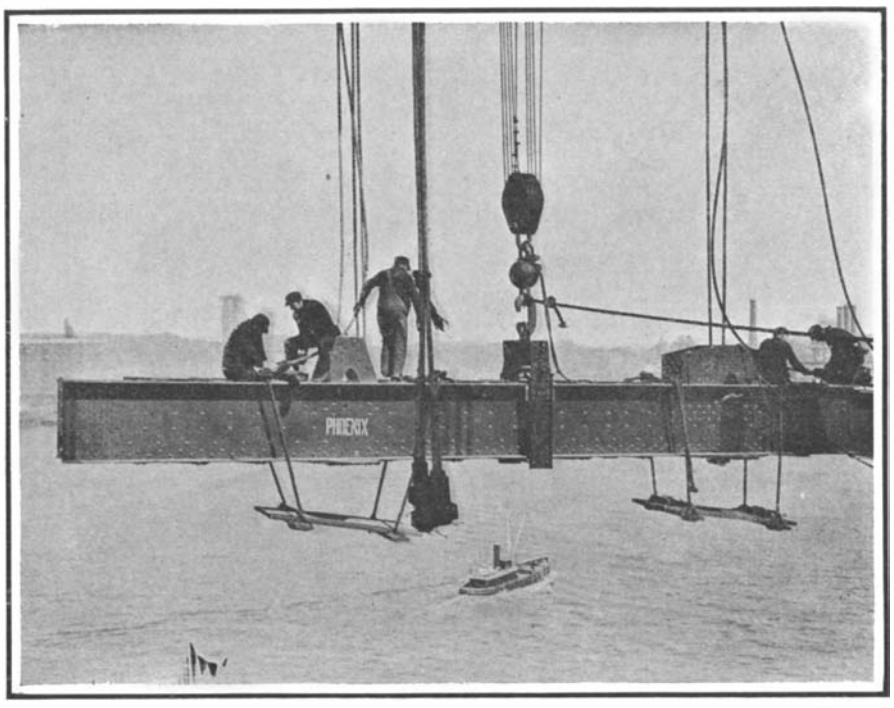
An English patent granted by J. N. Goldsmith in 1906 covers the following process of making artificial camphor: 250 parts of bornyl-ethyl-ether or isobornyl-methyl-ether, 7/10 part nitric acid of specific gravity 1.42, and 500 parts of water are heated under an inverted condenser, so that a uniform evolution of red vapors occurs. The reaction is completed in about three hours. A portion of the oily mass which floats on the liquid is then removed and shaken with water or lye. The oil is thus oxidized into solid camphor. The oxidation can be accelerated by adding sulphuric acid, and the action of the nitric acid, in the first part of the process, can be intensified by adding reducing substances, such as starch, molasses, or copper filings. The crude camphor is removed from the acid liquid and washed. It contains a by-product which gives it a yellowish color. When it is distilled with steam the greater part of the camphor passes over, leaving the impurities in the form of a brown oil. The distilled camphor is dissolved, and bleached with solution of caustic potash.

THE QUEENSBORO AND MANHATTAN BRIDGES ACROSS THE EAST RIVER.

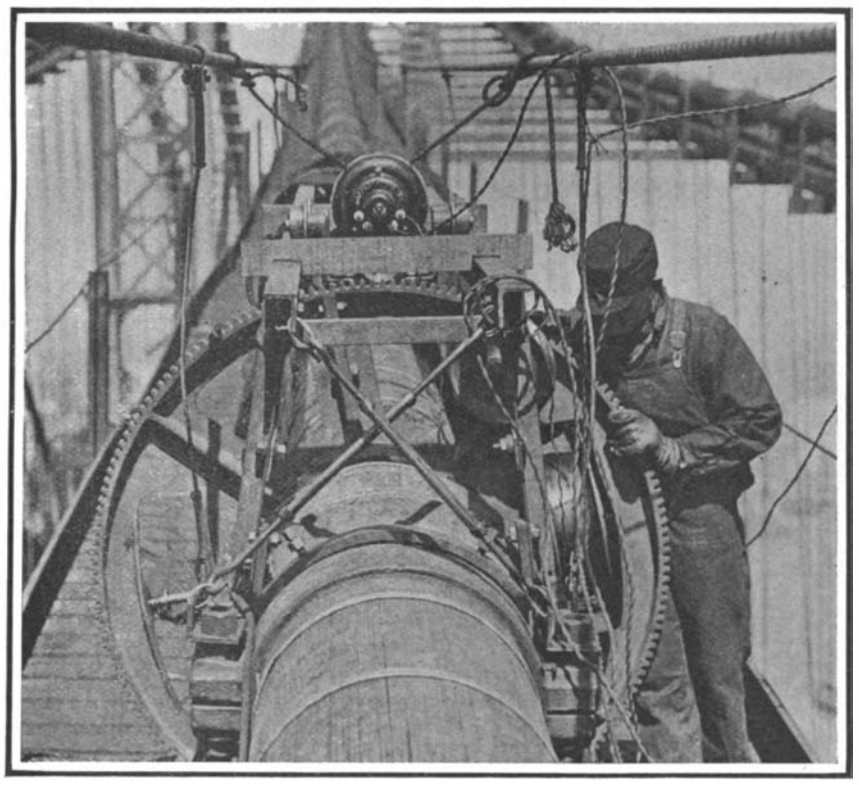
At half-past two on Tuesday, the 30th of March, 1909, the great cantilever bridge across the East River at 59th Street, New York, was formally opened for public use, when Mayor McClellan accompanied by the Commissioner and Chief Engineer of the Bridge Department, and followed by members of the Queensboro Bridge celebration committee, rode across the structure from the Manhattan terminus and back in automobiles.

We have so recently described the Queensboro Bridge (see Engineering Number, December 5th, 1908), that it will be sufficient to recapitulate the principal features of this great engineering work. In the first place, it is notable as being the heaviest steel bridge ever erected, surpassing, in this respect, the great cantilever bridge across the Firth of Forth, Scotland. The Firth of Forth spans are longer, it is true, each being 1,710 feet in the clear; but the greater weight of the Queensboro Bridge is explained by the great width of the floor system; the two decks with which it is provided; and the unusually heavy loading for which it is designed. Thus, the 630-foot span across Blackwell's Island in the center of the river alone weighs 10,400 tons, or 16½ tons to the lineal foot. Commencing from the Manhattan shore, the bridge is made up of the following parts: An anchor span, 469 feet long; a channel span of 1,182 feet; the island span, across Blackwell's Island, 632 feet long; a 984-foot span over the east channel of the river, and a 459-foot anchor span on the Long Island shore. The total length of the bridge, including approaches, is 8,600

Pair of cables with suspenders in place.



Adjusting length of chord section to suspenders.

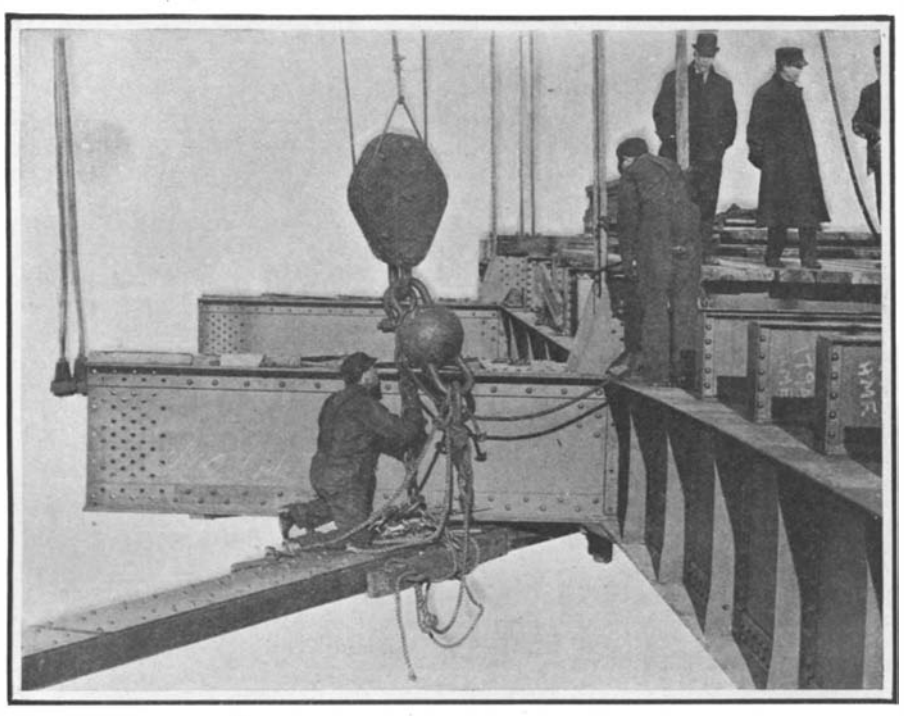


Motor on top of frame drives the spur wheel, which carries a spool of wire. This wire is wrapped upon the cable under the tension of an adjustable brake.

Wire-wrapping the 21¼-inch cables.

Note on cable to left the saddles which carry the suspender cables. Below is seen the completed portion of the roadway.

Manhattan bridge from the Brooklyn tower,



Floor system; showing bottom chords and floorbeams.

In bo'sun's chair painting suspenders.

BUILDING THE MANHATTAN BRIDGE OVER THE EAST RIVER.

feet. The maximum depth of the trusses at the towers is 185 feet; and the bridge is 88 feet wide over all. Originally planned to carry a maximum congested live loading of 12,600 pounds to the foot, it was subsequently decided to add two additional elevated railroad tracks on the upper deck, and the congested loading was raised to 16,000 pounds to the foot. Anxiety regarding the structure, due to the fall of the Quebec Bridge, led to an investigation of its design, which showed that if it were completed on the amended plans, some of the members would be overstressed by from 25 to over 47 per cent. To bring the stresses down to a safe limit, the two additional tracks of the upper deck have been removed, and other heavy material has been taken out of the bridge. Furthermore, the traffic will be run under strict police supervision, to prevent the accumulation of congested live load. The compression members and floor system of the bridge are built of ordinary commercial structural steel and the eye bars and tension members of nickel steel. The bridge was built by the overhang system, and in the whole cantilever structure, from abutment to abutment, there has been worked in a total of 52,000 tons of steel. There is provision for four trolley tracks and one 34-foot roadway on the lower deck, and two rapid transit tracks and two 14-foot footwalks on the upper deck. The total cost was $20,000,000 and it has taken about seven years to build.

CONSTRUCTING THE MANHATTAN BRIDGE.

The work of completing the Manhattan suspension bridge, which is located about a quarter of a mile to the east of the Brooklyn Bridge, is progressing so rapidly that it will probably be completed by the close of the present year. In respect of its weight, strength, and carrying capacity, this is considerably the most important of the long-span suspension bridges. The length of the main span is 1,470 feet; the side spans are each 725 feet in length; and the total length of the bridge, including the approaches, is 6,855 feet. The width of the roadway over all is 120 feet. The towers extend 322 feet above mean tide water. Traffic will be carried upon two decks, and the bridge will accommodate four rapid transit tracks, four surface tracks, one 35-foot roadway, and two 11-foot footwalks. Construction work was commenced in 1901, and, as we have said, it will be completed toward the close of 1909.

One feature of the Manhattan Bridge which has attracted much attention and called for considerable comment is the apparently light construction, and the certainly light appearance of the towers. This is noticeable if they are compared with the massive masonry towers of the adjoining Brooklyn Bridge, or the bulky and very inartistic towers of the Williamsburg Bridge farther up the river. As a matter of fact, the Manhattan Bridge towers are of particularly strong and stiff construction. The weight is carried on four closed, plate-steel, box columns, which rise uninterruptedly from base to top. They are built of heavy plating, upon the cellular system, heavy transverse diaphragms running throughout the full height of each tower, and assisting to give the required amount of cross sectional area of steel and the necessary stiffness, to prevent distortion by buckling under the heavy loads imposed. To preserve the four legs in the true vertical position and resist all tendency to displacement by wind pressure, the whole of which on the full length of the bridge will be communicated to and must be resisted by the towers, each pair of legs is heavily braced together by transverse trussing. In addition to this, each pair of legs, as thus braced, is strongly tied together at the top, at the mid-height, and at the level of the floor system by massive trussing and knee bracing.

The great weight and capacity of the bridge is shown by the large size of the cables, which are 21¼ inches in diameter, as against 18¾ inches in the Williamsburg Bridge and 15¾ inches in the Brooklyn Bridge. The cross sectional area of each cable is 353 inches for the Manhattan cable; 275 inches for the Williamsburg cable, and 196 square inches for the Brooklyn cable; so that the four Manhattan cables, in view of the superior quality of steel of which the wires are made, have over double the carrying capacity of those of the Brooklyn Bridge.

The accompanying photographs showing the erection of the floor of the bridge speak for themselves. The floor beams, stringers, and chord sections are brought by barge to the masonry piers on which the towers stand; hoisted up to the floor level; and run out on trolleys to the end of the finished work, where they are picked up by erecting derricks, swung out into place, and bolted to the suspenders. The suspenders are hung in sets of four from cast steel saddles which are clamped to the cables overhead. At the end of each cable is a hollow threaded length of bolt, with a large nut for adjusting and carrying the floor system. The bridge is stiffened by four longitudinal trusses, 45 feet in depth, which extend continuously from anchorage to anchorage. These trusses lie in the same vertical planes as the main cables, and at each panel point they are hung from the cables by means of the four suspended cables above mentioned, the latter passing down below the bottom chord, and the proper adjustment of level being obtained by means of the threaded bolts and nuts. One of the illustrations shows a section of the bottom chord of the trusses being swung out and adjusted in place. Another view shows the intersection of the transverse floor beams with the longitudinal chord sections, and also the stringers which run longitudinally between the floor beams. The whole of this work is unusually heavy and strong.

Attention is drawn to the fact that in the photograph on the front page showing the whole of the bridge, the floor already built in place is curved in the opposite direction to that which it will assume when the span is completed. This is due to the fact that the cable, being flexible, is pulled down below the catenary curve in that portion of it on which the load is hung, and straightened out and pulled above the curve in the unloaded portion in the center of the span. When the whole of the floor is built in place it will assume the graceful curve of equilibrium for which it was designed.

A LIFE PRESERVER FOR BALLOONISTS.

BY DR. ALFRED GRADENWITZ.

Because of the remarkably rapid advance made of recent years in the conquest of the air, the adoption of proper safeguards against drowning has become imperative. In recent balloon races aeronauts were

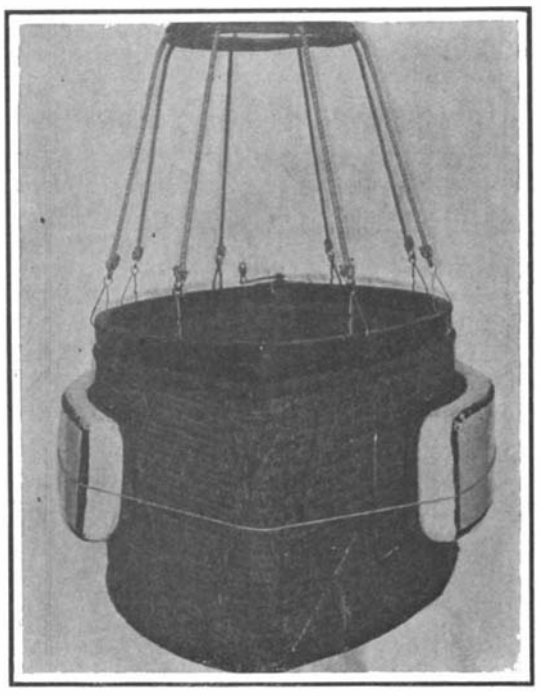


Fig. 1.—Car attached to balloon and floats held to its side wall.

deceived by fog and alighted on water. Only extraordinary skill and good luck saved them. Hence a competition for floating balloon baskets was instituted recently by the vice-president of the French Aero Club. As a makeshift German aeronauts have coated their baskets with cork. If a car so protected were to drop into the sea, the aeronaut would be compelled to stand in the water up to his hips, his safety being assured only as long as the lifting power of the gas sufficed to hold the car above water.

A really practical floating balloon-basket would be of oblong shape, the ratio of its length to the width being 2 to 1. It should consist of two substantial strata of wickerwork fastened together and having between them an intermediary layer of impervious material. A basket thus constructed would not leak.

This design has been adopted by Mr. G. Kretschmer of Berlin for the balloon car illustrated in Figs. 1 and 2. The car is made up of two light wickerwork baskets separated by an intermediary layer of some impervious material. The upper metallic rim of the car is provided with fastening devices to which the ropes running up to the gas bag are attached. The car can be cast loose from the balloon by rotating the metallic rim and releasing the fastening devices at the very moment the car touches the water.

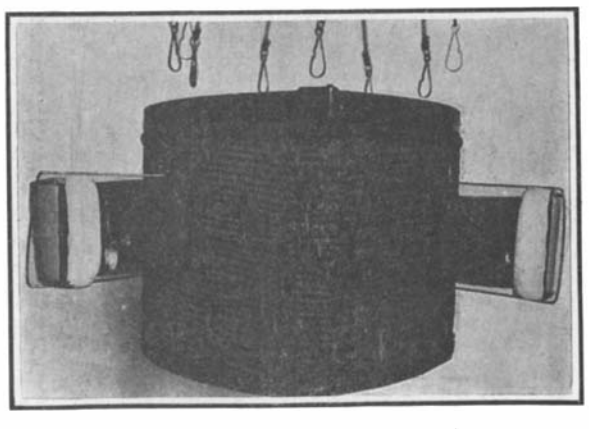


Fig. 2.—Car disconnected from balloon and floats thrown out.

A LIFE PRESERVER FOR BALLOONISTS.

Around the outside of the car are placed two semicircular floats of wood and waterproof cloth. Normally these floats are tied to the basket, as shown in Fig. 1. They are, however, provided with suitable extensible brackets and springs, so that, as soon as the rope is cut, they are instantly extended, as shown in Fig. 2. There is also a special device for automatically inflating the cloth half of each semicircular float and for hermetically sealing the flexible air tubes extending from these to the basket. The safety of this new type of basket is primarily due to the release of the suspension ropes at one time. If they were cut off successively as usual, the unequal strain on the car might capsize it.

AERONAUTICAL NOTES.

A short time ago a proposition was made by the proprietor of a Paris hostelry to have an alighting place for aeroplanes upon the roof of his hotel. The proprietor of the Hotel Astor, New York, is considering doing the same thing with the roof of his hotel. About 60,000 square feet of surface are available for this purpose.

Austria and Italy have lately taken up the construction of dirigible balloons for military purposes. The former country will have two sizes, one having a capacity of 1,500 cubic meters (52,972 cubic feet), and the other of 2,500 (88,287 cubic feet). Both are of the semi-rigid type constructed upon the designs of Dr. Raymond Nimfuhr, who is at present constructing models. Italy has ordered the construction of nearly a dozen airships similar to the successful dirigible built last year by Messrs. Croco and Ricaldoni. Russia has purchased the large Clement-Bayard dirigible and will probably order more airships of this type in the near future.

The latest prize for aeroplanes to be offered in America is $100 for the machine which covers a distance of 500 meters in the shortest time at the Morris Park race track of the Aeronautic Society, during the present year. The donor of this prize is Mr. Albert C. Triaca. In Germany the Opel firm has recently given $5,000 as a prize to be won by the first German aviator who flies from Frankfort to Russelsheim and back (about 25 miles) at any time during the Frankfort Aeronautical Exhibition which is to be held at Frankfort from June until October. Count Zeppelin is at the present time constructing a second new airship which is to be stationed at Frankfort during the exhibition, and is to be used for carrying passengers on sightseeing flights to different parts of Germany.

The first use this season of the Aeronautic Society's grounds at Morris Park will probably be made by the promoters of the automobile carnival, which is to be held in New York city the last week in April. It is proposed to hold an automobile gymkhana at the park on either the 24th or the 29th instant, and if possible to have an aeronautical demonstration of some kind also at the same time. The Aeronautic Society expects to have its first 1909 exhibition and mechanical flight demonstration as soon thereafter as possible—probably about the middle of May. At this time Glenn H. Curtiss—the first winner of the Scientific American Trophy—will make flights with the new aeroplane he is building for the society. In order to have as complete an exhibit as possible of aeronautic development in America, the Society will be glad to hear from anyone who has a flying machine developed far enough to make demonstrations, or who has anything novel or interesting to exhibit. Communications should be addressed to the secretary, Aeronautic Society, Morris Park, Westchester, New York.

A Novel Automobile Transmission.

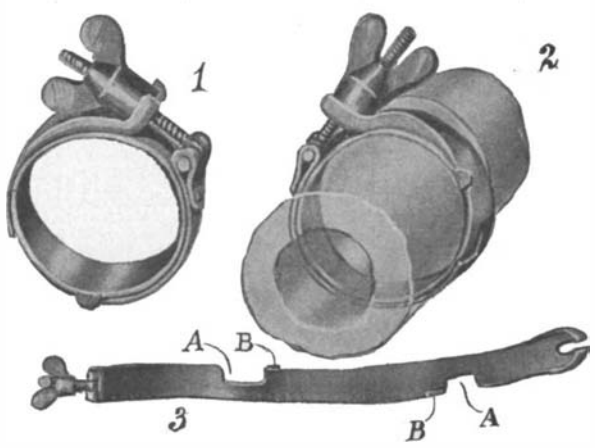
The novel friction-cone transmission described in the article on the buggy-type automobile in our March 20th issue was wrongly ascribed to the Simplo car. We take this opportunity of correcting the error and of stating that the transmission in question is patented by A. B. Cole and is used on the cars of the A. B. C. Motor Vehicle Manufacturing Company, of St. Louis, Mo., exclusively.

Every driver should learn to start and stop a car slowly and deliberately, and to negotiate curves and corners with care. The desire to develop top speed immediately after starting the motor, the lack of foresight which necessitates the urgent application of the emergency brakes, and the wish to cover ground rapidly irrespective of the kind of road, do more damage in racking the car and destroying tires than all the other abuses to which the average car is subjected.

Patent Department

AN IMPROVED HOSE COUPLING.

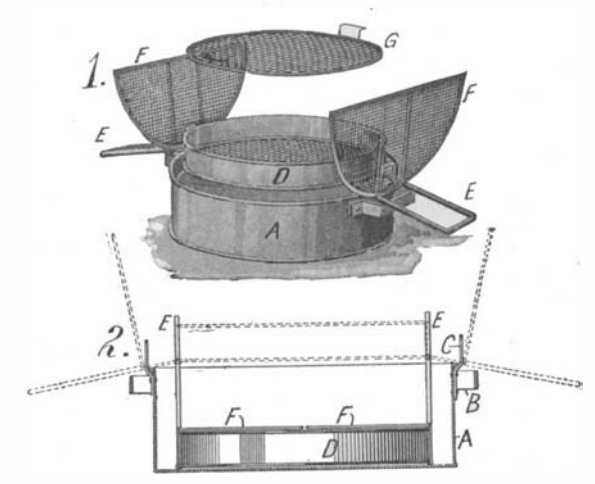
It is absolutely necessary that the pipe connections between the radiator and pump of an automobile be kept perfectly tight. Otherwise, whatever leakage exists will result in the introduction of air in the cooling system which may cause air locks and so complete the stoppage of the flow. The ordinary hose couplings do not completely encircle the hose. When they are tightened up they compress the under side of the hose, but dilate the upper part immediately under the adjusting screw. Hence, unless a very tight fit of hose is provided leakage will take place under the dilated part. To overcome this difficulty, the hose coupling illustrated in the accompanying engraving has been designed. It consists of a strip of brass which passes twice around the hose, thus completely encircling it even under the adjusting screw. In order to permit the two layers of the coupling to lie one on top of the other, the brass strip is cut away at the points *A*, Fig. 3, where one part passes through the other. Lugs *B* adjacent to these strips serve to keep the two layers of the coupling over each other. When this strip is applied to the hose it compresses it with an equal pressure at every point, overcoming the liability of leakage, and for this reason it is not necessary to have the hose fit so tightly that it can only with difficulty be forced on. The inventor of the device is Mr. Thomas B. Reid, of 132 Nassau Street, New York.



IMPROVED HOSE COUPLING.

A NOVEL FRYING DEVICE.

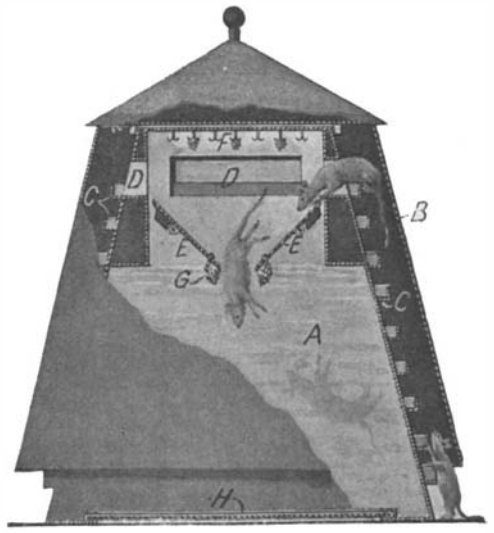
Pictured in the accompanying engraving is a cooking utensil adapted to take the place of the common frying pan and which will prevent grease from being spattered over the kitchen floor. The utensil is formed with an outer pan, *A*, provided with lateral handles *B* and vertical handles *C*. Adapted to be placed within the pan *A* is a second pan *D*, which is formed with a bottom of wire netting. Hinged to the pan *D* at opposite sides are two handles *E* each provided with a cover section *F* of wire netting. The cover sections are of such form as to completely close over the top of the pan *D*. Additional inner bottoms of wire netting are provided as indicated at *G*. In use the lard or butter is placed in the pan *A* and set on the stove. The food may be placed in the pan *D*, after which the covers *F* are closed over the pan, which is then completely submerged in the boiling lard. Whenever desired the pan *D* may be lifted bodily out of the pan *A* by means of the handles *E*, or it may be raised out of the fat and supported on the pan *A* by swinging the handles *E* outward and hooking them over the handles *C*. The grease will then drain off through wire netting bottom. It will be understood that as the covers are adapted to hold the food below the hot fat, it will be unnecessary to turn it and the food will be just as brown on top as on the under side. Whenever desired the inner bottom *G* may be used, which will permit the cook to remove the contents of the fryer without lifting the pan *D* off the pan *A*. A patent on this improved frying device has been secured by Mr. Jacob Renner, of Rockville City, Iowa, P. O. Box 238.



FRYING DEVICE.

AN IMPROVED RAT TRAP.

A novel form of rat trap has recently been devised which is provided with dark runways leading to a bait room in which are trap-doors adapted to open under the weight of the rat and precipitate it in a receptacle containing water or an acid that will quickly kill it. The inventor finds that rats do not care to frequent places which are exposed to light, and for this reason he has provided darkened runways of a special form which are attractive places for rats to collect in even when there is no bait in the bait room. Furthermore, the arrangement is such that when the rat falls into the receptacle the trap doors swing back to their original position and prevent any noise being heard by other rats that might be attracted to the trap. As illustrated in the accompanying engraving, the trap comprises a receptacle *A* with converging sides over which is placed a hood *B*, the latter being spaced from the receptacle to form the runways. The side walls of the receptacle *A* are provided with steps *C* which will permit the rats to climb to the top of the trap and enter the bait room by way of the openings *D*. The trap doors in this room are indicated at *E*. Above them is a series of hooks *F* on which the bait is hung. Each door *E*, at its inner end is further provided with a bait receptacle *G*. The interior of the receptacle *A* is filled with the water or acid which is to destroy the rats that are caught. At the bottom of the receptacle is a slideway *H* which may be opened to permit of emptying the receptacle of the liquid and of the rats that have been caught. The operation of the trap is self-evident. Mr. M. Kaiser, of 2816 Bryant Avenue, San Francisco, Cal., has secured a patent on this trap.



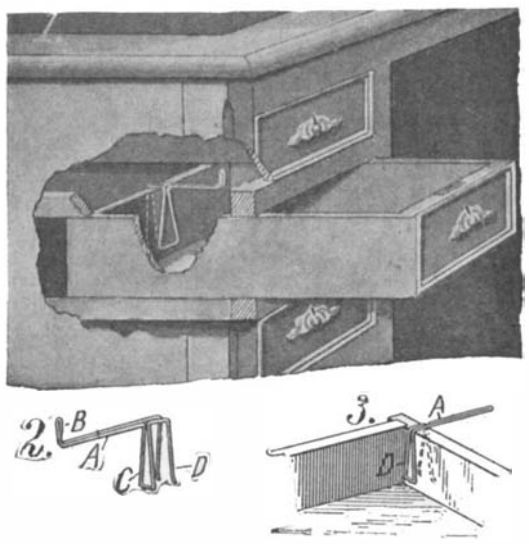
IMPROVED RAT TRAP.

A NEW RAILROAD SPIKE.

With a view to preventing a spike from being bent outward in the tie so that the head slips off the base of the rail, spikes have been invented which are provided with a spur at the rear side adapted to act as a brace for the main body of the spike. However, owing to the enormous pressure applied to the tie as the train passes over the rails, the tie is apt to be slightly bent between the shank and the spur, working the spur loose, and in this manner tending to loosen the main spike. Furthermore, in spikes of this character the shearing effect is resisted almost entirely by the main spike and a slight bending of the spike causes a movement of the spur with respect to the body of the spike and a loosening of the spur. In order to overcome these difficulties a new form of spike has been invented which we illustrate herewith and which consists of two separate shanks *A* and *B* connected to the same head *D*. Furthermore, the bridge *C* that connects the two shanks is arranged to cut into the wood. The head is of such form that the spike may readily be withdrawn whenever desired. It will be observed that the shank adjacent to the rail is longer than the other one and that each shank terminates in a chisel-cutting edge of such form as to facilitate the driving of the spike into the tie. The bridge *C* connecting the shanks is formed with a cutting edge adapted to sink into the wood. Lateral thrust on the spike is resisted not only by the area of both shanks, but also by that of the bridge portion *C*. The substantially parallel sides of each shank render the device less liable to work loose than if it were tapered throughout its length. Mr. George K. Hoff, 7800 Frankford Avenue, Philadelphia, Pa., has been granted a patent on this improved spike.

A SIMPLE DRAWER STOP.

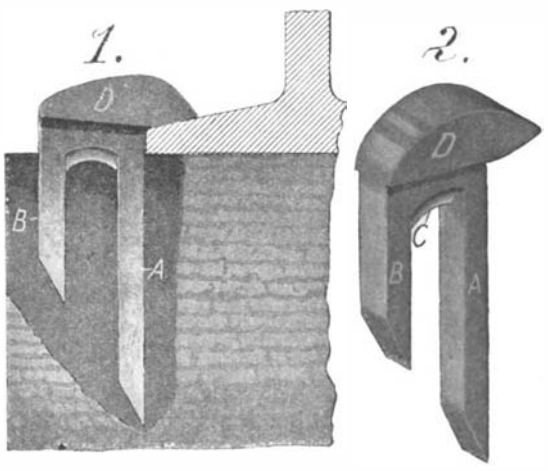
The invention illustrated herewith consists of a stop of very simple form adapted to be used in connection with the drawers of tables, desks, cabinets, and the like. The stop may readily be applied without the use of any special tool and without involving any changes in the construction of the drawer or adjacent parts. The stop prevents the drawer from being accidentally pulled entirely out of the table or desk; and furthermore, prevents papers or other contents of the drawer from slipping out at the rear. The device is formed of a single piece of wire so bent as to frictionally engage with and grip the upper edge of the rear wall of the drawer, and projecting upward sufficiently to strike the cross cleat or bar of the desk which lies directly above the opening into which the drawer extends. As shown in Fig. 2, the wire is bent double and comprises a body portion *A*, and an upwardly projecting part *B*. The wire at one side is bent to form a downwardly-extending jaw *C*, while the ends of the wire are bent down to form the jaws *D*. The edge of the drawer is gripped between the jaws *C* and *D*, while the part *B* is adapted to engage the stop bar. In the case of a flat top table in which there is no cleat or stop bar above the drawer, the drawer stop may be secured to the side of the drawer. In this case the modified form shown in Fig. 3 is preferred, as it has no upwardly-projecting part *B*. The body *A* of the drawer stop assists in holding down the contents of the drawer at the rear end thereof. Mr. William C. Heaney, of 802 Wells Fargo Building, Portland, Ore., has patented this drawer stop.



A SIMPLE DRAWER STOP.

Helium in Rocks.

R. J. Strutt has found in numerous rocks helium in quantities which bear definite relations to the proportion of radio-active ingredients. He inferred that helium, being the final product of the radio-active transformation, must be present in quantity proportional to the age of the rock. In order to test this theory Strutt selected for examination a series of similar materials of very different ages and containing radio-active ingredients, namely, the phosphatic concretions derived from bone, which are found in many Pliocene and older strata. All of this material was found to possess much stronger radio-activity than is exhibited by ordinary rocks, and all of it yielded more or less helium, and uranium. From the proportion between the helium and the uranium Strutt estimated the time required for the accumulation of the former, or in other words, the age of the stratum. This age was found to be 225,000 years for the English Pliocene or late Tertiary, 3,080,000 years for the upper green sand of the Cretaceous period, 3,950,000 years for the lower green sand, and 141,000,000 years for the hematite which covers the limestone of the Carboniferous. Of course, these figures, as Strutt observes, are only provisional estimates.



RAILROAD SPIKE.

RECENTLY PATENTED INVENTIONS.

Of General Interest.

NON-REFILLABLE BOTTLE.—A. A. JOHNSON, New York, N. Y. The improvement pertains to non-refillable bottles, and the object is to produce a bottle of very simple construction which can be constructed without the employment of metal parts or complicated valves, but which will operate effectively to prevent the refilling of the bottle.

TILE.—J. A. MCKEE, Jeffersonville, Ind. This invention provides a form of joint or fastening means for the abutting ends of drain tile sections. Two semi-circular sections of concrete or the like are provided each with a metallic reinforce and the ends of the reinforcing members extend beyond the concrete sections and are provided with clamping bolts or other suitable fastening means for drawing the semi-circular sections.

Hardware.

ATTACHMENT FOR THE JAWS OF VISES.—D. E. SHANKLAND and O. F. BROWN, Whiteriver, Colo. The false grip jaws will incase the fixed jaws of a metal vise, be detachable therefrom and hold the bodies of bolts, rods of metal either round or angular, and also grip and hold the toe calks of horse shoes or like objects without injury thereto, and aid to give correct shape to the gripped angular calks.

DOOR-STOP.—R. R. SNOWDEN, Houston, Texas. The door-stop will operate efficiently to hold the door against closing, and is constructed in such a way as to facilitate the adjustment of the device to the edge of the door. In case the door is moved beyond the usual position on the stop, the stop will then operate as a resilient buffer to limit the further movement of the door.

Heating and Lighting.

OIL-BURNER.—J. W. PIPPIN, Brownwood, Texas. In operation, the tanks being supplied with oil and water respectively, oil is admitted to the pan and ignited. The heat will soon generate steam which will pass into the steam dome, whence the dry steam passes to the atomizer, spraying the oil from the heater onto the spreader. The excess steam passes through the heater, heating the oil therein, in its passage, and discharges through the discharge pipe.

Household Utilities.

WATER-CLOSET CABINET FOR INFANTS.—G. JOHNSON, Kaleva, Mich. The invention relates to an infant's cabinet or closet and the object is to produce a construction which will enable the infant to support his body in an easy position while he is seated. A tray provides a rest or guard for the infant to lean forward upon, and on which toys may be placed.

FIREPLACE-GUARD.—J. A. AUTRY, Pinegrove, Miss. In this case the invention is a skeleton guard applied in front of fireplaces and open grates to prevent children falling into the fire. A wooden bar serves as a protector for an adjacent bar, and does not become heated sufficiently to become ignited and therefore not heated enough to burn a child as much as the metal guard bars.

KITCHEN SINK COVER.—ADAM GIFFEN DEMAREST, 216 West 22nd Street, New York. The device is in the form of a tray which may be placed on the kitchen sink to support dishpans and the like. Two large openings are formed in the tray directly under the faucets, so that when the water is turned on, it will pass through without spattering. In the illustrated notice of this sink cover published in the SCIENTIFIC AMERICAN, March 27th, 1909, Mr. Demarest's address was wrongly given as 216 West 26th Street.

Prime Movers and Their Accessories.

ROTARY ENGINE.—J. J. TANNER, Clover, Utah. The design of the inventor is to provide a rotary engine which may be easily reversed so as to run in either direction and which engine also embodies such features of construction as to allow it to be used as a brake when employed on a locomotive and going down hill.

Railways and Their Accessories.

DOOR FOR GRAIN-CARS.—LILLIE DIMICK, South Whitley, Ind. Broadly stated, this invention consists of a series of plates which are pivoted together so as to be movable with each other, and arranged in vertical position, and connected with transverse springs in such manner that their lower edges are held in close contact with the floor of the car when depressed by the load therein.

Pertaining to Vehicles.

ELECTRICALLY-PROPELLED ROAD-VEHICLE.—H. DUCASSE, 17 Rue Jean Goujon, Paris, France. The motor in this case has a fixed and rigid support upon the rear axle of the vehicle which support may also serve as the fixed point of attachment for the brake strap. The motor is absolutely independent of the frame, and thus preventing the vibrations of the motor in working and those due to inequalities of the ground being transmitted to the vehicle.

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

Legal Notices

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Electric fire alarm, automatic, E. Johnson	916,711
Electric furnace, C. W. F. Gorrell	916,548
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