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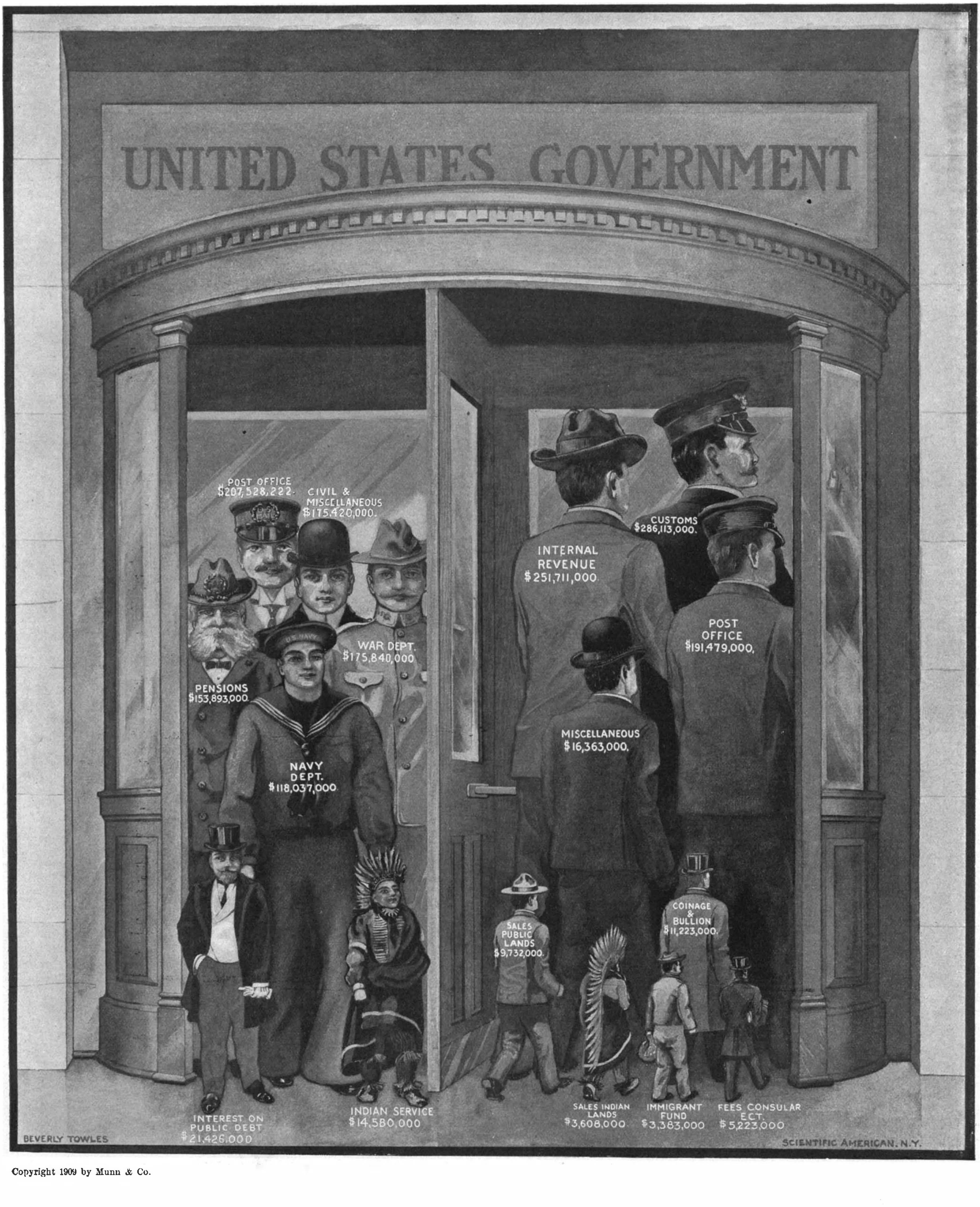

RECEIPTS AND EXPENDITURES OF THE UNITED STATES GOVERNMENT FOR THE FISCAL YEAR ENDING JUNE 30, 1908.—[See page 243.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, MARCH 27th, 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 SCIENTIFIC AMERICAN FLYING MACHINE TROPHY FOR 1909.

In another column will be found the rules governing the contest for the SCIENTIFIC AMERICAN Trophy for the year 1909, and it will be timely to explain in the present issue the object of offering this prize.

It has long been recognized that one of the most effective means of stimulating the development of a new science is the offering of prizes or trophies, and the SCIENTIFIC AMERICAN Trophy was offered with the object of encouraging inventors to build and try out heavier-than-air machines, and also with the hope of stimulating competition in this new field of development.

When the prize was first offered in 1907, it was recognized that the era of aerial flight had only just dawned, and it was felt that the prize should be awarded to the *first* machine which succeeded in sustaining itself in its equilibrium in flight over a distance which should exceed a mere jump or leap in the air. This minimum distance was arbitrarily fixed at one kilometer. In spite of these very moderate conditions, the trophy was not won until the following year, when the "June Bug," in charge of Glenn H. Curtiss, succeeded in covering the required distance at Hammondsport, N. Y., on July 4th, 1908.

Under the deed of gift the Trophy was presented to the Aero Club of America, and the rules governing each contest are to be arranged by the Contest Committee of that organization.

After the performance made by the "June Bug" it was decided to arrange for competitive trials, to take place at a point near Washington, D. C., where Orville Wright was making his experiments for government trials. Unfortunately, there were no entries for this competition; and, inasmuch as it has been found that even in France, where the art of aerial navigation has been carried further than it has in this country, it is extremely difficult to induce experimenters to arrange for competitive trials at any given point and date, it was decided that for the competition for 1909 some other form of trial should be arranged. After a thorough consideration of all the circumstances of the case, it was determined that the most attractive and satisfactory form of competition for the year 1909 would be, not to fix a given place and time for an aerial tournament, but to allow the experimenters to make trial flights at or near their own homes, and allow such records, if made under the auspices of the Contest Committee of the Aero Club, to stand as record trials, and that the cup should be awarded to the competitor making the longest and best flight during the year 1909, provided such flight should exceed twenty-five kilometers. It was believed that such an arrangement would sustain an interest in the sport during the entire season.

In our last issue we made announcement that Dr. Alexander Graham Bell had made entry for the SCIENTIFIC AMERICAN cup. While that issue was on the press, however, Mr. Bishop, president of the Aero Club, received a telegram from Dr. Bell, stating that the rules for the year were not satisfactory to him, and that he wished to withdraw his entry unless the cup should be awarded to the first machine making the flight. In conclusion he states: "We are purely an experimental association, and do not care to enter into competition or attempt to make the longest possible flight."

It is difficult to understand the object of making an entry for a trophy and eliminating, at the same time, the idea of competition. Such a principle is entirely antagonistic to the ideas of the donors, and also of the Contest Committee of the Aero Club, as the main object of the trophy is to stimulate competition in every possible way; to measure, if possible, the progress that is being made in the art of aerial navigation, and to award the trophy to the inventor or experimenter who has shown the greatest development in the art.

It may be said in explanation of Dr. Bell's telegram that he arrived at his determination to withdraw his entry before having seen the complete rules for 1909, and it is hoped that when the conditions are fully understood, he will decide to compete for the trophy at some later date.

It may be said in explanation of the action of the Aero Club in this connection, that it was stretching a point in favor of Dr. Bell, in allowing the test to be made outside of the borders of the United States.

The rules for the trophy will be changed from year to year, as occasion requires, the contest each year being made more severe than the previous year.

It has been found, even in France, that aerial tournaments, where a number of competitive machines may be tried and tested at one time and at one place, are not now practicable, and the rules governing the SCIENTIFIC AMERICAN Trophy are framed upon the same general principles as those governing the principal trophies offered in Europe. It is interesting to note that both Farman and Wright made successive attempts under official supervision to win the Michelin trophy last year; and it was in his last and crowning effort, made on the last day of the year, near sundown, that Wilbur Wright broke the world's record for flight and succeeded in winning this prize.

It is hoped that before long the science will be so far developed, that it will be possible to arrange for an aerial tournament, where a number of competitive machines may be tried and tested at one time and at one place. There seems to be little doubt that such a consummation will be reached in the near future.

THE HIGHWAY AND THE AUTOMOBILE.

A serious problem which grows in importance every year is that of the relation of the automobile to the public highways. That the automobile is the most active of all agents in the breaking down of macadamized roads is a fact that has been long recognized by our State Engineers, and of late years it has become so evident, that not even the most enthusiastic automobilist can deny that great damage is done. When a new stretch of macadamized roadway is thrown open to the public, it offers such strong attraction to automobile owners that, even in cases where its use involves a considerable detour as compared with shorter routes over roads of inferior quality, it is certain to become so popular with the rubber-tired vehicles that they will frequently constitute the majority of the traffic. The initial breaking down of the carefully-prepared surface is almost immediate. The so-called "suction" of the swiftly-revolving rubber tires picks up the finely-crushed binding material of the surface, and throws it to the rear, exposing the broken edges of the top course of macadam. These in their turn are broken down, ground into dust, picked up by the passing wheels, and carried by the wind into the adjoining fields, or sifted upon the lawns and buildings of adjacent property. The process of disintegration goes on at a speed proportionate to the density of the traffic, until finally the heavy underlying foundation rock of the macadam is exposed. When this condition has been reached, there is nothing for it but to practically rebuild the roadway, or at least the upper half of it. The destructive action of automobile traffic has been greatly intensified in recent years by the introduction of chains and other non-skidding devices, which are undoubtedly active agents in breaking down and pulverizing the surface dressing and the upper, broken-stone layers of a macadamized road.

There are but two courses open in dealing with this perplexing and very serious problem. Either the automobile traffic must be restricted, or new and improved methods of road construction must be used. No one who seriously considers the matter believes, for a moment, that fines, heavy licenses, and restrictions as to speed, travel, or the use of non-skidding devices will fully meet the problem. Legislative restrictions may modify the evil, but they cannot possibly eradicate it; and this for the reason that, as we have shown above, the destructive effects of the automobile are inherent in that very feature of its construction—the pneumatic tire—which has made the automobile a possibility. A vehicle weighing from 1,200 to 3,000 pounds, running at speeds of from 20 to 30 miles an hour on pneumatic tires, will break down, and very quickly break down, the type of macadamized road of which we are building thousands of miles throughout this country. This is an indisputable fact; and no amount of legislative control can get rid of it.

Evidently, then, the only solution of the problem lies in constructing our highways with a view to meeting the exacting conditions of traffic which have arisen within the past ten years. We must build automobile highways; and since the automobile is by far the most frequent user of the State roads, this will be a perfectly logical thing to do. It is pretty well agreed that if some binding material can be found, which will shed the surface water of the winter, and prevent the surface dressing from grinding up into an impalpable dust in the summer, a long step will have been taken in securing a perfect road. The solution of the problem will be found, probably, in the use of some form of tar; although our experience in this country has shown that the mere coating of the surface with this material, unless the road itself has the proper strength and consistency, is not sufficient. In many cases the disintegration of the road still goes on, and because of the soiling effects of the tar, the dust and mud become even more objectionable than before.

The material for the upper layers of the macadam road should be selected for its strength and binding qualities; should be carefully broken to size, and thoroughly rolled in. Too often the finished surface is not given sufficient crown to insure a quick shedding of the surface water. This is a feature that should be most carefully attended to. In tarring the finished road, care should be taken to give the tar sufficient time to get thoroughly set before the road is thrown open to traffic. This may be hastened by giving the tarred surface a thin coating of sand.

Finally, as we have frequently pointed out in this journal, our whole system of maintenance needs to be thoroughly revised. Our present methods of allowing a road to go to ruin, and then spreading a layer of so-called top dressing upon it, and calling this procedure a repair job, is simply barbarous. Eternal vigilance is as necessary in the upkeep of a modern highway as it is in that of a steam railroad track. Local indications of subsidence or wear should be immediately repaired. The constant day-by-day attention of a repair gang, scattered at wide intervals over a stretch of State highway, will keep the surface in first-class condition for many years. They will do successfully, and for far less cost, what the periodic and spasmodic repairs under our present systems of maintenance fail utterly to accomplish.

CLOSE OF THE FOURTH DIMENSION CONTEST.

On April 1st the contest inaugurated by a friend of the SCIENTIFIC AMERICAN'S for the purpose of awarding $500 to the best popular essay of two thousand five hundred words on the Fourth Dimension will be definitely closed. We take this opportunity of expressing our gratification at the relatively large number of competitive offerings that have been received, not only from American readers of the SCIENTIFIC AMERICAN, but from foreign sources as well. In the last fortnight the mails have brought to us essays from Turkey, Austria, India, Australia, France, and Germany. Almost every civilized country is represented.

Naturally some time must elapse before the essays can be read and passed upon by the judges. In all probability, the prize will be awarded in the latter part of June or the beginning of July. The winning essay will be published in the SCIENTIFIC AMERICAN, and a few of the meritorious contributions in the SCIENTIFIC AMERICAN SUPPLEMENT. It is not impossible that a collection of the better essays will be made and published in book form.

RAINMAKING BY DYNAMITE.

Many attempts have been made, notably by Dyrenforth in Texas a number of years ago, to produce rain by the explosion of dynamite or gunpowder. Despite the failure of these experiments, a fresh attempt was made in 1907 in southern New Zealand, in a district frequently exposed to severe droughts. Bates, the meteorologist detailed by the government to furnish hygrometric data for the rainmakers, has recently published a report of the experiments. The results were purely negative, but as rain happened to fall soon afterward, the explosions were popularly credited with its production. Bates himself, like all other intelligent men, rejects this belief. It is impossible to conceive the process by which the explosion of a few pounds of dynamite could produce rainfall.

The compression of the air caused by the explosion would develop heat, which would raise the temperature still farther above the dew point and thus diminish the chance of precipitation. The shock caused by the explosion is infinitesimal. Bates compares its effect with the effect produced on the air of a room by striking a match. The natural forces opposed to any artificial change of atmospheric conditions are enormous beyond our power of imagination. Bates points out that a rainfall of one inch means a precipitation of 64,640 tons of water on each square mile. The heat set free by the condensation of this quantity of water is mechanically equivalent to fifty million horse-power hours. What is the most powerful explosion that man can produce in comparison with such an outburst of energy? Bates concludes that reforestation is the only method by which the dryness of this district can be remedied.

AERONAUTICS.

The first international aeroplane race for the Bennett Aviation Trophy is to be held near Rheims, France, on August 29th. France and England have entered three machines, while Italy, Austria, and America have entered one each. The minimum distance required is 20 kilometers (12.42 miles).

Considerable attention has been given in Germany to the destruction of dirigible balloons by means of guns. The Krupp firm has a special department devoted to the construction of such guns, and has recently brought out two models, one for discharging explosive shells, and the other for throwing a burning projectile. A gun mounted in an automobile is the latest device of this character.

In a lecture before the Aeronautic Society in New York city, on March 16th, Mr. Hudson Maxim brought out the point that the dropping of dynamite from air craft would not be as dangerous to fortifications and buildings as was generally supposed, because, in order to do much damage, this explosive must be confined. If 100 pounds of it were dropped into the smokestack of a warship or exploded in the water close to the vessel, it would be effective; but dropping it upon the deck would be of no avail. Mr. Maxim, as is well known, is an expert upon explosives. He also described some new explosives that may be available for use in explosive motors.

The flight competition over Monaco Bay, which was to take place between January and March 24th, has been extended to April 23rd. No less than seventeen flying machines have been entered, six of these being Voisin aeroplanes, two Wright machines, three Antoinette monoplanes, and two others helicopters. There is also a curious aeroplane, having three sets of planes arranged in steps and which is mounted upon a hydroplane boat. M. Delagrange is the only well-known aviator who has entered this event.

On March 15th Roy Knabenshue made a flight from Los Angeles to Pasadena with his dirigible balloon in less than an hour. He was accompanied by his brother-in-law. The distance between these two places is more than fifteen miles. Capt. Baldwin has an order for a 100-foot dirigible, which is to carry four people and is to be used by a well-known member of the Aero Club of America for pleasure trips this summer. Abroad, in Germany, the "Parseval III." airship has recently undergone its initial trials with decided success, while the new Zeppelin has been tested several times of late, and has demonstrated its capability of landing safely upon *terra firma* instead of upon floats.

Twice lately have the Wright brothers given exhibitions before royalty. A few weeks ago King Alphonso XIII. of Spain visited them, and was greatly interested in their flights. Last week King Edward of Great Britain also paid them a visit. On this occasion Wilbur Wright first made a flight of seven minutes, in which he performed difficult evolutions with great precision. He afterward took his sister, Miss Katherine, for a six-minute spin in the direction of Pau. King Edward was greatly pleased, and congratulated Mr. Wright upon his achievement. In a few weeks Wilbur Wright expects to go to Rome and make exhibition flights. He has started the construction of a half dozen aeroplanes in England, in addition to the fourteen already nearing completion in France. Several of his pupils at Pau have mastered the machine, and have made successful flights alone.

At the meeting of the Aeronautic Society, on March 10th, Mr. Elmer A. Sperry gave an extremely interesting talk upon a new form of gyroscope which he calls "active," to distinguish it from the ordinary or passive type. The Schlick gyroscope, which was experimented with so successfully upon a German torpedo boat, is of the latter type. A gyroscope of the active type has several hundred times the energy of the passive type, for the same weight. A 10-pound wheel, 10 inches in diameter, can be made to offer a resistance of 10,000 foot-pounds a minute, whereas the Schlick gyroscope, weighing 1,109 pounds, developed but 8,900 foot-pounds at 1,600 R. P. M. Mr. Sperry believes that his new form of gyroscope, on account of its great power and small weight, can be applied successfully to aeroplanes in order to maintain their transverse stability. He demonstrated the superiority of the active type of gyroscope over the passive by means of a small electrical apparatus mounted on top of a heavy pendulum. The rapidity with which it would stop the oscillations of the pendulum, and the much smaller angle to which they could be confined, were far more noticeable when the gyroscope was operated upon the active principle. Mr. Sperry said he has found that the kinetic energy put into the outer ring to move it in one direction could practically all be recovered from the inner or precessional ring that moved at right angles to it. In making the gyroscope active, he connects these two rings in a certain way through gears, so that they react upon each other and make the device much more sensitive and powerful.

ELECTRICITY.

The North Carolina State Legislature has passed a law requiring the use of electric headlights on engines of through lines and all lines that are 115 miles long. This law is the result of an agitation started by the Brotherhood of Locomotive Engineers.

Over two billion candle-power will be used in illuminating the Falls of Niagara this summer. It is believed that the illumination will be clearly visible in the sky as far away as Toronto. The illumination is to be an annual summer feature.

During the present strike among the telegraphers and operators of telephones in Paris, efforts have been made to establish wireless communication between England and France. The Marconi Company has proposed to send messages from its station at Clifden to the Eiffel Tower in Paris.

An inventor has recently devised a method whereby a ship can determine its distance from another vessel, or from shore. The vessels, as well as the shore station, are provided with wireless telephone apparatus, which is used to transmit the sound of a submarine signal bell. The difference in time which it takes for the sound to be transmitted by wireless telephony and to travel through the water enables the receiver to determine the distance of the sending station from him.

A recent number of l'Industrie Electrique describes a method of using the wires of a power transmission line for establishing telegraphic communication between the generating plant and the sub-stations. By using an induction coil, which obtains its power from the transmission line, a local high-frequency current is generated, which may be superposed on the current in the power line, and thus affect instruments at the receiving station. It is not necessary to use two lines for a system of this sort, because the circuit can be completed through the ground.

A recent consular report states that representatives of European interests manufacturing air nitrates by hydro-electric power for fertilizers are in the United States to see what can be done in the way of securing large water powers for establishing such factories in this country. An industry of this kind is needed, as the imports of Chilean nitrate of soda now amount to $14,000,000 a year. Difficulty is being experienced, however, in securing suitable water powers at reasonable cost. Governments of other countries are said to be offering inducements for the location of the extensive nitrate mills which the company proposes to erect.

The part that light-colored walls may play in the illumination of a room or building is clearly brought out by an illustration in the current number of the Electrical Journal. A person reading in a room with dark-colored walls, and with a source of light entirely behind his field of vision, may declare the illumination to be excellent. However, if another light is brought into the room in the field of his vision, though not shining on the page he is reading, the pupils of his eyes will commence to contract. Less light will enter them from the printed page, and it will appear to the reader that the page is growing darker. This shows the use of white or very light-colored walls may actually decrease the efficiency of the illumination.

The motormen and conductors of the Lake Shore Electric Railway Company, Cleveland, are being subjected to a series of tests which are quite rigid. A special car has been fitted up, in which these tests take place. Not only are the motormen required to learn the operating rules of the company, but they must be able to make any slight or temporary repairs to their motors. One side of the car is fitted with a dark room, where the men are subjected to a color test. A novel feature of the test in this room is that which requires the men to judge distances by the sizes of illuminated signs. Different sized tail lights, letters, etc., are used, corresponding to the sizes as they would appear at different distances from the car, and the men are required to determine their distances merely from their size.

Before the recently-electrified St. Clair tunnel was delivered into the hands of the railroad, it was operated by the Westinghouse Company for a period of several months, in order to thoroughly try out the electric apparatus. A report on the operation of the railroad during this period has recently been published. This report shows that the electric locomotives handled 1,000-ton trains, as against 700-ton trains with steam locomotives. The electric trains, numbering on the average 27.3 cars per train, made the run of the electrified section in 10 minutes, as against steam trains averaging 19.7 cars, which required 15 minutes for the same distance. The steam locomotives consumed nearly $5,000 worth of coal per month, as against $1,152.60 per month for the electric service, the reason for this difference being that steam locomotives had to burn hard coal costing $6 a ton, while soft coal at $2 a ton may be used in the power station.

SCIENCE.

In a recent lecture delivered before the Royal Society of Arts, Leon Gaster advances the opinion that ultra-violet rays from indoor electric lamps are injurious to health. He advices the use of bulbs which will obstruct these rays.

A new test for ascertaining the hardness of metals has been proposed by W. I. Ballentine. A disk of metal is attached to the lower side of a drop weight, which falls on an anvil. The anvil carries a pin on its lower side, which rests in contact with the piece of metal to be tested. The diminution in thickness of the disk is the measure of hardness.

As a result of the successful work of the ten Belgian hounds doing police work in Brooklyn, their working hours have been lengthened and their beats will be extended. Police records show that since the advent of the dogs, about a year ago, the number of burglaries has been reduced at least fifty per cent. They previously occurred at the rate of about three a week.

It has been proved by many observers that the sensitiveness of photographic films is increased by a preliminary exposure, too short to produce a latent image. The color sensitiveness of both the chloride and the bromide of silver is unquestionably increased by such preliminary exposure, and it is now asserted by Streissler that the increase in general sensitiveness is merely the consequence of the increase in color sensitiveness.

Not since the discovery of the Neanderthal skull in 1856, has so much excitement been created as by the finding of a prehistoric human skull at La Chapelle-aux-Saints in France. The French skull has been declared to be the most ancient in the world. It is practically complete, although originally found in pieces. The task of reconstructing it has been assigned to Marcellin Boule, director of the Laboratory of Palæontology of the Paris Museum.

A simple method of visualizing the sound waves in air from electric sparks has been devised by M. Toepler. The sparks may be made by use of an induction machine and Leyden jars. In shunt with the "sound spark" is another, the "illuminating spark," and this latter is conveniently formed on the surface of a piece of wet chalk or other semi-conductor. The light from it passes through a lens, is refracted by the alternately compressed and rarefied shells of air in the sound waves, and is then viewed by the eye direct or, preferably, by a telescope.

Prof. Muensterberg's "machine for detecting lies," technically known as a galvanic psychometer, has attracted much attention, despite the caustic comments with which it has been received in scientific circles. Many interesting results have been obtained by experiments carried out by Dr. Veraguth of Zürich with the psychometer. He found that when mind and body were completely at rest there was a gradual diminution of the current. A noise, a light, a touch, reading of an exciting novel, mental calculation, or the recollection of some exciting incident, all produced—at the end of a few seconds, which may be called the latent period—a marked increase of the current.

The suppression of sleeping sickness is only a question of efficient administration and organization, and there is little doubt that in time the tsetse fly will be conquered, with the result that the disease will cease to devastate wide districts in Africa. The disease is spread by a biting insect which is distributed in patches over many thousands of square miles in Africa, the inhabitants of which vast areas are too apathetic to lift a finger to save themselves from annihilation. Moreover, the disease is difficult of detection in its earlier stages, during which period infected persons may travel long distances, affording opportunities for the diffusion of the malady. One of the first essentials in grappling with the difficulty is to instruct the African native as to the true nature of the disease and its mode of spreading.

The Italian Egyptologist, M. Schiapparelli, in the course of recent excavations in the Valley of the Queens, discovered intact the tomb of the engineer Kha, architect of the mighty buildings at Thebes, and of his wife, Mirit. The tomb contained two huge sarcophagi, with a mummy in each, and also a large number of objects of domestic use, buried, according to Egyptian custom, with the dead, and including furniture, utensils, tools, clothes, boxes of linen, jewels, etc. From an inscription on a papyrus, over sixteen yards long, found in the tomb, it appeared that husband and wife had died within a few days of each other and were buried together. Among the most interesting objects in the tomb were the numerous boxes containing the wardrobe and articles of toilette of the young wife. Mirit had carried with her to the grave a dozen boxes, some of which contained clothing, of the finest material, carefully folded; others had in them combs, powder boxes, vases, and nicknacks.

THE MERCURY TELESCOPE.

BY PROF. R. W. WOOD, JOHNS HOPKINS UNIVERSITY, BALTIMORE.

At the request of the Editor of the Scientific American, the following account is furnished of the reflecting telescope of liquid mercury which I constructed at Easthampton, L. I., during the past summer. The idea of utilizing, in the construction of a reflecting telescope, the principle that the surface of a liquid in rotation assumes the form of a paraboloid, has been suggested from time to time for the past half a century, and as long ago as 1868 an instrument was constructed by Mr. R. C. Carrington in England, which was driven by a steam engine and was not a success, for reasons obvious to anyone who has attempted to use a mercury surface as a mirror, even when the fluid is at rest. So far as I have been able to find, no really serious attempt has ever been made to devise a method of setting a basin of mercury in rotation, without communicating to it jars which set up ripples on the surface of the fluid. I became interested in the problem more as a mechanical puzzle than anything else, but preliminary experiments with a poorly constructed mirror seven inches in diameter gave such promising results, that I determined to have constructed a larger instrument of the finest workmanship possible. Accordingly I ordered one 20 inches in diameter from Messrs. Warner & Swasey of Cleveland. Before preparing drawings for the large instrument, various experiments were made with the small model, in order to learn as much as possible about the sources of disturbance, and the best probable means of overcoming them. The fundamental idea, which made the solution of the difficulty seem possible, was to drive the basin by means of a rotating ring or collar, mounted on ball bearings, and carried on a support not in contact at any point with the mercury basin or its support. Various devices were tried for transmitting the power from the revolving ring to the mercury basin. The most promising appeared to be a magnetic clutch. A number of small horseshoe magnets were attached to the rotating ring, and a similar number to the basin, the poles of the opposed magnets being in very close proximity, without actually touching each other. When the outer ring of magnets was set in rotation, the inner magnets followed them, pulling the mercury basin around with them. It was found simpler, and almost as satisfactory, to transmit the power to the revolving basin by means of fine threads of India rubber, which transmitted little or no vibration from the driving ring.

The construction of the instrument is shown in Fig. 1. A plug of hardened steel, *A*, which was driven into the dish, rotated upon a second steel cylinder, *B*, which could be raised or lowered by means of the screw *C*, turned by a nut. The bearing surfaces of these two steel cylinders were ground flat and accurately perpendicular to the axis of rotation. Though the weight of the dish was carried upon the steel plug, there were in addition two conical bearing surfaces, which served to steady the basin during rotation. By lowering the dish the weight could be thrown wholly upon these surfaces, but in this position it could be turned only with difficulty. The best results were secured by raising the dish by an amount just sufficient to abolish this friction. The driving mechanism, or "rotor," a wooden pulley *F* mounted on ball bearings, was carried on a tripod *H*, supported independently of the rotating basin. The rubber threads were attached to the brackets *G*, six in number, and to the rim of the basin. As the instrument was originally designed, these brackets carried a steel hoop which surrounded the basin, the plan being to pack the space between with light tufts of cotton. It was found however, that jars were readily transmitted by the cotton. The instrument, speed pulleys, and electric motor are shown in Fig. 2.

The circular, flat-bottomed basin is filled to a depth of half an inch with mercury, the surface of which assumes the form of a perfect concave paraboloid under the action of centrifugal force, when the dish is rotated with a uniform velocity. The focal length of the concave mirror thus formed depends upon the speed of rotation, one turn in five seconds giving us a focus of 15 feet. As the speed increases, the focus shortens very rapidly, dropping to about three feet at a speed of one revolution in three seconds. The mercury telescope thus possesses the very remarkable property of having a focal length which can be varied at will.

It requires fully two minutes from the moment at which the dish is set in rotation for the fluid to attain the same velocity. The mercury begins to spin first along the rim of the basin, the motion being gradually transmitted toward the center. As we stand beside the dish and watch the reflection of the room in the surface of the liquid, the effect is quite startling. The room appears to expand in a most remarkable manner,

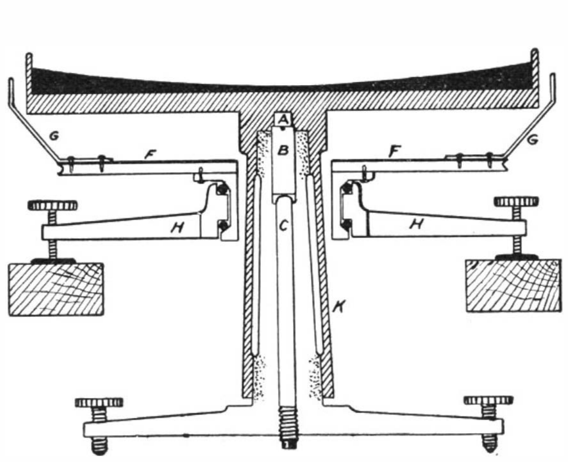


Fig. 1.–Construction of the instrument.

the ceiling retreating to a great height, and the walls moving outward. The smoothness of the mercury surface, and the freedom from ripples, is shown by the photograph, Fig. 3, of the real image in space formed by the concave surface. This image is inverted in reality, and it must be remembered that reflection in a flat surface (a pool of water, for example) would give us an image which is upside down, and not rightside up, as in the present case.

The mirror was mounted at the bottom of a cement pit 15 feet deep and 30 inches in diameter, with a foundation of granite blocks and cement 5 feet in thickness. At a distance of 6 feet from the pit a second shaft was sunk, and a tunnel cut through at the bottom. The observatory is shown in Fig. 2, the mouth of the pit being visible just inside the door. The tripod which carried the "rotor" was supported on a Y beam, imbedded in a cement pier at the bottom of the entrance shaft. The belt from the speed pulley passed under the floor of the tunnel, and was therefore not in the way when making adjustments of the mirror. It was found that everything depended upon getting the basin exactly level, which could be done only by watching the image of a Nernst lamp formed by the mirror when in rotation. The finer adjustments had to be made by observing the image of a star, which develops a "coma" if the instrument is not in perfect adjustment. It was found that the only outstanding disturbance was a system of long waves of very small amplitude, due to periodic variations in the velocity of rotation. Jars from the motor or from the grinding of rough bearing surfaces produce ripples of very short wave length, and these appeared to be completely eliminated. The periodic fluctuations in the velocity caused the focal length to vary slightly, the star images moving up and down rhythmically. This variation in the velocity was found to be due to the fact that the friction was not quite uniform, the force necessary to turn the dish being slightly greater in some positions than in others. At these points the basin lagged a little behind the rotor, the elastic threads stretching. On passing the point, the increased tension of the threads produced an acceleration, and the dish caught up again with the rotor. The source of the trouble has been located, and the instrument is now in the hands of the builders undergoing alterations.

Upon the whole, the definition was surprisingly good, when one considers the difficulties, much better in fact than I had ever dared to hope for. Readers of the Scientific American, who are interested in the subject, will find a fuller description of the sources of trouble and the methods of obviating them, in the Astrophysical Journal for March. The star images are formed a little above the mouth of the pit, where they can be examined with an eyepiece. By mounting a photographic plate in the focus, star trails can be obtained, which tell the whole story of the outstanding trouble. Instead of obtaining a narrow black line upon the plate, we find a series of black dots, each one about the size of a small pinhole. Between the dots the image broadens out to a diameter of about a millimeter. This is due to the periodic change of focus previously referred to, which trouble I hope to obviate.

The mercury telescope has the disadvantage that it can only be used for viewing objects near the zenith. With small instruments we can of course employ an auxiliary mirror, and view objects situated in any part of the sky, but with a large telescope this would be out of the question. Even with this limitation, interesting photographs of planetary details might be obtained, if it should prove feasible to build a reflector in a southern latitude, with a diameter of 10 or 20 feet. Very short exposures could be used. Probably 1/10 of a second would be sufficient, for the mirror is absolutely achromatic, and the ultra-violet rays could be utilized as well as the visible. Prof. Todd's photographs of Mars were taken with exposures of one-half a second, with a color screen which absorbed the larger part of the spectrum. It will be time enough to consider the advisability of building a large instrument, after the small one has been brought to a state of perfection.

Should it turn out in the end that complete elimination of the ripples is impossible, I feel very confident that they can be damped out by covering the mercury surface with some viscous transparent fluid. Experiments made last summer with oil showed this to be feasible, and more recently I have tried glycerine, which exerts a most astonishing effect. If we place a dish of mercury where it is violently agitated by jars, and cover the surface with glycerine, the waves disappear almost entirely. This may be of use in the case of artificial horizons.

The two most interesting objects which pass across the zenith at the latitude of Easthampton during the summer months, are the great cluster in Hercules and the Andromeda nebula. I have already had some splendid views of the great nebula, almost as satisfactory as with a large refracting telescope, since definition was not of so much importance. It can be seen to good advantage without any eyepiece, by merely looking down into the pit, where we see the oval phosphor-

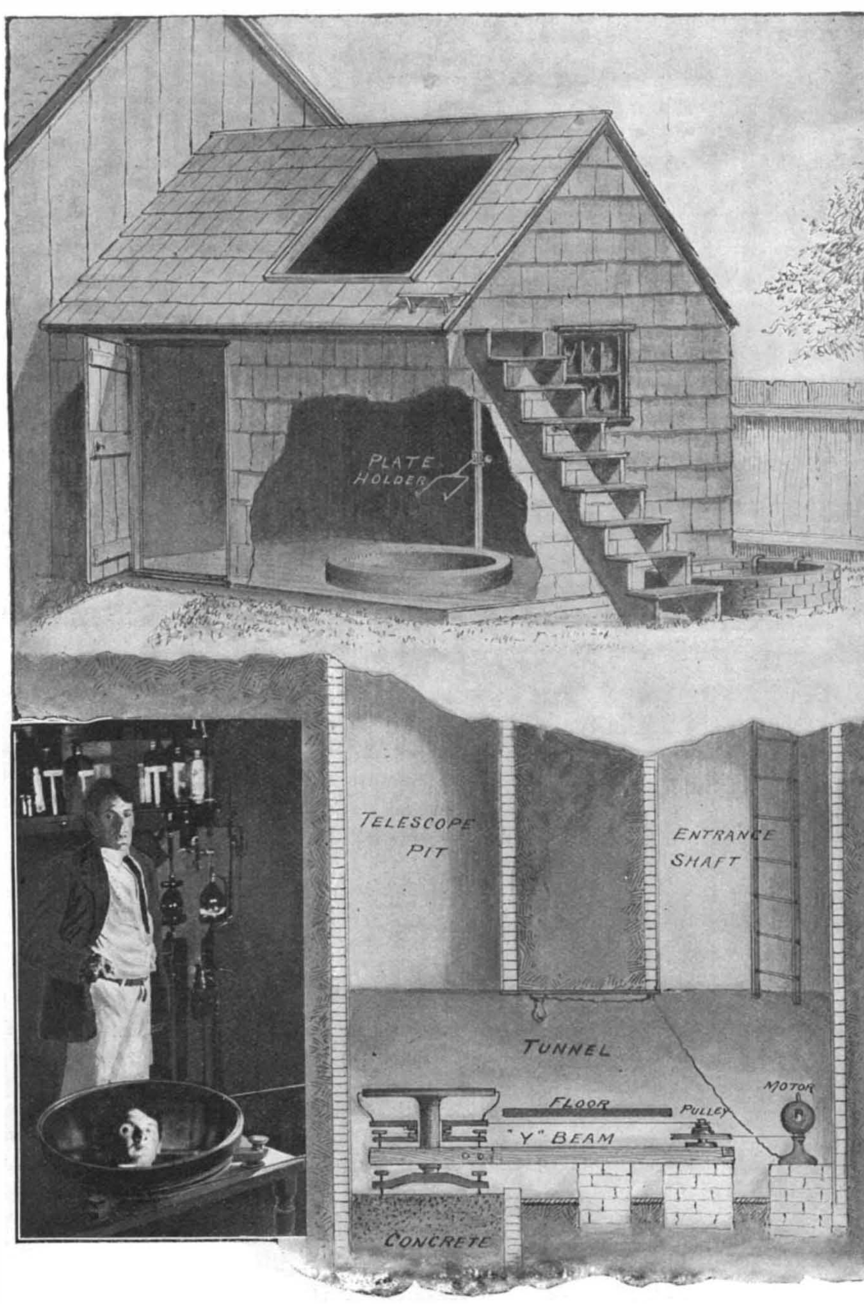


Fig. 3.—The revolving reflector.

Fig. 2.–Observatory, showing arrangement of basin and motor.

THE MERCURY TELESCOPE.

escent yellowish-green cloud floating in space. I am tempted in closing to tell of the remark made to me by one of the older inhabitants of Easthampton, who had paid my laboratory a visit. The Milky Way happened to be overhead, and the mouth of the pit, which was formerly an old well in a shed adjoining the barn, was filled with hundreds of star images. "What *are* they all, anyway?" he asked. "Suns like ours, only bigger," I replied. "You don't say so," he answered. "And have they earths and things going round 'em, and are they all inhabited?" "Very likely," said I; "some people think so." He scratched his head, and then turned to me with a restful smile and said, "Well, do you know, I dunno as it makes so *much* difference after all whether Taft or Bryan is elected."

My summer home at Easthampton was formerly an old farmhouse dating back to the reign of George the Fourth. On the door of the "observatory" we discovered a penciled memorandum "Heifer calf, born May 12"; under which my brother-in-law has inscribed, "Mercury telescope July 2."

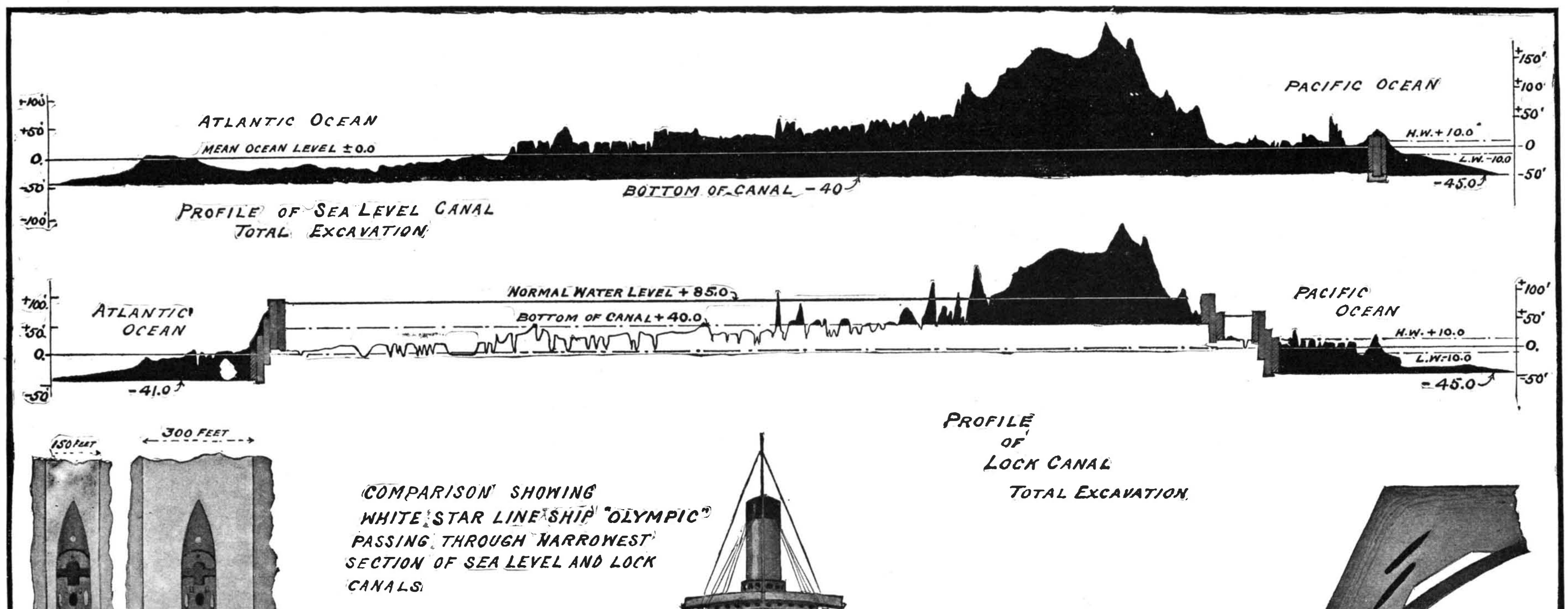
Several cities in which ousehold refuse is disposed of by incineration, have utilized the heat evolved by the combustion in the production of power for electric lighting and other purposes. Chicago has improved on this plan by making its sewage serve, indirectly, as a source of power. The Chicago drainage canal, which connects Lake Michigan with the Illinois River, a tributary of the Mississippi, and which was constructed for the purpose of carrying the sewage of the city away from the lake and furnishing an ample flow of water for this purpose, is traversed by a swift current. This current is now utilized in driving generators which supply part of the electric lighting service.

SUPERIORITY OF LOCK TO SEA-LEVEL CANAL.

The reasons which have led the government to decide upon the construction of a lock rather than a sea-level canal are simple, clear, and convincing. This will be evident from a study of the comparative diagrams shown in the illustrations which accompany this article, in which the physical characteristics of the two types of canal, the quantities, costs, convenience of operation, etc., are shown side by side. The lock canal has been chosen, first, because it can be built more easily, more quickly, and in less time; secondly, because when it is built, it will be a much better canal to operate, the ships being able to pass through it with less risk and in considerably less time.

I. THE LOCK CANAL IS EASIER, QUICKER, AND CHEAPER TO BUILD.

1. Control of the Chagres River.—The key to the canal problem is the control of the turbulent Chagres River. The greater part of the canal lies along the course of the Chagres, which meets the canal at about its mid-length, and then turns to the right on its way to the Atlantic Ocean. In the dry season the river is a sluggish stream; but during the tropical rainstorms it rises with great rapidity, and may quickly be transformed into a vast turbulent torrent, flowing at the rate of over 65,000 cubic feet a second. These mighty waters must be checked, held in reserve, and gradually released; otherwise they would flood the canal, damage its works, and render it, for a long period of time, unnavigable. To control these floods, the sea-level plan calls for the construction of a $6,000,000 masonry dam across the Chagres Valley, above the point where the river reaches the canal, which, in times of flood, will be subjected to a pressure, due to a depth at the dam, of 170 feet of water. From above this dam the waters will be gradually discharged through sluice gates into the canal. In the lock canal plan the floods of the Chagres are received into a vast artificial lake, 160 square miles in area, which will cover the greater part of the route of the canal across the Isthmus. On the Atlantic side, the waters will be impounded by a dam at Gatun, and on the Pacific side by a dam at Pedro Miguel. This lake will take the place of about 25 miles of the narrow sea-level canal, and, for 20 miles of its distance, it will offer unobstructed deep-water sailing, in which the channel will be from 800 to 1,000 feet wide. The surplus waters will be wasted through sluice gates, built in solid ground at the center of the Gatun dam. Because of the great area and volume of the lake, the heaviest floods of the Chagres will make comparatively little difference in the water level. It will thus be seen that, while the sea-level plan calls for a $6,000,000 dam exterior to the canal for the control of the Chagres, the lock canal plan makes the Chagres subservient to the canal by forming it into a huge navigable lake; saves an enormous amount of excavation; and for 20 miles of distance secures a broad navigable channel in place of one only 150 feet in width.



DIAGRAMMATIC COMPARISON SHOWING SUPERIORITY OF LOCK CANAL TO ONE AT SEA LEVEL.

2. The Lock Canal Requires Less Excavation.—A comparison of the longitudinal profiles and cross sections gives an impressive idea of the vast amount of extra excavation necessary, if the canal be dug down to sea level. The total amount of excavation for the completed lock canal will be 174,666,595 cubic yards. For a sea-level canal the total amount will be 302,793,000 cubic yards. Moreover, when the two are completed, the least width of the sea-level canal will be just one-half of the least width of the lock canal, and its average width only 218 feet, as against 650 feet; so that it may be said that nearly twice the work will have to be done for only one-third the

result; at least as far as convenience of navigation is concerned.

3. The Lock Canal Will Cost Less.—The latest estimate of the engineers of the total cost, including expenses of sanitation, administration, etc., for the lock canal, is $375,000,000. There is no guesswork about these figures. The surveys and borings are complete; the character of the material to be dealt with is known. Using the same prices, and presuming that as the excavation goes deeper, the material to be taken out will be no more difficult, the cost of completing a canal only 150 feet wide down to sea level will be $563,000,000.

4. The Lock Canal Will Take Six Years Less Time to Build.—Sufficient work has now been done on the canal to enable the engineers to estimate closely the time that it will take to complete the work; and Chief Engineer Goethals has confidently expressed the conviction that the lock canal will be open for traffic by January 1st, 1915. Using the same basis of calculation, it is estimated by the same authority, that the sea-level canal cannot be open for traffic before the year 1821.

II. THE LOCK CANAL WILL BE EASIER TO MAINTAIN AND BETTER TO NAVIGATE.

1. Lock Canal Easier to Maintain.—The advocates of the sea-level canal, in speaking of the cost of operating the locks of the high-level canal, overlook the fact that locks will be required at the Pacific end of the canal, and that because the canal, in its course through the Chagres Valley, is cut through swampy alluvial soil, and is intersected by a score of rivers and streams, a large amount of dredging will be continually required. In times of flood these tributary streams will bring large deposits of silt into the canal. The only alternative to continuous and expensive dredging would be to build a subsidiary drainage canal on each side of the main canal, in which to receive these waters, and carry them off independently to the sea.

2. The Lock Canal Will Provide Much Broader and Deeper Channels.—For about one-half of its length, where it passed through earth formation, the sea-level canal would have the very inadequate width of 150 feet. Where the sea-level canal passed through rock it would have a maximum width of 200 feet, and only in the four or five miles of dredged channel through the ocean approaches would it be 500 feet in width. The depth of the canal throughout would be 41 feet. The lock canal, on the other hand, will nowhere be less than 300 feet in width, and throughout its whole length it will be 45 feet in depth. For 20 miles through the great Gatun Lake, the channel will be from 800 to 1,000 feet wide, and from 70 to 45 feet in depth. About 22 miles of the canal will be 500 feet in width, and the remaining 8 miles 300 feet in width.

3. The Lock Canal Would Have Less Curvature.—Out of the whole 50 miles of the sea-level canal, nearly two-fifths, or 19.16 miles, will be curvature, leaving about 31 miles only of straight sailing. The lock canal, on the other hand, will contain 7½ miles only of curvature, and ships will be able to sail a straight course over the remaining 42½ miles.

4. The Lock Canal Will Be Much Easier to Navigate.—The two points of superiority mentioned above, namely, the broader and deeper channels, and shorter length of curvature, will be appreciated at once by any navigator. The difference in this respect will be understood by reference to the plan view, showing the curves of the two canals at the same point in Gatun Lake. We have drawn a 900-foot ship in a curve of the sea-level canal, and also two such ships passing each other at a turn in the 1,000-foot channel of the lock canal. The lock-canal channel is laid out on long tangents, with quick turns at their point of junction. Pilots prefer to make the turns in this way, which is the method followed in navigating the channels of the Great Lakes. The ship proceeds on a given course, until the lights or buoys show her to be in range for the next course, when the helm is put over and the ship's head swung sharply around. It is a very difficult matter to steer a large ship on long curves, such as are provided for in the sea-level canal, and keep her exactly in mid-channel. No curves of this character exist throughout the lock canal, whereas, as we have shown, two-fifths of the sea-level canal consists of such curves.

5. The Lock Canal Will Take Less Time to Navigate.—The report of the Board of Consulting Engineers of 1906, speaking on the question of the time of transit, says: "In the narrow channels of the sea-level canal, with its large proportion of curves, night navigation will be more hazardous than by day, and ships will probably move at lower speed than that assumed for the calculation of time of transit. Unless ships arrive very early in the day, they will not be able to pass through the canal by daylight on the day of arrival, but will have to submit to delays of night navigation or tie up until the next day. The cost of this delay on a tonnage through the canal of 20 million tons annually would amount to $1,500,000." But even if a ship could enter the canal at once on arrival, it is estimated that at the rate of thirty ships per day, vessels 540 feet in length would require 12.9 hours to pass through the sea-level canal, as against only 10 hours through the lock canal; while vessels 700 feet long, which would pass through the lock canal in 11.1 hours, would require 18.9 hours to pass through the sea-level canal. The even slower speed of navigation required of an "Olympic" or "Titanic," 900 feet in length or over, would probably cause the time of transit to be twice as long through a sea-level canal as it would be through a lock canal.

THE SCIENTIFIC AMERICAN FLYING MACHINE TROPHY.

The SCIENTIFIC AMERICAN Trophy for heavier-than-air flying machines was offered by the SCIENTIFIC AMERICAN for annual competition under the rules and regulations formulated and promulgated by the Aero Club of America in 1907.

The first trial for this cup was held at Hammondsport, New York, on July 4th, 1908, by the Aerial Experiment Association of Hammondsport, New York. At the second attempt the "June Bug," in charge of Glenn H. Curtiss as pilot, rose from the ground and flew from a designated point a distance of 5,090 feet. Mr. Curtiss was awarded the trophy; he having fulfilled the requirements of the Contest Committee and performed in this aeroplane a flight of more than a kilometer, which was the minimum distance required under the rules adopted for 1908 by the Aero Club of America.

In accordance with the deed of gift, which provides that the conditions for each contest for this trophy shall be made progressive in their severity of test, in conformity with the progress of aerial navigation, the conditions to be fulfilled by the next person entitled to have his name placed on the Trophy shall be a

MEDALS PRESENTED TO ORVILLE AND WILBUR WRIGHT BY THE AERO CLUB OF AMERICA.

flight of not less than twenty-five kilometers, including a return to the starting point.

RULES GOVERNING COMPETITIONS FOR THE SCIENTIFIC AMERICAN TROPHY FOR 1909.

I. It is distinctly understood that the trophy is to be the property of the club and not of the members thereof, except in the event that any one person shall win the trophy three times, in which case it is to become his personal property.

Should the trophy be won by the representative of some foreign club affiliated with the Aero Club of America through membership in the International Aeronautic Federation, it shall be held in the custody of such club, but it shall be subject to competition under the same terms and conditions as if it were still held by the Aero Club of America. Should the holding club, for any reason, be disbanded, the custody of the trophy shall revert to the Aero Club of America.

Should a contest or trial under the rules not be held within a year from the date on which a foreign competing machine shall have won the trophy, the foreign aero club having possession of the cup shall give up its custody of the same and shall return the cup to the Aero Club of America, in order that the competition or trial for that year may be held in the United States of America.

The conditions under which the competitive tests and trials shall be made, shall be determined by the Contest Committee of the Aero Club of America, and such conditions shall be made progressive in their severity of test, as far as possible, in order to foster and develop the progress of the art of aerial navigation.

II. All heavier-than-air machines of any type whatever (aeroplanes, helicopters, orthopters, etc.) shall be entitled to compete for the trophy, but all machines carrying a balloon or gas-containing envelope for purposes of support are excluded from the competition.

III. To compete for this prize each contestant must notify the club of his intention to compete, by telegraph or by registered letter, addressed to the club at its headquarters in New York, and must specify the days on which trials are to be held. He must also deposit the amount of the fare from New York to the place of trial and return. Sufficient time must be allowed for the representative of the club to reach the place where the contest is to be held, with an additional two days in which to make arrangements for the journey. If trials are to be made within twenty-five miles of New York city the club will send a representative without expense to the contestant.

IV. The person or committee having charge of the test or trial shall make careful measurements of the distance covered by the flight, and shall prepare a written report of the test or trial, which shall be delivered to the Contest Committee of the Aero Club of America, and in such report shall state fully whether in his opinion the machine can be handled with safety, and, as far as possible, he shall determine the speed attained during the flight. He shall also take into consideration the question of stability and ease of control, and he shall state in his report weather and wind conditions.

V. The flights will be made in as calm weather as possible, but the contest committee or its representative will at its discretion order the flight to begin at any time it sees fit, provided the velocity of the wind does not exceed twenty miles an hour. The machine may start by running on the ground or upon a track under its own power, but no special launching device will be permitted. There is no requirement as to the height above the ground at which the machine must fly, but it must demonstrate its ability to rise or descend and circle to the right and left at the will of the operator.

VI. Complete specifications of the competing machine, giving weight, supporting surface and power of engines, together with a description of the best trial of the machine, shall be forwarded to the contest committee at or before the time of making entry for the contest.

VII. The minimum distance which must be covered by the competing machines during 1909 shall be twenty-five kilometers, including the return to the point of starting, and a descent or alighting at a point not more than one hundred meters from the point at which the machine rose from the ground. Under the rules promulgated for the year 1909, bona-fide owners of machines may make application for a test or trial, as above provided for. No entrance fee shall be required from persons desiring to compete for the SCIENTIFIC AMERICAN Trophy.

VIII. No trial or test for the year 1910 will be allowed until the rules governing the competition for that year have been promulgated.

IX. All tests and trials shall be under the official supervision and direction of the Aero Club of America, and all questions that may arise in regard to such contest or trial shall be decided by the contest committee of said club, and its decision in all questions of dispute shall be final, and without right of appeal to a court of law or equity.

X. The winner of the SCIENTIFIC AMERICAN Trophy for 1909 shall be the entrant of the flying-machine which, in accordance with the above rules, shall make during the year mentioned the longest and best flight in excess of the minimum performance specified in Paragraph VII. His name and record will be appropriately inscribed on the trophy.

XI. In case the contest committee is unable to determine which machine has made the best performance during the year 1909, it shall arrange that a competition between such machines be held, and the machine making the best performance in such test shall be awarded the trophy for the year.

Waterproof Paper.

Japanese waterproof paper is made of fibers of bamboo and eucalyptus, mixed with fibers of the gampi and other shrubs. The fibers are torn apart, dried, cleaned, scraped, boiled in weak lye, and washed with water. They are then beaten and mixed with a viscous infusion of certain roots and a solution containing camphor, caoutchouc, and resin. The sheets formed from this pulp are calendered at various temperatures. The paper is light, washable, and very difficult to tear. It is used to imitate leather and India rubber, and for a great many purposes.

According to a contemporary, the electrolysis of water mains in Boston and vicinity is proceeding at a greater rate than ever before. The investigations made in 1907 by the Metropolitan Water and Sewerage Board show that the pitting and disintegration of the pipes by electric action have been serious, and that the destructive process is continuing even in places where insulating joints and other devices have been applied as a remedy.

Correspondence.

PROPERTIES OF NUMBERS.

To the Editor of the Scientific American:

This article is suggested by the two articles on numbers published in the Scientific American, March 28 and November 21, 1908.

The pleasure which the mathematician experiences on the discovery of a new theorem has a character peculiarly its own. The schoolboy experiences the feeling when he gets the correct answer to a particularly hard problem. The gratification is undoubtedly due to the absolute sureness of the result. Naturally, there is often a corresponding pain, the disillusionment of the discoverer on learning that his discovery is hoary with age.

The formula for constructing two square numbers whose sum is a square, i. e. $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2\,xy)^2$, given by your correspondent in the issue of November 21, was first given 1700 years ago by Diophantos of Alexandria. The formula is made more general by multiplying throughout by k^2. Numerous mathematicians have given this and allied subjects attention. Mention may be made particularly of Fermat and of Gauss, who was probably the greatest mathematician in history. Fermat proposed the now famous theorem, to prove $x^n + y^n = z^n$, is not possible in integers for any integral values of n greater than 2. This has been proved for $n = 3$, $n = 4$, and for all values of n up to 100. The general proof awaits solution, and the finder of the solution will receive the prize of 100,000 marks ($25,000), left by M. P. Wolfskehl. Profound work along this line has been done by Kummer and Hilbert; it is quite certain that any solution must be based on the work of these scholars. It is also quite certain, as L'Enseignement Mathematique remarks, that the desire to gain 100,000 marks is evidently much more common than the comprehension of the fundamental theorems of modern mathematics which are necessary for the solution of this problem. As in the case of the squaring of the circle, the duplication of the cube, and the trisection of an angle (by straight line and circle) many false prophets will arise to demonstrate. These three problems have all been shown to be not solvable with ruler and compass.

Chrystal's Algebra (1900) gives as an exercise (p. 534, ex. 12) the problem that the cube of every rational number is the difference of the squares of two rational numbers. The problem itself is not original with Chrystal, but is much older.

That $x^3 - x$ is divisible by 3, $x^5 - x$ by 5, $x^7 - x$ by 7, $x^{11} - x$ by 11, $x^{13} - x$ by 13, depends on the well-known Fermat's theorem, published in 1670, that x^{m-1} is congruent to 1 modulus m when m is a prime number, x being any number not divisible by m. This means simply that when x^{m-1} is divided by m the remainder will be 1. The proof is elementary, and is given in any Theory of Numbers as well as on page 550 of the second volume of Chrystal's Algebra. Chrystal states explicitly the theorem that $x^m - x$ is divisible by m. By Fermat's Theorem it follows that $x^{13} - x$ is divisible not only by 13, but also by 2, 3, 5, and 7, since $x^{13} - x$ contains besides the factor x the factors $x - 1$, $x^2 - 1$, $x^4 - 1$, and $x^6 - 1$. Consequently, $x^{13} - x$ is divisible not only by 910, as given by your correspondent, but even by 2730.

To actually calculate $12^{13} - 12$, in order to prove the result divisible by 13, would be termed a mathematical barbarity. $12^{13} - 12 = 12\ (12^{12} - 1)$.

$12 = 13 - 1$. $12^{12} = (13 - 1)^{12}$, which when expanded by the binomial theorem shows that every term except the last contains the factor 13, and the last term is $+ 1$. Subtracting 1, the expression is divisible by 13. Similarly, to prove $7^{13} - 7$ divisible by 13, we write $7^{13} - 7 = 7\ (7^{12} - 1)$. $7^{12} = (13 - 6)^{12}$, which when expanded by the binomial theorem has every term except 6^{12} divisible by 13.

$6^{12} = (6^2)^6 = (36)^6 = (39 - 3)^6$, of which all terms except 3^6 are divisible by 13. $3^6 = (27)^2 = (26 + 1)^2$, which expression gives the remainder 1 when divided by 13. Therefore $7^{12} - 1$ is divisible by 13. Of course, this work is entirely unnecessary, as the results are proved by the general theorem.

$1297^{1901} - 1297$ is divisible by 1901, by the theorem (since 1901 is a prime number), and it would take a goodly portion of a man's life to verify the fact by computation. 1297^{1901} would be written with 6,118 digits; written out, it would take up about a column of the Scientific American.

The method given for constructing a right angle by using cords or boards of lengths 3, 4, and 5 feet—or 12, 16, and 20 feet—is hinted at in Egyptian records that are 4,000 years old. Heron of Alexandria, writing about 2,000 years ago, gives quite a full explanation of the matter.

The ordinary proof by nines is more than a thousand years old, as it is given by Alchwarizmi, an Arabic writer who dates back to 825 A. D. A proof by elevens was given by the Arab Abu Bekr Muhammed ibu Alkarchi about 1000 A. D., while the particular form mentioned of calculating the difference between the sums of the even and odd digits is found in many European arithmetics from 1750 on down to 1850.

That 142,857 when multiplied by 1, 2, 3, 4, 5, and 6 gives the same succession of digits rearranged in cyclical order (i. e., as though these six numbers were written around a circle) is explained by the fact that 142,857 is the repetend of the repeating decimal of $\frac{1}{7}$. $\frac{1}{7} = .\dot{1}4285\dot{7}$. Since in dividing 1 by 7 there appear all six different remainders from 1 to 6, it follows that when 2 is divided by 7, the same six remainders will appear beginning at a different point.

$1 \times 142,857 = 142,857$
$2 \times 142,857 = 285,714$
$3 \times 142,857 = 428,571$
$4 \times 142,857 = 571,428$
$5 \times 142,857 = 714,285$
$6 \times 142,857 = 857,142$
$7 \times 142,857 = 999,999$

Using these seven arithmetical facts, one can multiply offhand 142,857 by any number; e. g., to multiply by 233, divide 233 mentally by 7, giving 33 3/7. Write the 33 first, followed by the succession for 3/7; finally subtracting 33. This gives 33/4285.38. Since $7 \times 142,857$ gives 999,999, or $1,000,000 - 1$; $33 \times 7 \times 142,857$ gives $33,000,000 - 33$. It is evident that the seven facts need not be written down; the repeating decimal for 3/7 begins with 4 and has same succession of digits in same order as the decimal for 1/7.

The sequence given $.\dot{0}52,631,578,947,368,42\dot{1}$ repeating gives 1/19; as there are 18 places in the repetend, all eighteen remainders have appeared. Consequently, the same sequence of digits in cyclical order is obtained when you multiply this number by any number from 1 to 18. A similar rule holds for multiplying mentally this number by any number; e. g., to multiply by 254, divide 254 by 19, giving 13 7/19. This gives the product as 13/368,421,052,631,578,934. The first 13 is the integral part of $\frac{254}{19}$; the second part is the repeating part of the decimal for 7/19 with the exception of the last two places, which are obtained by subtracting 13 from the final 47.

$19 \times 0.052,631,578,947,368,421$ gives 999,999,999,999,999,999, or $1,000,000,000,000,000,000 - 1$. This fact combined with the cyclical permutations when multiplied by numbers from 1 to 18 gives the explanation of the method.

Tradition holds that the Hindus, to whom we are indebted for our system of numbers misnamed the Arabic, were the first people to occupy themselves with magic squares. On a copper engraving of Melancolia made by Albrecht Dürer about 1500 there is depicted a small magic square. The magic square given by your correspondent is not what is termed a regular magic square, as this is supposed to use all the integers from 1 up to 18^2. About 1835 a three-volumed work appeared on the subject of magic squares, and within a month an American firm (Open Court) has brought out a small work on the same subject.

Louis C. Karpinski.
University of Michigan, Ann Arbor, Mich.

GOVERNMENTAL INCOME AND OUTGO.

On March 16th President Taft transmitted to Congress a message pointing out the necessity for a revision of the tariff. On March 17th Chairman Payne of the Ways and Means Committee introduced the new tariff bill, on which his committee had been working steadily for four months. It is not within the province of the Scientific American to comment on the merits or imperfections of this bill, which will undoubtedly be more or less modified in the legislative alembic, but it is interesting to know what that highly complex organization of highly complex units actually costs, and where the revenue actually comes from.

The Division of Bookkeeping and Warrants of the Treasury Department states that the receipts derived from Customs, Internal Revenue, sales of Public Lands, and miscellaneous sources was $601,126,118 for the fiscal year ending June 30th, 1908, while in the same period disbursements exclusive of the principal of the public debt were $659,196,319. It is this deficit which the new tariff will wipe out, as well as give increased revenue for public works, increased protection, etc.

For purposes of comparison we have represented the receipts and expenditures in graphical form, using the revolving door as a means to this end. Customs furnish the largest item, amounting to $286,113,000; Internal Revenue follows with $251,711,000, then come the other larger sources of income, each man being shown of a size normal to the amount of money he is supposed to be carrying.

The "Outgo," represented on the other side of the door, shows the soldier, the sailor, the postman, the veteran, etc., of the proper size. The amounts are so clearly shown that they do not need recapitulation here. Smaller items are not shown, as then the pictures would be misleading.

It is needless to say that the appropriations and expenditures of the government are increasing annually, but the revenues from imports have recently shown substantial gains; and should these continue, as there is every reason to believe that they will, the Treasury will be in good condition to await the approaching readjustment of the tariff.

The Taylor-White Steel Patents Held Invalid.

The two patents granted to F. W. Taylor and M. White (668,369 and 668,270), which apply substantially to all steels for cutting tools in the composition of which chromium and tungsten or molybdenum appear, and to all temperatures employed in treating such steel for machine-tool purposes in excess of 172 deg. F., have been declared invalid in the suit brought by the Bethlehem Steel Company against the Niles-Bement-Pond Company for infringement.

Taylor and White invented no new composition of steel. Their patents cover simply a process for the treatment of steel of certain limited compositions. Taylor and White claimed to have discovered that, when air-hardening steels are made with certain constituents in ascertained proportions, the deterioration that ordinarily results at temperatures above a cherry red, prevails only from 1,550 deg. to 1,700 deg. F. (called the "breaking point") and up to a temperature at which the steel softens or crumbles when touched with a rod (approximately 1,900 deg. to 2,000 deg. F.), the efficiency of tools of such special steels—that is to say, their cutting speed and also their uniformity in efficiency—is greatly increased, and largely so in proportion to the degree of heat to which they are raised.

The decision of the court lays great stress on the alleged "breaking-down point" between 1,550 and 1,725 deg., mentioned in the patent. "If such breaking-down point did not exist, or did not exist between the degrees of temperature named, the patentees made no discovery and no invention; or, again, if workers in the art were accustomed to temper their steel by the application of more or less heat, according to its composition, and in its treatment applied temperatures exceeding 1,725 deg., the higher limit of the alleged breaking-down point, the patent must likewise fail."

That the patentees were wrong in their claims followed from tests made in the presence of representatives of both parties to the suit. The result was to show that a heat of 1,500 deg., regarded by the patent as the highest point of efficiency in the prior art, was, indeed, the lowest point of efficiency; that from 1,550 deg. to 1,600 deg. the same degree of efficiency, or rather of inefficiency, was substantially maintained; and that from and after a temperature of about 1,600 deg., and not of 1,725 deg., as called for by the patent, marked improvement was shown. In short, every material assertion of the patent bearing upon the point in question was disproved.

The court held that "it would seem that the prior art need not, and ought not, to be strictly limited to what was done in making metal-cutting tools of the precise character indicated in the patent. The questions involved, broadly considered, have to do with the tempering of steel, the use to which the steel might subsequently be put being relatively unimportant. . . .

"A reasonable application of this principle would seem to broaden the prior art, for if it were customary to temper steel in analogous arts by the application of very high temperatures, equaling and even exceeding those of the patents, and this without injury, then the application of the same treatment, for a like purpose, to steels for metal-cutting tools would not necessarily involve invention. . . .

"The testimony shows that it would have been impossible to make an efficient cutting tool out of the chrome-tungsten steel in vogue for some years prior to the patent in suit at a temperature below those within the patent in suit. Such steels not only required, but, in fact, were given, a much higher temperature than that given to the old carbon and cast steel, and a much higher heat treatment than 1,725 deg. named in the patent as the highest of the temperature defining the breaking-down point. The art developed continuously along this line as the carbon constituent was reduced and the toughening elements were introduced into the composition of steel.

"No satisfactory basis appears in the record for the assertion that the patents in suit led up to or were the means of producing or introducing the high-speed steels. On the contrary, such steels were developed normally along lines laid down and recognized prior to these patents. The process of their development has always been gradual, but at the same time consistent and in a single direction, and may well be characterized as one of degree, and the same may be said of their treatment.

"If the composition of steel were always uniform, the best heat treatment for that particular kind of steel, once ascertained, could safely be followed. But inasmuch as the compositions of steel are not uniform, but variable, and frequently unknown, it has always been more or less a matter of experiment to ascertain the degree of heat requisite for their proper treatment, and it is this experimental practice to ascertain what after all was merely a matter of degree that precludes all possibility of invention in the patents."

The Current Supplement.

A new automobile tilting truck recently constructed for the city of Cologne is the subject of the illustrated article that opens the current Supplement, No. 1734. Alcohol as a motor fuel is once more discussed. Day Allen Willey tells how smokeless powder is made, and explains how some ship explosions have occurred. Prof. Reginald Fessenden concludes his masterly treatise on wireless telephony. O. Froehlich describes his new process for refining copper. The wonderful engineering feat of connecting the Simplon and Loetschberg tunnels is described by the Paris correspondent of the Scientific American. Sir Oliver Lodge writes on the ether of space. A very exhaustive description of the Walschaert valve gear is furnished by C. O. Rogers. The Optics of Skulking and Scouting is a fascinating military subject well handled by W. R. Gilbert. Deslandres' investigations of solar electric phenomena and their relation to terrestrial magnetic perturbations are summarized.

It is announced that the French mints are about to coin for the first time 25- and 10-centime pieces (fractional currency) made of aluminium to take the place of the old copper coins, which are to be withdrawn from currency.

THE NAVY'S DUMMY DRILL GUN.

BY WALTER L. BEASLEY.

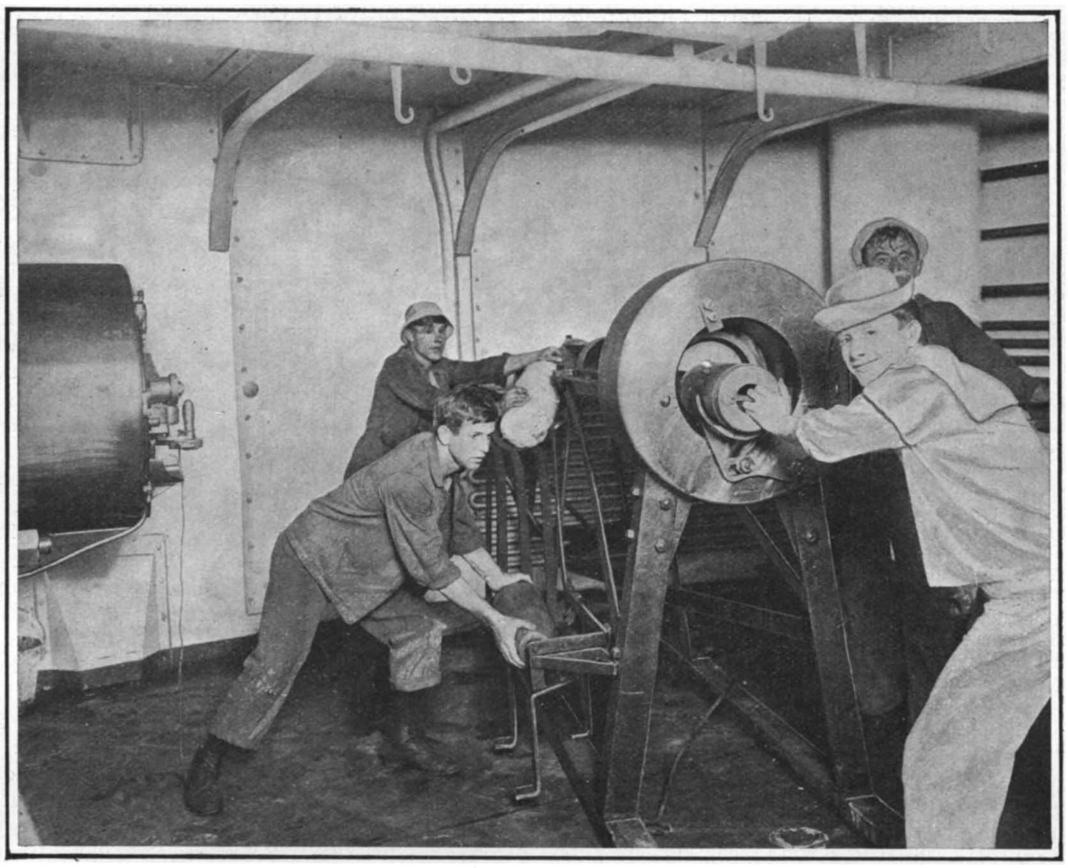
The recent brilliant and surprising scores made by the ships at target practice at Magdalena Bay shows a marked advance over previous years, and demonstrates that the men behind the guns have been trained up to the highest point of efficiency in the various operations connected with firing the batteries, such as quick handling of shells, ammunition, pointing and sighting, and other matters entering into the performance of successful naval gunnery. As recently announced by the Navy Department, the battleship "Maryland" of the Pacific Squadron carries off the honors, winning the trophy by the fine score of 76,470; the cruiser trophy goes to the "Albany," having a score of 76,924, while the gunboat trophy was won by the "Wilmington," whose record was 67,448. The following are classed as "star ships," having obtained at least 85 per cent of the final merit of the trophy winners of their respective classes: the "Illinois," "Kentucky," "Vermont," "Louisiana," "Alabama," "Connecticut," and "Tennessee." The new ships "Connecticut," "Louisiana," "Vermont," and "Minnesota," showed remarkable efficiency with their new 12-inch 45-caliber guns, the shooting being extremely pretty and accurate, and the ships averaging about 1.5 hits per minute. The "Louisiana" made 1.7 hits with her 12-inch rifles. The work, however, of the 7-inch rifles caused the greatest surprise. The average was about 5.5 with these guns, the "Louisiana" making 5.3, while some of the ships made 5.87, 5.8, and 5.89. The "Minnesota" on one run made nearly 100 per cent with her 7-inch gun, hitting the target 11 times out of 12 shots fired.

As the successful achievements of these creditable and record-breaking performances are due almost entirely to a particular method of training, it will be of timely interest to picture and describe the dummy drill gun. By the use of this device the men become experts in lifting and loading the heavy shells, and develop into human automatic machines, handling the weighty projectiles and shoving them into the breech with great rapidity and skill. The main object of the "dummy loader" is to give the shell men an opportunity to acquire speed and proficiency in the handling of the shells without wearing out the breechblocks of the guns. Of late much attention is being paid by all the ships in the navy to these drills, for in actual service much depends upon the promptness and accuracy of the shell man. Should he "muff" a shell at the critical moment, or let it roll away from him, should he drop it—in short, should he fail to send it home safe and true when the breechblock of the big gun is swung open for him—the consequences might be serious.

The "dummy loader" is the latest invention of the Ordnance Department, and is a *facsimile* of the breech and powder chamber of a big gun up to the point where the rifling begins. Loading it requires the identical motions that are employed in the loading and firing of the real weapon. One man opens and closes the breech; the shell man grasps the projectile and quickly rams it inside, followed by the dummy charge of powder in a bag; the shell comes down the return chute on the left side of the apparatus; the "take-off" man catches the shell as it falls out at the end, and shoves it again to the loader at the front. The dummy powder charge is handled in the same way, and the whole makes a continuous operation for the loader. By the time he has put in the last shell and the breech is closed and locked, it is ready to be swung open again by the plug man, and an additional shell shoved in. A marked economic improvement in the saving of the life of guns is thus obtained. The breechblock of these costly weapons would soon be worn by the constant slamming and the denting of quickly-thrown shells.

The new device is manufactured entirely in the Brooklyn navy yard, N. Y., in the ordnance machine shop. It is made mostly of steel; although there are a few parts of brass and cast iron, the supporting framework and return chute are entirely of steel. The one shown in the accompanying illustration is the latest 7-inch model, and is on board the battleship "New Hampshire." It is 7 feet 4 inches long, 4 feet 4 inches high, and weighs about 1,800 pounds, costing the government $375 to manufacture.

Before reaching the target grounds, the gun crews are kept at systematic and continuous drills with the dummy loading machine, consequently the men have acquired the top-notch point in speed, coupled with a mathematical precision in the handling of the projectiles, powder charges, etc. When the vessel reaches the range, and as, at the speed assigned, a very short time interval is allowed for the run, it is important to begin firing at once with the rapidity consistent with "getting on" the target. The size of the target varies according to caliber and practice, but the target screens for the great guns are about 21 feet in length and 17 feet in width, and are distant from the range about 1,600 yards. The Navy Department provides four trophies for excellence in gunnery—one each for battleships, cruisers, gunboats, and torpedo craft. In addition, money rewards are distributed according to gun rank or rating among the successful crews.



THE 7-INCH DUMMY DRILL GUN OF THE BATTLESHIP "NEW HAMPSHIRE."

Our high-speed target records are due to practice with the dummy.

A Gold-Brick Town.

There are many remarkable towns in Mexico, but none more interesting than Guanajuato, "The Hill of the Frog." It might more properly be called the "gold-brick town," for the houses have been found to contain much gold. This is a curious situation, but it came about naturally. Guanajuato—pronounced Wah-nah-wahto—is one of the oldest mining towns in Mexico; but the value of the place as a town was discovered when a railroad company decided to build a station there. It was found necessary to tear down about three hundred adobe buildings, which were made of the refuse of various mines after the ore was extracted.

When it became known that the old adobe buildings would be torn down, pieces taken at random were assayed. It was found that because of the old process, which lost much gold and silver, they assayed from $3 to $24 a ton. The mean value was estimated to run about $8 gold per ton. The old buildings have brought about $30,000 Mexican in gold, and persons who have built since the new machinery has been installed in the mines are bemoaning the fact that the new houses do not contain as much gold as the old.

Permanence of Iron Gall Inks.

Various iron gall inks which, when freshly made, had been analyzed by the Prussian government testing bureau and had been ranked in the first class, were allowed to stand three years and again examined. It was found that the quantity of iron in solution remained unchanged, but that the tannic and gallic acids were greatly diminished, in some cases by more than one half, so that many of the inks no longer satisfied the conditions established for inks of the first class. The sediment deposited in the bottles contained only traces of iron and consequently could not consist of tannate or gallate of iron, as has hitherto been assumed. It was probably composed of products of the decomposition of tannic and gallic acids. If this decomposition is favored by exposure to light, as is not unlikely, ink should keep better in earthen jugs than in transparent glass bottles.

THE ICE OF THE ARCTIC WATERS.

BY DAY ALLEN WILLEY.

It is an interesting fact that the actual iceberg always comes from near the ends of the earth. Becoming detached from the immense ice masses of the north or the south polar regions, the huge pinnacles and mounds and other formations too often in the path of vessels crossing the Grand Banks of Newfoundland have made a long journey before reaching this locality, for they have come the length of that interesting river in the ocean, the Labrador current, besides floating hundreds of miles in the waters about Greenland.

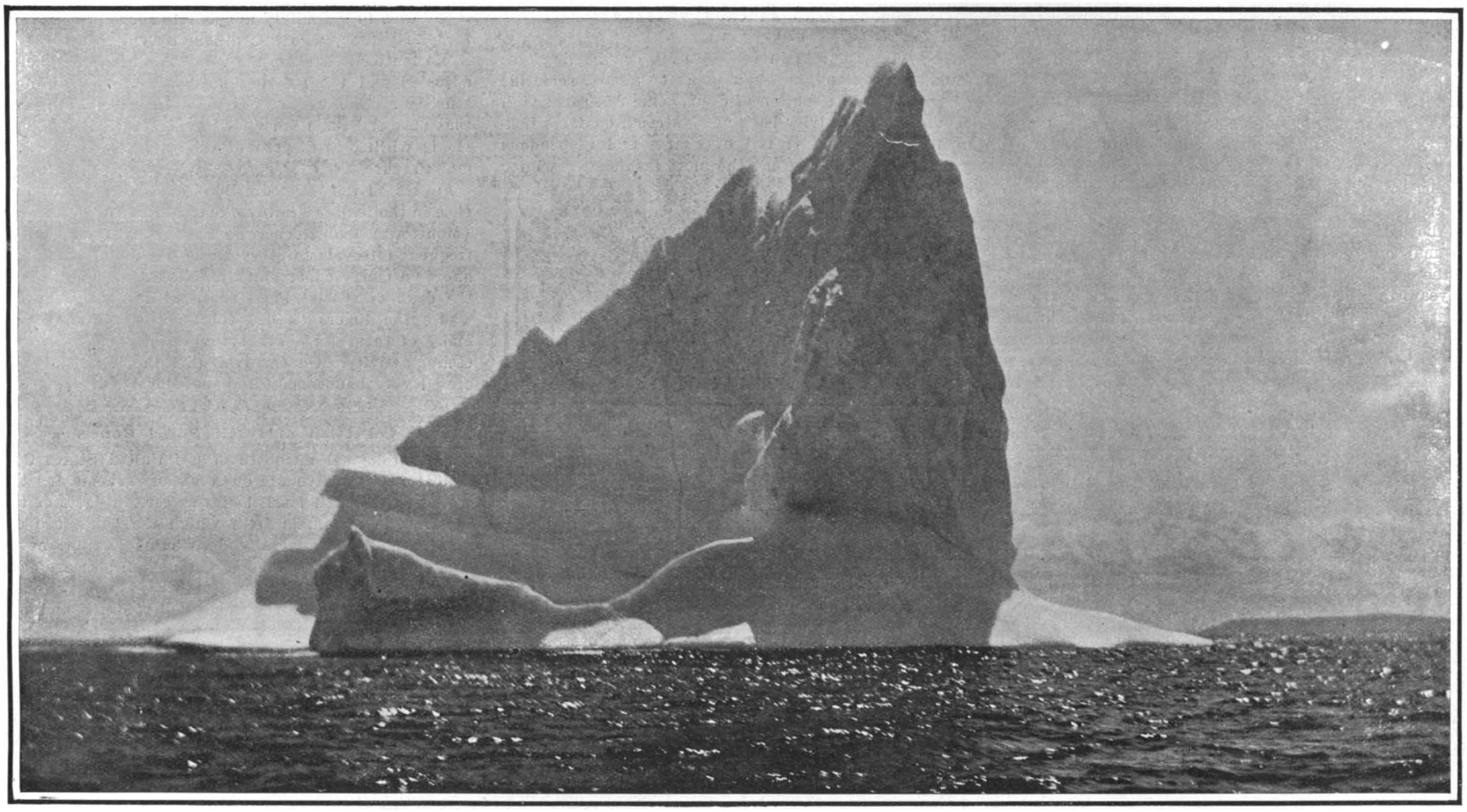
The distance covered by an iceberg of the North Atlantic from the time it is formed until it reaches the Banks is fully 2,500 miles. It may have been afloat for a year exposed to wide changes of temperature, battered by ice floes, possibly other bergs, and ceaselessly washed by the waves. Yet some of those seen 2,000 miles south of their starting point are nearly 300 feet in height and truly of majestic proportions, often a thousand or more feet in length, while it is an established scientific fact that so much more of the bulk is under water than is visible, that the largest ones may extend into the ocean to a depth of over half a mile.

Their enormous size when they become detached from the glaciers is proved by the observations of explorers along the Greenland coast. A few years ago one was measured as nearly as possible around the edges. This distance was about five miles. It had several peaks estimated to range from 300 to 500 feet high. Judging from its appearance it was a solid mass that had separated in its entirety from the glacial edge of Greenland. As Arctic navigators who venture far north often see a score or more of great bergs in a day, the tremendous glacial activity in this region can be appreciated. The majority of these that drift to the Grand Banks come from Melville Bay. Some of the distinct glaciers that terminate the Greenland ice cap on this coast extend along it a distance of fully 25 miles. Their thickness or height can only be estimated but in places near the open sea it is believed to be several hundred feet.

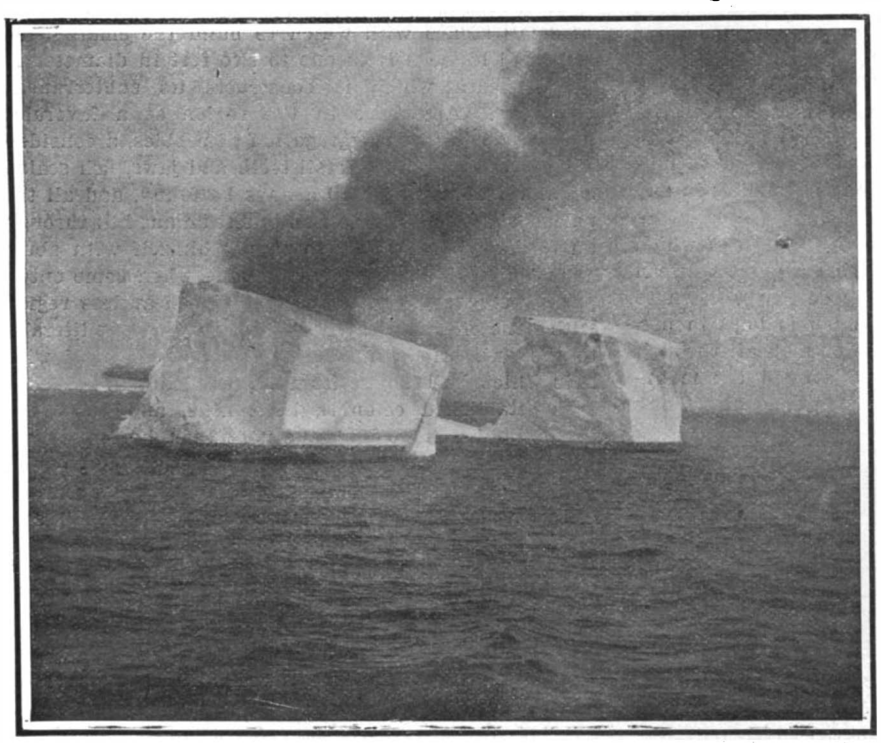
Recent examinations of this coast show that during the short summer the formation of bergs in the bay is almost continuous. The glacial movement keeps pressing the ice forward until a thick stratum often projects many feet beyond that beneath. After a time the great weight overcomes the tensile strength of a mass and it falls into the sea and a berg is created. The warmer temperature of summer may also widen crevasses on the fringe of the glacier and wave action loosens another mass. The explorers in this sheet of water say that enormous force is displayed by these ice falls and that the sound of the great body striking the water is so deep and loud that it resembles heavy thunder. The many reports that may be heard in a day indicate the rapidity with which the glaciers disintegrate in summer.

Probably the natives of Newfoundland and Labrador are more expert in the knowledge of marine ice and ice forms than any others. This might be expected since the shores of the island and the long, bare peninsula are incased in ice in some form so many months in the year while the berg-laden current flows past them on its southerly course. The seal hunter or fisherman of this region can tell the character of a piece of floating ice or an ice pack merely at a glance. When searching for seal on the ice fields in winter, if he becomes thirsty he looks for ice having a bluish or grayish tint—not the white or transparent variety. He knocks off a lump of the darker hue and tests it with his tongue. But the field may consist of a pack of pan or floe ice which, though dazzling in its whiteness and clearness, is unfit to quench the thirst owing to its salt. So it is that much suffering is endured by these fur hunters unless they chance upon a fragment of a berg which may have gone to pieces and been wedged in the pack.

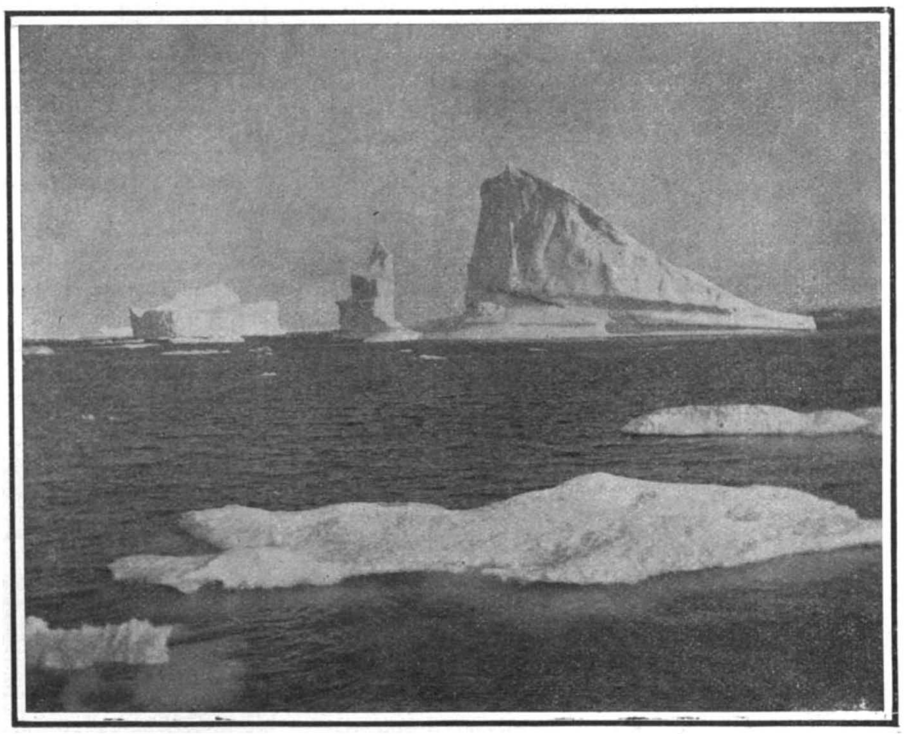
Usually the iceberg is of such large proportions that it can be distinguished from the floe and pan ice, but occasionally a berg splits apart because the superstructure becomes too great for that supporting it. Again, a storm may send two crashing against each other,



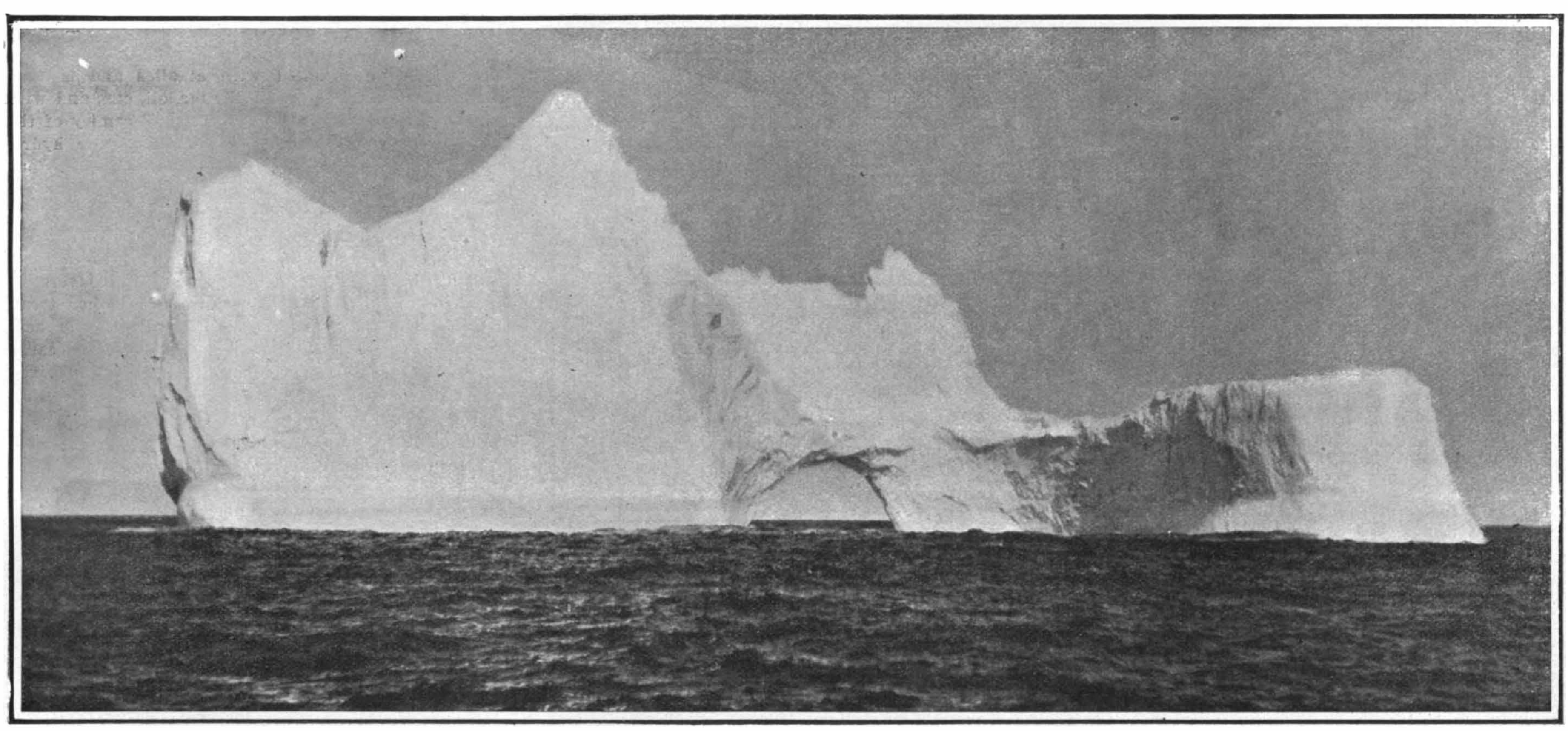
An iceberg that looks like a racing yacht under full sail.



A small iceberg. Its sharp edges denote great hardness.



Greenland icebergs surrounded by floe ice.



A curious arch in an iceberg.

THE ICE OF THE ARCTIC WATERS.

knocking pieces off them, perhaps weakening them so that they go into fragments. The debris of a large berg may cover a square mile, but even if mingled with other ice, the eye of the skilled observer can usually detect it by its darker color. But there is the sure test of the tongue, for glacial ice is almost invariably "fresh," containing but a slight percentage of saline matter in its composition. Still another method of discovery is to take a chunk and try to break it, at the same time putting a piece of pack ice to the same test. A blow which shatters the pack ice may only knock a little powder from the surface of the other. During the hundreds, perhaps thousands, of years it has existed, its particles have been so constantly subject to pressure from the glacial movement that the ice has solidified to a wonderful degree. It not only resists the sharp edge of the cutting tool but will remain a much greater length of time without melting than any other variety found in the ocean. This accounts for the dimensions of some of the bergs which have floated a year or more before they reach the Grand Banks. Although the temperature rises rapidly as they go southward from these shoals it is known that some have gone 200 miles farther south before they have melted or separated into fragments.

If an iceberg moving down with the Labrador current is swayed by an eastern storm or eddy too near shore owing to its "draft," as the sailors would say, it is liable to ground. Thus an opportunity to study the changes which occur is given. It has been discovered that while the summer temperature of Newfoundland is high enough to reduce the surface considerably by melting, it goes to pieces much more rapidly by the weakening of the lower portions. The action of the waves and tides tends to undermine it, so to speak, holes appear at the water line, a piece of the upper portion "caves in," then another and another, until the berg disappears in a remarkably short time considering its dimensions. There have been instances where parts of these stranded bergs remained in sight throughout the summer and were preserved by the winter temperature until the next year, but usually after striking bottom they disappear entirely before the warm season in this latitude has closed.

The novice might often mistake a piece of floe ice for a small berg not noting the difference in color and formation. Some of the hummocks formed by rafting or overlapping of pan and floe ice are fifty and sixty feet in height. Torn from the edge of the field by a gale or unusually high waves, they fall into the procession of bergs and some are of such size that they drift to the south of the great island before they disintegrate.

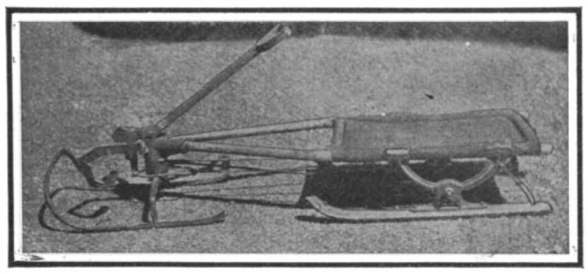
There is a continual movement of ice from the vast pack in the upper Baffin's Bay, the quantity of course varying according to the season. The field which comes southward on the Labrador current in February of each year sometimes extends outward a hundred miles from the shore line and five hundred miles to the north. Great sections of it may present a solidly frozen surface without a rift of water while another portion may be of floes and individual cakes separated by lanes of open sea. It is on this field that the hair seal is born and here is the scene of the annual seal hunt. The field is often broken by violent storms and the cakes piled into the hummocks are solidly frozen together, but this ice is soft in contrast with the "Arctic pack." Masses of this fifteen and twenty feet in thickness are sometimes broken from the pack in the Arctic basin and come south with the new ice, gradually melting until the surface is just awash. The Islanders and sailors call such pieces "growlers" because they are so hard that they will pierce an iron as well as a wooden hull, and lying almost entirely below the surface they may not be seen until the vessel strikes their sharp edges. Next to the bergs the Arctic pack is the oldest ice which is brought into the Atlantic by the Labrador current. A study of its composition leads investigators to believe that some of it may have been formed a century before it was detached from the main body which lies miles to the northward of Newfoundland.

The examination of some photographs taken at the observatory of Arequipa (Peru) has revealed what appears to be a new star. According to Prof. Pickering, of Harvard University, this star was of less than eleventh magnitude June 1st, 1906. It rose to a magnitude of 8.9 from June 14th to July 2nd, and then diminished in brightness. At the present time it has again fallen below the eleventh magnitude. This star is probably not new in the strict sense of the word, but is a variable star of long period, or perhaps rather of irregular period. The Arequipa photographs happen to have caught one of the maxima of brightness. It is a matter of the greatest scientific interest to make a close study of such new stars which continue to remain visible, for there is always the possibility that they may manifest some unforeseen phenomena of great importance.

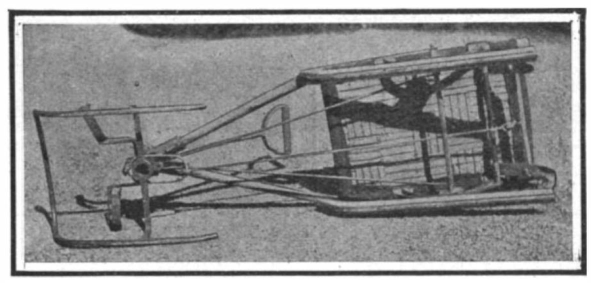
TOBOGGANING AT CAUX, SWITZERLAND.

BY DESHLER WELCH.

The winter sports in tobogganing, or "lugeing," at Caux, Switzerland, reach a point of almost scientific diversion. The situation of Caux, some 3,000 feet high on the great acclivity back of Montreux, on Lake Lehman (or Geneva) is full of charm and stupendous grandeur. It has become the most fashionable winter resort in Europe. The famous places of Danos and St. Moritz, where winter sports are carried on with almost professional records, are, more or less, winter residences for people suffering with weak lungs or tuberculosis. But Caux, which is called the Ermine King, is an all-the-year-around resort that is patronized by the most distinguished people in the world as a place of healthful rest and luxury. In the winter the great hotels, the Palace and the Grand, are mainly filled by Englishmen who spend all their time in skiing, lugeing, and skating, and a Caux "record" is now considered sufficient to establish one's standing in any one of the sports.

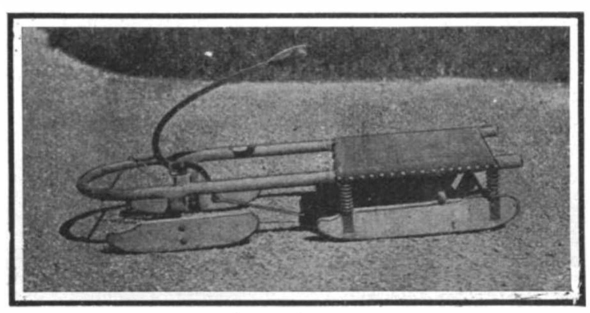


Swiss iron-frame bob sled.



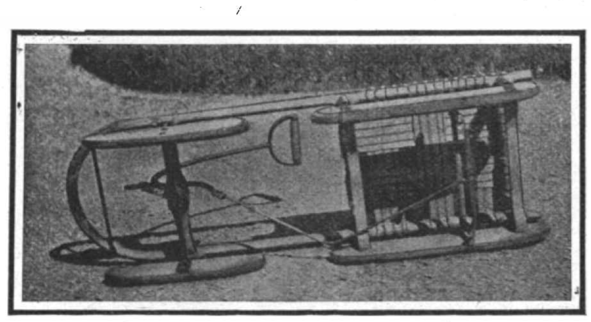
Arrangement of brake on the iron-frame sled.

The toboggan slide is the "Cret d'y Bau" run which extends a distance of five miles, from a point between Caux and the mountain of Rocher de Naye, down to Territet—a fine, hard roadway, which is kept in perfect and safe condition by a force of men all through the winter. It curves, snake-like, around the mountain sides, through patches of pine woods and along the edges of great declivities that are safely guarded. All the curves are banked so as to throw the sled into a proper equilibrium.



The wooden-frame bob sled or "luge."

It is here that the "luge" itself has been notably developed on scientific principles. Mr. Hugo Eulenstein, director of both the hotels, has been an active participant in all the winter sports and has accomplished some remarkable feats with the luge. He owns one called "Bob-Phœnix," manufactured in Couvet, Switzerland, that cost 1,200 francs, on which he has sped down the run at the rate of 120 kilometers an hour. It has a double truck and carries four or five people, with a wheel steering gear. An American make of "skeleton" has also been popular and was first exploited here three seasons ago by Mr. Henry Harrison, a guest from Chicago.



The "luge" turned over to show the brake.

TOBOGGANING AT CAUX.

Mr. Eulenstein has now patented a "dirigible-brake luge" that is splendidly adapted for long runs. It is for one person, who has absolutely full control over it, no matter how steep the run. The brake is quickly adjusted and the steering mechanism is exceedingly sensitive. The "bobs" are so arranged on an axle that ruts or bumps are glided over with hardly a jolt. He is willing to dispose of the patent for American manufacture.

Lugers on the "Cret d'y Bau" have a great convenience in the inclined railway that runs between Territet (Montreux) and Rocher de Naye. A car is run at frequent intervals to carry back people and sleds, and affords a merry opportunity for social contact. During the days of special races the scenes at the roadway where the lugers "slide" through Caux, and where many of them start, are brilliant in color and interesting activity. On carnival days the luges are decorated very handsomely and ingeniously.

Collection of Small Fossil Bones.

Paleontological members of the United States Geological Survey have hit on a unique scheme for the collection of small fossil bones in certain parts of the West. The mammals from which the bones are derived are pretty generally distributed but are never abundant, and on account of their small size are seen with difficulty. They may be more frequently found in what are locally known as "blow-outs," and are almost always associated with garpike scales and teeth, and teeth and bones of other fish, crocodiles, lizards, and small dinosaurs. These remains are frequently so abundant in "blow-outs" as to attract attention easily. When such a place is found, careful search is almost always rewarded by the discovery of a few jaws and teeth of mammals. This has been known for a long time, but it was only more recently that it was discovered that a certain species of ant, in excavating its burrows and in collecting material from and beneath the surface, brings together great numbers of small stones with which to build the small hemispherical hillocks from one to two feet in diameter in and beneath which it constructs its subterranean chambers. Anywhere in the region at a favorable locality among this aggregation of pebbles, a considerable number of small fossil teeth and jaws, fish scales, small vertebræ, etc., will always be found, and all the paleontologist had to do was to sift an ant hill through an ordinary flour sifter to supply himself with abundant material. The next step came when some enterprising sluggard, wishing to sample an antless region with little effort, followed Scripture, and went literally to the ant. He deliberately "sowed" the place with ants which he brought from several miles away. The ants established colonies, built hills, and when the paleontologist went back the next year, he found that they had collected thirty or forty teeth, etc., to each hill. This particular locality, which is in Wyoming, has proved almost inexhaustible, having yielded several thousand isolated teeth and jaws of the diminutive mammals. Paleontologists generally, therefore, owe a debt of no inconsiderable gratitude to the ant in making known the wealth of small mammals and other diminutive vertebrates that inhabited the region in ancient times, and the Biblical injunction takes on a new significance.

Fibrous Plastic Masses.

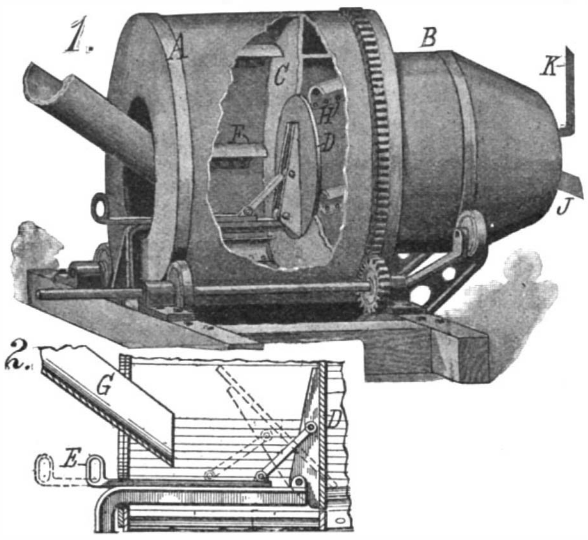
In Reif and Gonnermann's process (patented in Germany) for the production of plastic compositions of fibers of all sorts with oil, fats, and tar, the fibrous material is impregnated with alkalies and is then sprayed simultaneously with the tar, oil, etc., and with sulphur chloride, in order to secure uniformity of the mass, effect vulcanization and neutralize the hydrochloric acid set free in that process. In previous methods of combining fiber with tar and the like these binders were not chemically altered, so that it was necessary to knead the mass and also to subject it to a process of drying and hardening. In the new method the fibers are connected by thin layers of vulcanized material which require no further treatment. The alkali required to neutralize the acid formed in vulcanizing is applied to the fiber, because it would interfere with the spraying if it were mixed with the oil or the sulphur chloride, while neutralization of the composite mass, even if it could be effected, would come too late, as the fiber would already have been injured or destroyed by the acid.

A writer in a recent number of l'Industrie Electrique describes a method of using the wires of a power transmission line for establishing telegraphic communication between the generating plant and the sub-stations. By using an induction coil, which obtains its power from the transmission line, a local high-frequency current is generated, which may be superposed on the current in the power line, and thus affect instruments at the receiving station. It is not necessary to use two lines for a system of this sort, because the circuit can be completed through the ground.

Patent Department

CONCRETE MIXING MACHINE.

In the ordinary concrete mixers, wet cement is liable to collect on the inside of the mixing drum. Unless this is frequently scraped off, the caking of

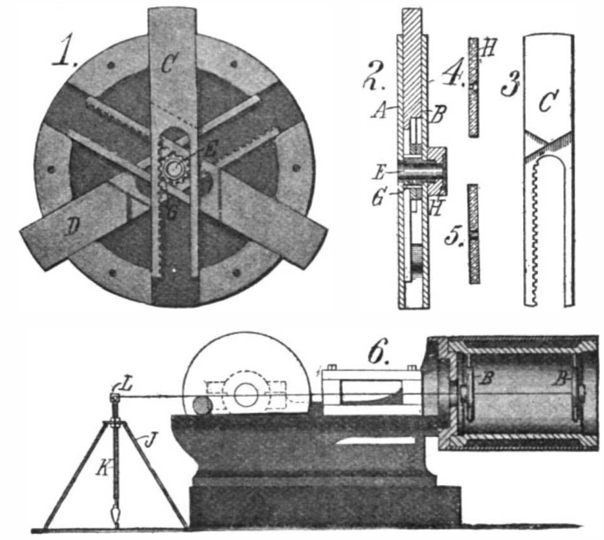


CONCRETE MIXING MACHINE.

the cement has the effect of contracting the capacity of the mixer, rendering it less efficient in operation, and causing some of the mixtures to be too poor in cement, while others contain a higher percentage of cement than desired, owing to the occasional breaking loose of a cake of the material. In the machine illustrated herewith, the aggregates are mixed dry, and during this mixing are widely scattered. But thereafter they are placed in a second drum, where the wetting takes place, and here they are confined as much as possible, so that the moisture is quickly and uniformly distributed. The dry mixing chamber of the machine is indicated at *A*, while the wet chamber, which is partly conical in form, is shown at *B*. In order to increase the strength of the construction, the chamber *B* is partly telescoped within the chamber *A*. A partition *C* separates the two chambers, and in this partition is a hinged gate *D*, connected by a link to an operating lever *E*. The drum *A* is formed with the usual gear ring, engaging a driving pinion, and is supported on rollers, so that it may be rotated by operating the pinion. Within the drum *A* is a series of buckets *F*, which pick up the material as it is introduced through the chute *G*, and thoroughly mix it. When the material has been sufficiently mixed, the gate *D* is lowered to the position indicated by dotted lines, when it acts as a chute to deliver the material into the second drum *B*. The latter is also formed with buckets which pick up the material and thoroughly mix it before it is delivered through the chute *J*. Water is introduced into this chamber through the pipe *K*. This cement mixer has been patented by Mr. A. G. Olsen, of Elkhorn, Wis.

ENGINE ALINER.

An improved device for lining up engines has recently been invented, which possesses a number of advantages over the ordinary device. It consists of two circular plates *A* and *B*, the plate *B* being formed with a flange in which recesses are cut to receive three radial members. These radial members are quite similar to each other, and each is formed with two oppositely-disposed parallel bars, one of which is provided with teeth adapted to engage a spur pinion mounted centrally in the disks *A* and *B*. By rotating this pinion, all three of the radial

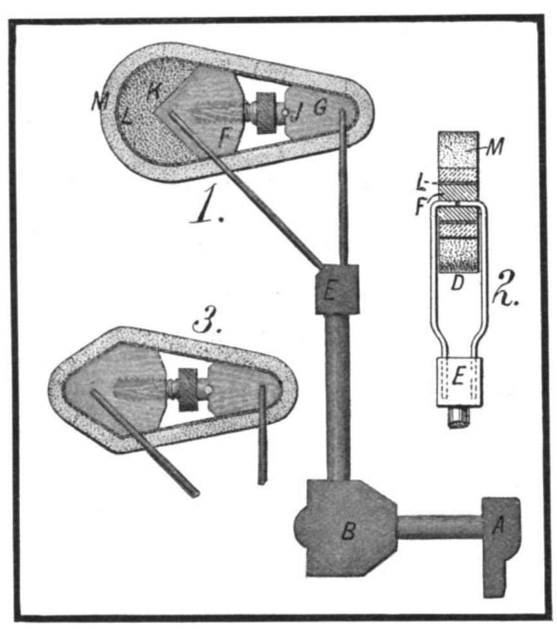


ENGINE ALINER.

members may be moved inward uniformly to center the device in the engine cylinder. A central opening is formed in the pinion, and this is covered by a glass plate *H*, in which is a central aperture. Two centering devices are commonly used when alining the engine, in one of which the glass disk is formed with an aperture such as shown in Fig. 5, while the glass disk of the other has a countersunk aperture, such as indicated in Fig. 4, to receive the knot of a cord. One of the figures shows how the apparatus is used. The cord knotted in one of the centering devices passes through the second centering device, and thence over a support *L* to a plumb bob, which holds it taut. The support *L* consists of a horizontal screw, which passes through the head of the vertical screw *K*, mounted in a tripod *J*. By operating these screws, the outer end of the cord may be adjusted horizontally or vertically, so that it will not touch the edges of the aperture in the glass of the second centering device. As the centering devices are provided with glass plates, the operator can look through them, and more readily direct the adjusting of the cord. The crankshaft is then adjusted to such a position that the cord crosses the wristpin half between the ends of the latter and across the center of the crankshaft. With the crankshaft supported in this position, the bearings may be rebabbitted, or otherwise adjusted to properly support the shaft. Mr. Oliver Gibbons, of Lookout, Cal., has been granted a patent on this engine aliner.

ADJUSTABLE HEAD FOR PIANO HAMMERS.

The piano hammer, which is illustrated in the accompanying engraving, is provided with a head, on which the felt strips are adjustable. The head of the hammer is resiliently supported on the shank, so as to permit of a quicker rebound than in the ordinary hammer. The hammer is formed with the usual back stop *A* and butt *B*, with a shank which supports the head *D*. The base *E* is mounted on the end of the shank and thence a pair of wire arms extend upward to a pair of blocks *F* and *G*, which are thus

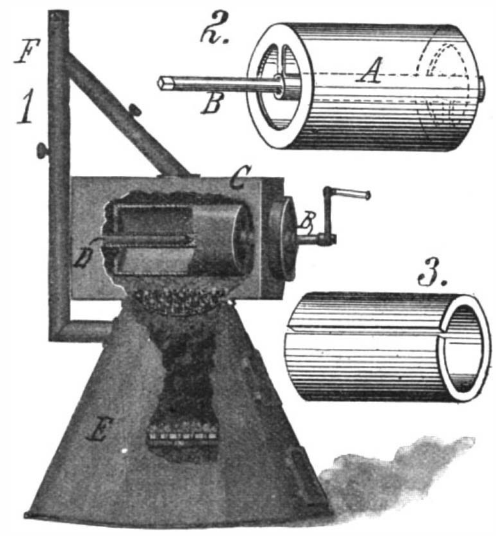


ADJUSTABLE HEAD FOR PIANO HAMMERS.

resiliently supported by the shank. Between these blocks a spreading screw is mounted, which is provided with a pin *J*, adapted to engage a depression in the block *G* to prevent the screw from turning after it has been set at the desired adjustment. The block *F* is formed with a V-shaped end over which a filler *K* of felt or suitable material is placed. Around the filler and the blocks is an endless felt strip preferably formed of an inner part *L* and an outer part *M*. By turning the screw the tension of the felt may be adjusted to any desired degree. When it is desirable to shift the felt, the screw is turned to loosen the tension, and it may then be moved to bring a fresh surface to the striking position. The wire members which support the blocks are bent inward at their upper end to engage perforations in blocks so that when it is desired to remove the head they can be made to release the blocks by merely spreading them apart. Fig. 3 shows a slightly modified form of the adjustable head. The inventor of this piano hammer is Mr. John W. E. Laker, Box 103, Victoria, B. C., Canada.

APPARATUS FOR TREATING RUBBER.

In preparing crude rubber from the juice of the rubber tree, the usual method is to dip a stick into the juice, and then hold it in a smudge, so that the smoke will coagulate the rubber in a thin layer on the stick. Layer upon layer is thus formed, until a large mass of the crude rubber is obtained. A machine for performing this work has recently been invented. The machine comprises a drum *A*, open at each end, but formed with flanges to retain the juice of the rubber tree when placed therein. The drum is formed with an axle *B*, on which is a crank to permit of rotating it during the process of coagulating the rubber. The drum is mounted within a smoke chamber *C*, being supported on a pivot rod *D*, that enters a hollow portion of the axle of the drum. The axle at the opposite end of the drum passes through a cap, which closes a large opening in one side of the smoke box. Below the smoke chamber *C* is a fire chamber *E* of frusto-conical form. The two chambers are separated by a screen, which supports a mass of pebbles and broken stone. The purpose of this screen is to prevent soot

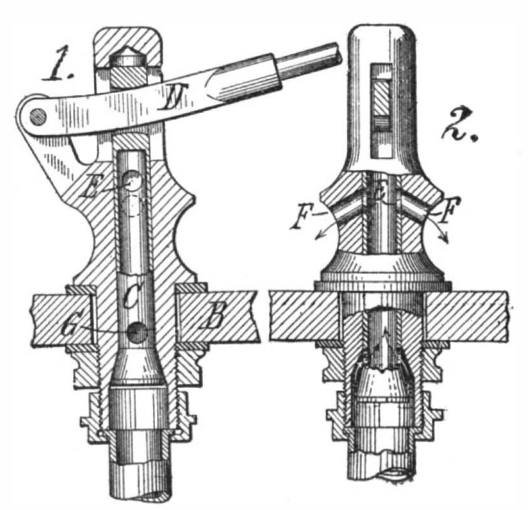


APPARATUS FOR TREATING RUBBER.

or ashes from passing upward and lodging in the rubber. A smoke pipe *F* is formed with two branches, one connecting with the smoke chamber *C*, and the other with the fire chamber *E*. In operation the drum is partly withdrawn from the smoke chamber, while its inner end is supported on the pivot rod *D*, and a quantity of the juice is poured into it. The drum is then moved back, and the smoke chamber is closed. Now, on operating the crank, the drum is revolved, and a thin layer is formed on the inner side of the drum. This layer gradually grows until the entire mass of rubber is coagulated. The dampers are then turned, to permit the smoke to pass up the chimney without going through the smoke chamber. The drum *A* can now be removed, and the mass of rubber taken out of the drum by cutting it lengthwise. The rubber thus formed will have the shape shown in Fig. 3. Mr. Enrique Molina, of 131 East 63rd Street, New York, is the inventor of this apparatus for treating rubber.

VALVE FOR FLUSH TANKS.

The valve which is illustrated herewith contains no gaskets or packing in its working parts, and hence is less liable to get out of order than the ordinary valve. The valve casing as indicated in the illustration, is fastened on the bottom *B* of the flush tank. The valve is formed with a stem *C*, which is adapted to slide vertically in the casing. Passing through an opening in the upper end of the stem is the float arm *D*, which is hinged to the casing and is provided at its opposite end with the customary float. The lower end of the stem is formed with a conical plug, constituting the valve proper, which is adapted to fit the conical valve seat, as indicated in Fig. 1. There are two pairs of openings, *E* and *G*, leading into a hollow portion of the valve stem. The upper pair *E* is adapted to register with a pair of ports *F* in the valve casing when the valve is depressed or opened, as shown in Fig. 2. When in this position, the water runs from the supply pipe, past the conical plug, through the ports *G*, into the hollow portion of the valve stem, and thence by way of openings *E* and ports *F* into the flush tank. It will be observed that the ports *F* are downwardly inclined, thus directing the streams of water downward, and preventing spattering over the sides of the tank. When the float arm *D* rises, the plug is seated, cutting off the supply of water. The



VALVE FOR FLUSH TANKS.

inventor of this improved valve is Mr. N. C. Walterthum, of 157 Hopkins Avenue, Jersey City, N. J.

THE GERMAN CROWN PRINCE AS AN INVENTOR.

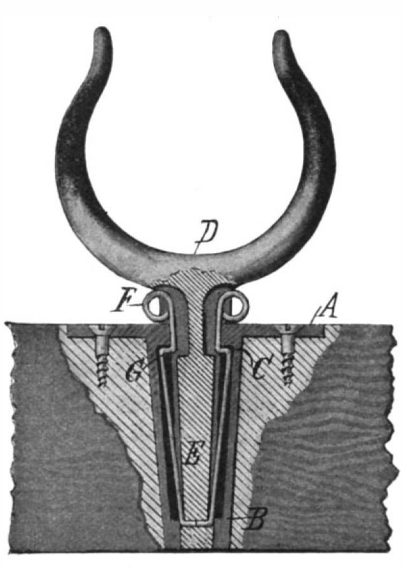
While there is nothing startlingly novel in the design of the cuff buttons shown in the accompanying engraving, yet they are interesting as the creation of a royal inventor. No less a person than the Crown Prince of Germany has originated this form of cuff button. The cuff buttons are of the link type, each link being formed with an eye to receive the crossbar of a short chain. While it is not the first time that one of royal

SLEEVE LINKS INVENTED BY THE GERMAN CROWN PRINCE.

blood has entered the ranks of inventors, it is not often that a royal personage has troubled to protect his invention with a patent. The Crown Prince of Germany has thought it worth while to apply for a patent on his cuff buttons, and has assigned the patent to the court jeweler, J. H. Werner, of Berlin.

IMPROVED OAR LOCK.

The accompanying engraving illustrates an oar lock of improved construction, which is provided with resilient means for fastening it to the gunwales of a boat. The construction is very simple. A plate *A* is secured by screws to the gunwale, and is formed with a depending socket piece *B*, which constitutes the keeper of the oar lock. The socket, which is tapered, is constricted at the upper end to provide an annular shoulder *C*. The oar lock proper is indicated at *D*, and is formed with the usual shank *E*, in which recesses are cut at opposite sides to receive a pair of springs *F*. The lower ends of the springs are bent inward, to engage an opening near the bottom of the stem *E*. The springs near their upper ends are bent to form shoulders, adapted to engage the shoulder *C* of the keeper. The recesses in the stem *E* are deepened near the upper end of the stem, as indicated at *G*, to make room for the springs *F*. When it is desired to remove the oar lock, the springs *F* are pressed inward to clear the shoulder *C*. When inserting the oar lock, the springs are automatically compressed until they snap out under the shoulder *C*. They then serve to hold the oar lock in its socket, and prevent it from being accidentally withdrawn. Mr. Charles



IMPROVED OAR LOCK.

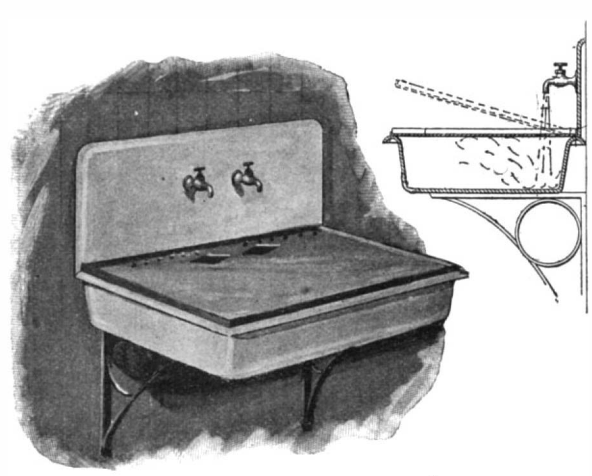
Bestman, of Friday Harbor, Wash., has received a patent on this improved oar lock.

RECIPROCITY IN PATENT LAWS.

The new tariff bill, now before the House of Representatives, contains a section which is most interesting to patentees. The section provides that the same patent regulations shall be applied to citizens of foreign countries as these countries apply to the citizens of the United States. This appears to be a retaliatory measure, and yet its purpose is not so much retaliation as reform. In nearly all European countries a penalty is imposed upon the owner of a patent for failure to manufacture within a certain period. In France the manufacture must be begun within three years after the date of filing the patent. In Germany the three-year term dates from the time of issue. England has just passed a law whereby a patent may be revoked if no serious attempt at manufacture is undertaken within four years of the date of issue. The United States, on the other hand, has stimulated invention by its liberal patent laws, and makes no restriction on the absolute monopoly granted to an inventor, whether he be native or alien. Thus a foreign patentee receives better treatment in this country than in his own, whereas citizens of the United States cannot secure the same advantages in foreign countries as they do at home. The status of foreign patentees is somewhat difficult to define. When an inventor discloses a secret, the patent rights he receives are granted as a reward by his country. The only purpose in granting such a reward is to stimulate invention, and work for the progress of the country. The difficulty, however, lies in the fact that when the secret is disclosed, the disclosure cannot be confined to one country, but is worldwide. The only advantage to a foreign country in granting a patent on an invention which has been patented here, is that we in our turn are willing to award the same rights to citizens of the foreign country. It would seem an injustice, then, for us to be granting a higher award to foreign citizens than they are granting to our citizens, particularly in view of the fact that no direct benefit is to be obtained from our award for a secret that has already been disclosed. The only solution of the difficulty would seem to be in reciprocity treaties with the various foreign countries. There is now a treaty pending, whereby Germany will agree to waive the three-year clause as far as it affects American inventors, in view of the fact that we are treating German inventors with such great liberality. The tariff provision should hasten the ratification of this treaty, and help to bring about similar treaties with other countries.

KITCHEN SINK COVER.

Pictured in the accompanying engraving is a cover for kitchen sinks, which serves as a support for the

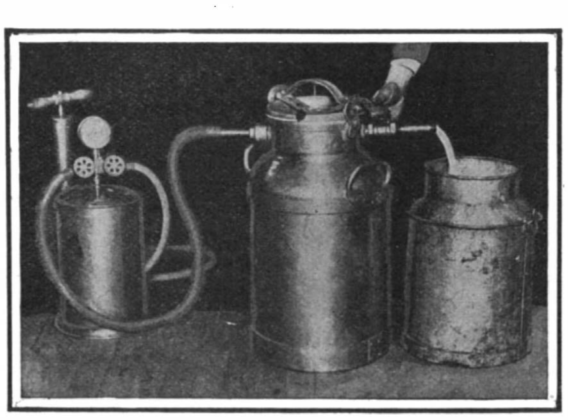


KITCHEN SINK COVER.

dish pan, and which is provided with openings to permit the water from the spigots to pass through. The cover thus serves as a temporary tray or shelf on which the utensils may be supported, and prevents the objectionable splashing of the ordinary sink. The inventor of this device has found that diamond-shaped openings in the cover are the best for permitting the water from the faucets to pass through. In case any water should splash out of the tray, it may readily be drained off by tilting it, as indicated in one of the illustrations, when the water will pass out through a series of small openings near the rear edge of the tray. It is claimed for this sink cover that it acts as a great saving of clothes, which are often soiled with water that splashes from the bottom of the sink while the faucets were running. This fact alone would be appreciated by the housewife who frequently has to be her own kitchen maid. Mr. Adam Giffen Demarest, of 216 West 26th Street, New York city, is the inventor of this sink cover.

PNEUMATIC MILK CAN.

A recent invention provides a milk can which may be filled at the dairy, hermetically sealed, and kept in this condition until the entire contents of the can



DRAWING MILK FROM THE PNEUMATIC CAN.

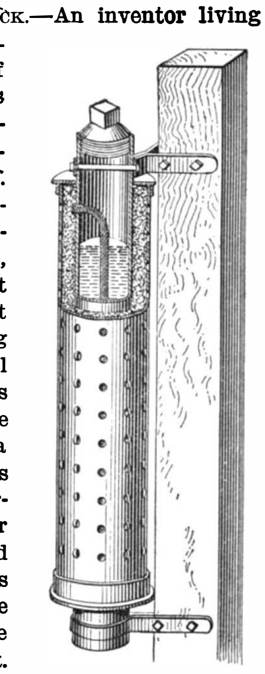
are removed at the place of sale. This result is effected by the use of compressed air in the can, which forces out the contents, as needed. The compressed air is sterilized, and everything about the milk is kept perfectly clean. There is no danger from contamina-

THE MILK CAN SEALED AND READY FOR SHIPMENT.

tion by exposure to dust and dirt or flies and other insects. It is impossible to change or adulterate the contents of the can in any way from the time it leaves the dairy until the contents have been placed in the consumers' hands. The can is locked, and no liquid can be pumped into it without breaking the lock and removing the cover. Whenever it is desired to draw off a certain amount of milk, it is merely necessary to turn a valve, when the liquid will be forced out by the air pressure in the can.

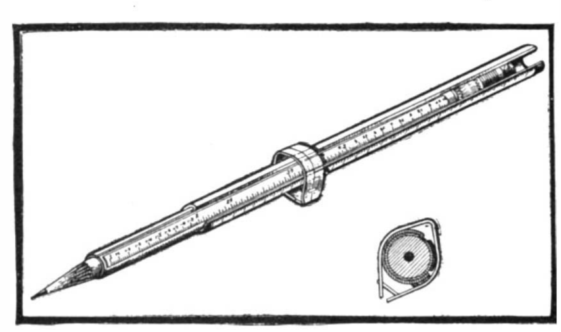
ODDITIES IN INVENTIONS.

Rubbing Post for Live Stock.—An inventor living in Nebraska has carried the automatic idea to the extent of enabling live stock themselves to apply insecticide, or soothing oils to parts that are irritated or affected by vermin. The invention consists of a rubbing post in which is a reservoir filled with the insecticide, and which may be placed at any suitable place convenient to the live stock. The rubbing post is formed with a central reservoir in which the oil is kept. Between this and the outer casing of the post is a felt-like filling. A wick serves to carry the oil from the reservoir to this filling. The outer casing of the post is perforated so that when the animal rubs against it the oil will exude from the perforations and be spread upon the affected part.



RUBBING POST FOR LIVE STOCK.

Calculating Rule and Pencil Holder.—For the benefit of the engineer and draftsman who is required to make hasty calculations, a combined pencil holder and calculating rule has recently been devised. The calculating rule is of tubular form, and is fitted with a slide indicator, formed in the shape of a cuff. One part of the tube comprising the rule is provided with a slide member, which is graduated and



CALCULATING RULE AND PENCIL HOLDER.

used in the manner of the ordinary slide of a calculating rule. Within the tube a pencil may be fitted. By thus combining the rule and pencil, the danger of mislaying the rule is avoided, and the combined instrument is of convenient form to carry in the vest pocket.

The annual production of nickel in Europe increased from 4,526 tons in 1900 to 7,600 tons in 1907. In America the production increased from 3,000 tons in 1900 to 6,500 tons in 1907. Of the European output in 1907, 3,200 tons were produced in England, 2,600 tons in Germany, and 1,800 tons in France.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

REMOVABLE RUBBER HEEL.—J. H. DEMPSEY, Cleveland, Ohio. The purpose of the inventor is to provide a construction for a rubber heel, which permits the easy attachment thereof to the heel of a shoe, and a removal of the rubber heel where desired, the improved features adapting the heel when mounted for service, to resist strain and prevent its accidental removal if struck against an obstacle.

Of Interest to Farmers.

PLANTER.—E. ST. AUBIN, Ganeer Township, Ill. The object of this invention is to provide a device for use in simultaneously planting three rows of corn, and arranged so that each of the planting devices will be at all times in engagement with the ground regardless of the inequalities in the surface thereof.

ADJUSTING DEVICE FOR GRAIN-DRILLS.—W. F. JACOBS, Okawville, Ill. The inventor's more particular object is to enable the operator to adjust the depth of the drill teeth, and consequently regulate the depth within the soil to which the seeds are carried. The invention relates to means whereby a number of related parts upon the same machine may all be moved in unison for purpose above indicated, thus saving a multiplicity of separate movements of various parts.

HARVESTER DEVICE.—W. L. GRIFFIN, Scottville, Mich. The invention relates more particularly to apparatus used in the harvesting of potatoes and other similar produce. It provides a device by means of which potatoes can be freed from the earth adhering to them, and by means of which the cleaned tubers can be easily and rapidly filled into receptacles therefor.

COTTON-SEED SEPARATOR.—J. T. COX, Monticello, Ga. This separator will effectively separate the large and select cotton seed from the small, faulty and undeveloped seed which should not be planted, as healthy plants cannot be grown from such poor seed and when it is intermingled with good seed, the good seed usually germinates first and impairs the development of the good plants.

CULTIVATOR.—A. BRIGDEN, Albertville, Ala. The cultivator comprises a plurality of cultivator hoes having points adapted to till the ground, the forward parts of the hoes being attached to two cross bars arranged substantially parallel and transversely of the implement. With one of this general construction there is a tendency of the teeth of the hoes to become broken at their point of attachment to the rear cross bar, which this invention prevents.

Of General Interest.

SYRINGE.—H. F. ONG, Portland, Ore. One purpose of this invention is to provide a compact syringe, one that can be conveniently carried upon the person and one in which the piston is provided with a chamber adapted to contain medical ingedients to be dissolved in the liquid to be injected.

COLUMN, GIRDER, AND THE LIKE.—J. W. MULDOON, New York, N. Y. The invention relates to improvements in reinforced concrete construction particularly adapted to the formation of columns, girders, walls, etc., and more particularly to that type described and claimed in Mr. Muldoon's previous patent. In this type he utilizes a metallic reinforcement of such a character that it serves the double purpose of holding the concrete in position while it is hardening, and serves as a reinforcement for the concrete after it has hardened.

SAFETY WINDOW CHAIR OR PLATFORM.—J. P. LUNDQUIST, Portland, Ore. The purpose of this invention is to provide a construction that will perfectly guard a person who occupies the same after sitting or standing, from falling off while at work outside of a window that is at an elevation from the ground, even if such person is faint or giddy.

HOISTING ATTACHMENT AND CORNICE-PROTECTOR.—J. H. MARVIN, Mount Vernon, N. Y. The invention relates more particularly to a device by means of which a fall and tackle can be suspended from a cornice of a building or the like, for hoisting heavy objects, the attachment being securely in position at the roof of the building, and being so formed that no injury results to the cornice in its use.

ANIMAL-TRAP.—W. M. KAISER, Berkeley, Cal. In this rat trap there is a receptacle around which are disposed run-ways serving as steps leading to a bait room, in which are pivoted trap doors held yieldingly substantially in horizontal position, there being an opening between the doors, and near the opening, and secured to the under side of one of the doors is a bait receptacle, holding water or acid. The trap is hooded which darkens the bait room and run-ways. At the bottom of the receptable there is a slide by which dead rats are removed.

SYRINGE.—J. R. HARRIS, Raton, New Mex. The syringe is for use in irrigating and cleansing the internal cavities of the body, and it consists in the construction and arrangement of a two-part syringe, with provision for separating the two members and means for introducing a double current of water and draining away the discharges.

Hardware.

DOOR-CATCH.—H. P. CONNOR, Englewood, N. J. In the present patent the invention relates to door catches, the inventor's more particular purpose being to produce a device of this character in which the locking of the latch has a positive relation to the pressure exerted by the door or other swinging member in opening.

SAFETY-RAZOR.—B. KIAM, New Orleans, La. One purpose of the invention is to provide a razor having a curved, flexible, detached blade and a guard to co-act with the blade and arranged to be clamped against the latter to straighten the same and thereby provide it with sufficient rigidity, and to permit its adjustment with respect to the guard.

ADJUSTABLE NUT-LOCK.—F. YOUNG, Denver, Colo. The object here is to provide a device which can be easily arranged on a bolt to hold a nut in place, and which is so constructed that, should it be necessary, it can be constantly adjusted as the objects that are held in place by the nut become loose through wear.

MERCHANDISE-HANGER.—S. S. WEAVER, Shelby, Ohio. The invention is adapted especially for displaying carpets, floor rugs, and such like articles, and is provided with nine arms, each arm supporting two floor rugs, or twenty-four samples of carpets. By tightening or loosening the nut the outer edges of the supports may be raised or lowered for use in adjusting them with respect to the bracket and to each other.

Heating and Lighting.

COMBINED LIQUID SEPARATOR AND INDICATOR FOR GAS-CONDUITS.—R. L. DEZENDORF, New York, N. Y. The improvements are in means for use in separating liquids from gases and indicating when the liquid has collected to such an extent as to prevent the free passage of the gas. The invention is particularly applicable for use in the delivery conduits for illuminating gas and may be utilized at any desired point along the delivery conduit.

COKE-OVEN.—J. F. DONAGHY, Charleroi, Pa. The invention is an improvement in coke ovens and particularly in the means for closing the ends of the oven. After the oven is charged and the doors closed, the opening between the upper edges of the top doors and the crown of the oven arch may be filled in as usual, the doors supporting such filling when the latter is applied.

Household Utilities.

CURTAIN-POLE.—J. B. PHINNEY, Tampa, Fla. In this case the invention is an improved curtain pole which is made telescopic and provided with a screw clamp whereby it is adapted to be secured to window frames of different widths, without the aid of screws, nails, or brackets, which are usually employed for the purpose.

CURTAIN-SUPPORTER.—L. NACHMANN, New York, N. Y. The invention refers to curtain supporters, the more particular purpose being to provide means for readily securing the curtain upon rings which may permanently encircle the curtain pole; the invention also making provision for stiffening the upper surface of the curtain so as to prevent the exposure of the pole and rings.

AIR-MOISTENER.—C. G. MCKENDRICK, Monroe, N. Y. The object of this invention is to provide a moistener for use in moistening the air in the room in which the steam radiator is located, the moistener being connected with the steam chamber of the radiator and arranged to allow steam to pass into the moistener and to be diffused by the same into the surrounding air, to moisten the same.

WATER-CLOSET-SEAT PROTECTOR.—G. F. THOMPSON, East Orange, N. J. The invention refers to means for protecting a closet seat from soiling or other contamination, and has for its object to provide an appliance for a seat, which affords convenient means for placing and holding taut a paper covering upon the seat, and also facilitates the substitution of a clean paper sheet for the one that has been used.

Machines and Mechanical Devices.

BUNDLE WIRING MACHINE.—J. PFEFFER, Spokane, Wash. This machine is to be used in fastening together by wire, bundles of small boards, such as are used in making boxes, and for fastening together shingles into bundles, and other similar uses. It may be used in subjecting a bundle of materials to pressure in order to get the same into compact condition and to hold it while the binding wire is being applied.

CABINET.—J. W. SCHAUER, Kalispell, Mont. The object of this invention is to provide a device which is provided with movable shelving for retaining articles, and which has means for rotating the shelving so that the articles can be successfully brought to register with an opening through which they can be removed, whereby a small opening only is necessary.

TRANSMISSION MECHANISM.—M. BOUCHET, 22 Rue Alphonse de Neuville, Paris, France. The object of the invention is a transmission movement, automatically modifying the speed of the driven member according to the force to be overcome, and serving at the same time to limit the transmitting force. The device is applicable to automobiles, and in an automobile provided with the device, the speed of the vehicle will be inversely proportioned to the resistance to be overcome.

BALING-PRESS.—J. C. DAMRON, Roanoke, Va. The present invention provides a machine adapted to be operated by power, such as horse-power or the like and to furnish tripping devices for automatically releasing the shifting and locking devices for the gear mechanism when the plunger reaches the end of its pressing stroke. It is an improvement on a former patent granted to Mr. Damron.

BALING-MACHINE.—C. E. MCLIN and J. S. BACHMAN, Rome, Ga. Guides are disposed on a table, some being connected through the table top by operating mechanism, a core being disposed in the ties, which are then doubled on themselves, transverse pins being secured to the upper terminals of some of the guides, between which the ties are disposed and by means of levers and links the guides disposed through the table top, are forced downwardly, pressing the ties between the pins and the table. The guides are held yieldingly upward, and held down independently of the levers and links.

Prime Movers and Their Accessories.

STEERING DEVICE FOR TRACTION-ENGINES.—A. HARROLD, Lima, Ohio. Mr. Harrold's invention is an improvement in steering devices for use on traction engines. When the plate is swung in one direction, the friction wheel on one side will engage the rim, thus rotating the drum in one direction, while a reverse movement of the plate will rotate the drum in the other direction. The shaft on which the wheels are mounted is provided with a cranked portion to which are attached the piston rods of the engine in the usual manner.

Railways and Their Accessories.

TIE-BAR FOR RAILWAY-RAILS.—J. H. CROWLEY, Duluth, Minn. This bar is preferably in the nature of a T-iron extending crosswise of the track with its face turned upwardly and abutting underneath the base flanges of the rails, and at each side of each rail it is provided with one or more fingers engaging over the rail flanges. These fingers on the inside of the rails prevent the rails from turning outwardly and the other pins insure that no spreading of the rails will take place.

DROP-DOOR STRUCTURE FOR CARS.—F. W. BRADLEY, McKees Rocks, Pa. The more particular object here is to provide a car body with swinging doors, that under certain conditions, when closed, the doors are by their own weight and by the weight of materials resting upon them, forced toward each other and thus prevented from opening, said doors being locked in this position to prevent their receding from each other in order to open, and also being locked independently of their pressure against each other.

Pertaining to Recreation.

AMUSEMENT-STEPS.—J. H. CROSS, Philadelphia, Pa. The apparatus is in the nature of steps, certain of which are adapted to sustain the weight of a person, and others designed to sink under slight pressure. These two types of steps, which are termed firm steps and yielding steps, are arranged in sections, and so distributed in a stairway that the same cannot be traversed or climbed over without taking a circuitous route, which route is adapted to be changed by the unlocking or locking of certain of the yielding steps.

FISH-HOOK.—C. M. WILLIS, Austin, Texas. The invention refers to a hook wherein duplicate hooks are provided that are spaced apart by the pull of a fish on the line. The improvement adapts the hook for reliable service, and positively insures the divergence of the hook members upon the application of draft strain.

AMUSEMENT APPARATUS.—B. J. SAGEHOMME, New York, N. Y. The invention may be defined as consisting of tracks, each track composed of a series of reverse curves regularly arranged about a common central axis, with the tracks intersecting at the points of change of curvature, and the sets of cars simultaneously movable over the tracks in opposite directions.

Pertaining to Vehicles.

SLEIGH-RUNNER.—W. E. TURNER, Escanaba, Mich. The runners are in the nature of I-beams, each having a knee applied thereto provided with opposed jaws, with the beam of the sleigh provided with approximately semi-circular grooves near each end and at both sides, receiving the jaws of the respective knees, which admit of a slight relative endwise movement of the runners and thus relieve the connections of the bench of undue shock.

Designs.

DESIGN FOR A PLATE OR PLATTER.—L. ROUQUART, New York, N. Y. This ornamental design shows a circular form of plate. The rim rises from the bottom of the plate slightly fluted up to near the edge which latter is embellished with a scroll border of beautiful design.

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.

Notes and Queries.

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12025) J. L. asks: Kindly state in your paper what meerschaum is, and if it was ever sea foam in any form? A. Meerschaum is a hydrated silicate of magnesia which occurs in veins and nodules, principally in Asia Minor. It has nothing whatever to do with the sea as regards its formation, and owes its name to an imaginary resemblance of some of the nodules in which it occurs to sea foam. It is occasionally found floating in the Black Sea, freed from its matrix, being lighter than water, which may be a further derivation of its name.

(12026) J. H. asks: What is the consensus of authority and scientific opinion on the true value and usefulness of lightning rods as a means of protecting buildings from strokes of lightning? Do they afford real protection? Are they worth what they cost, in preventing fire? Doubtless you know how opinions differ on this subject. Many people declare that lightning rods are worse than useless; they actually invite danger. Others contend that they are as necessary as fire insurance in every well-regulated establishment. A. We are of the opinion that lightning rods are a distinct advantage to a building in the open country and in thinly built portions of a city; also upon tall spires and chimneys in any part of a city. The method of protection to be employed has been many times discussed in our paper. You will find a note in the Queries column of our issue, Vol. 99, No. 16, October 17th, 1908, which you must have on file. The Weather Bureau publications named therein will be a sufficient guide to you. Lightning rods not only greatly reduce the damage to the building upon which they are used when struck by lightning, but actually decrease the liability of disruptive discharges of atmospheric electricity occurring at all when they are present in quantity. The town of Johannesburg is a notable example: electric storms were so frequent there and the resulting damage so great that nearly every building in the town was protected by lightning rods. Now lightning in the common sense of the term is most rare there, the formerly common electric storms being dissipated by brush discharges on the forest of lightning conductors.

(12027) A. K. S. asks: Take (for illustration) one cubic foot, v, of hydrogen gas at 32 deg. F., t, under a pressure, p, of one atmosphere. It will weigh, w, approximately 0.0056 of a pound. Let P remain constant and t —273 deg. C. or absolute zero. Then $V = 0$, by contraction, for nothing has been taken away excepting heat. Heat has no weight, therefore w remains 0.0056 pound, but $V = 0$, accordingly $W = 0$. What is wrong, the assumption that $V = 0$ at —273 deg. C., or that when $V = 0$, $W = 0$, or do the conditions existing in the theoretical state of absolute zero counteract one another? A. Your difficulty with absolute zero is simply a logical one. What you require is to state the conditions more clearly. The law of contraction of a gas upon which the absolute zero depends is true of gases; it is not true of liquids or of solids. So long as hydrogen is a gas it will contract in the ratio of 1/273 of its volume for a loss of 1 deg. C., but when it approaches its temperature of liquefaction it is no longer a gas but a vapor and no longer obeys Boyle's law nor the law of contraction. Neither will it do so after it liquefies. The proper statement with which to start the discussion is, if conditions remained the same, at —273 deg. C. the volume would be zero, and all heat would be gone. We do not see any contradiction in the matter excepting the pressing of the logic too far. What is true of a gas is not necessarily true of a liquid or a solid.

(12028) H. W. A. asks: 1. How many volts and amperes should a continuous current dynamo give to ignite a three-horse-power stationary gasoline engine? A. The current for electrical ignition of gas engines varies from 6 to 14 volts, and from 4 to 2 amperes. Perhaps one may go beyond these limits. You can get a good ignition dynamo from the Holzer-Cabot Company, Boston, Mass., or from the Dayton Electrical Company, Dayton, Ohio. 2. What difference, if any, is there between the construction of a continuous-current motor and dynamo, volts and amperes the same in each machine? A. There is no electrical difference between a dynamo and a motor. Such differences as are to be seen are due to the nature of the service to be performed by each. 3. How is the gage of sheet iron arrived at? Has it any reference to the B. & S. wire gage? A. There is much confusion in the gaging of sheet metal. It may be specified in thousandths of an inch, and this is at present the best way. The American or Brown & Sharpe gage is the same for wire or for sheet metal and is sometimes used, but it differs from the U. S. standard gage which has been the legal standard for sheet metal since 1893.

(12029) C. E. P. asks: Will you kindly answer the following questions? 1. I have an induction coil of the Collins type. The core is 1½ x 14 inches. Primary consists of two layers or sections of No. 12 D. C. C. wire. There are 200 turns. Secondary consists of 10 pounds No. 30 D. C. C. wire. The coil is supposed to give 4-inch spark. Independent interrupter is used. Can I use battery energy to operate such a coil? Please state number of cells, and the volts and amperes that are necessary. A. Try four or six good cells of bichromate battery for your coil. You may need to vary the number as the cells become exhausted, or to vary the area of plates immersed when the cells are fresh. For this purpose the plunging form of bichromate battery is best. One is given in full detail in our Supplement No. 792, price ten cents. Next to this probably would be the Edison primary battery, of which you will require more cells; perhaps eight will answer. 2. If water has a great resistance for electricity, why is it that a wet floor conducts better than a dry one? A. The water which is on a floor is not water, but a solution of any substances which may be on the floor also. Dirty water may be a fair conductor of electricity; pure distilled water is not to be classed with conductors. Any substance which can form ions in water will increase the conductivity of the solution.

(12030) P. E. G. asks: A question has arisen, does an ox push or pull? Please give me your opinion on this question, also several reasons for same. A. The answer to your question depends entirely upon the sense of the words "push" and "pull." The ox leans against his yoke and thereby pulls forward the plow or other load attached to it; a horse can pull in no other way, i. e., only by pushing with his shoulders against his collar or breast plate. A man in an approximately vertical position can pull no more than his weight; in a tug-of-war he pulls no more than he pushes against the ground with his feet. Standing above a weight he can lift a good deal more than his own weight, but still no more than he pushes against the ground with his feet; action and reaction are equal and opposite, and there is practically no pull without a corresponding push.

(12031) J. A. C. asks: Kindly tell me whether or not helium has been liquefied. If so, when and by whom? A. The liquefaction of helium was described in the Scientific American, vol. 99, page 59, and in the Supplement, vol. 66, page 186. It was liquefied by Prof. Onnes, of Leyden, Holland. To accomplish the result, gaseous helium was expanded from 200 to 40 atmospheres, having been previously reduced to about 15 deg. absolute. The temperature of the liquid was 4.5 deg. absolute. Its freezing point is below 3 deg. absolute.

(12032) A. R. asks: Suppose a boiler say 12 inches diameter by 48 inches long be filled with water, filled absolutely full, so that there would not be even an air bubble, and then a screw plug put in the opening so that the water would be compressed (if such is possible), and under such condition there would be no room for steam? The boiler is supposed to have stood a test of 300 pounds to the inch. Now a fire is built under the boiler, and the water reaches the boiling point (212 deg). Can it be made hotter, there being no room for steam? What would be the result? A. The force exerted by the expansion of water due to heat in a boiler under the conditions you describe would be enormous, being equal to that which would be required to bring the expanded liquid back to its original volume. Water expands 0.00043 of its volume in being heated from 212 deg. to 213 deg.; it is almost incompressible, being compressed only 0.0000036 of its volume for every pound of pressure. The pressure would therefore be increased by nearly 117 pounds for every degree through which the temperature was raised, neglecting expansion of the boiler.

(12033) Seattle asks: What is the longest board, one foot wide and sawed off square at each end, that can be put on the floor of a room 10 feet long and 8 feet wide? A. Your problem is one partly of geometry and partly of arithmetic. The longest line which can be drawn in a 10 x 8-foot room is the diagonal, the length of which is the square root of the sum of the squares of the sides = $\sqrt{10^2+8^2}=\sqrt{164}=12.8=12$ feet 9⅝ inches nearly (9 39/64 inches). The ends of the board being cut off square, the length of the board will be shorter than the above by the height of a small triangle at the two opposite corners of the room. That triangle is similar to the triangles into which the diagonal divides the room, two of its sides being the same lines and its hypotenuse being at right angles to theirs. Its hypotenuse is the end of the board, 12 inches long, and one side. One angle and the proportions of the other sides and angles being known, the length of its other sides can be computed. So can the length of a perpendicular dropped from its right angle onto its hypotenuse, and this perpendicular is the amount by which the longest board which can be laid in the room is shorter at each end than the diagonal. The length of that perpendicular for your case is nearly 5¾ inches; so that the longest board 12 inches wide with square ends which can be laid diagonally across a 10 x 8-foot room is therefore 12 feet 9⅝ inches — 11½ inches = 11 feet 10⅛ inches. [As you do not give your name, we can only reply through this column.—Ed.]

(12034) N. T. W. asks: Do you publish a Supplement giving instructions for rewinding the dynamo described in Supplement No. 600, or rewinding the armature, so that it will develop a current of 110 or 115 volts? If so, I would like to secure it; and if not, I would like to be advised concerning the practicability of doing this. A. If you wish to alter or modify the dynamo of Supplement No. 600, you had better get the Scientific American, vol. 85, Nos. 1 and 7, price ten cents each, and take note of Queries 8250 and 8316, in which you will find how others have made alterations which are improvements in the machine. The wooden sleeve on the shaft and the paper washers are a very decided disadvantage to the generating power of the machine. They were in general use when the machine was designed, but have been abandoned long ago. The winding data for 110 volts with the core and field, as in the Supplement No. 600, are as follows: Field of No. 23, cotton-covered magnet wire, 3,640 turns, about 14 pounds; armature, No. 22 wire, 24 coils of 25 turns each. A field resistance of about 200 ohms will be required.

(12035) C. C. C. asks: Will you please decide this argument? Does the steam going into the cylinder of a locomotive engine when it is going forward drive the piston back? I claim it drives the engine ahead by forcing up against the cylinder. On a stationary engine the steam drives the piston forward and back, but not on a locomotive when it is going ahead. I claim the motion of a piston on a locomotive is only forward when the engine moves forward, making the piston apparently stand still, then the piston shoots forward again, and so on. A. The steam pressure in a locomotive cylinder acts equally upon the head and upon the piston, but the piston moves relatively to the engine, whereas the cylinder head does not. It is true that if the length of the stroke is less than the hemi-circumference of the driver (which it almost invariably is) the piston never moves backward relatively to the rails when the engine moves forward, but it moves relatively to the engine. The common argument as to whether a locomotive piston moves backward or not is entirely a question of whether the motion is relative to the engine or to the rails, but your view is not completely correct in either case. If the engine were pushed forward by the pressure of the steam against the cylinder head as you suggest, without motion of the piston relatively to the rails, the engine would go forward by the length of one stroke of the piston if the throttle were opened at the beginning of the backward stroke while the drive wheel was fastened down to the rail, which is of course impossible.

(12036) A. E. H. asks: I am interested in electroplating flowers, etc., and have had considerable success in coppering and silvering, using no wax. Now I want to permanently color these copper flowers various shades. 1. Would dyes dissolved in clear shellac or other varnish be practicable? A. Copper may be coated with any desired color of lacquer and so given a luster and finish. All sorts of lacquers are described in the "Scientific American Cyclopedia of Receipts," which we will send for $5. 2. How can I oxidize copper quickly? A. Copper and brass are oxidized by the same methods, since it is chiefly the copper in the brass which gives the color to the oxidized brass. A great many methods are to be found in the "Cyclopedia of Receipts." One formula is 2 ounces nitrate of iron and 2 ounces hyposulphite of soda in a pint of water. Dip till the desired color is produced, wash, dry, and burnish. 3. What colors can I simply get on copper chemically? A. Anything from green to black may be produced upon copper by chemical action. 4. Can I oxidize clean copper in oxygen to get the deep copper red, or would some chemical solution be better? I have formulæ for coloring brass, but not for copper. A. You cannot oxidize copper by the direct action of oxygen in the form of a gas. Oxygen acts with extreme slowness upon copper in the air. 5. How is the coloring done on the jewelers' hatpin roses? A. Articles of copper are colored by some one of the processes referred to above. We doubt that any new or secret ways of doing this work are known. 6. Kindly suggest all the coloring processes you can. I hope this may interest your readers of Notes and Queries. A. We cannot write out receipts which are already in print in our book, which we sell. It would cost more for us to get them copied than the book will cost you.

(12037) H. R. T. asks: 1. How much loss is there in compressing air to lift water from artesian or deep well, say with a lift of 40 to 80 feet, over raising it direct with a centrifugal pump of best designs? A. The losses in pumping with compressed air vary considerably with conditions, principally depth and consequent air pressure required. but as there is already a loss in converting steam or other power into compressed air power, there should be a saving in applying the same power directly to pumps. 2. Is a centrifugal pump as economical as a plunger pump for raising water from 40 to 80 feet in large quantities for irrigation purposes? A. The efficiency of centrifugal pumps is generally higher than that of plunger pumps, that is to say, direct-acting steam plunger pumps, which we suppose you mean, especially where conditions facilitate condensation in the steam pipes leading to the pump. The only disadvantage of centrifugal pumps is the difficulty of maintaining the proper alignment of their shafts when the latter are vertical and of great length. If properly set up and carefully watched they are very efficient, and for such a lift as you mention they should not present the above difficulties. 3. In raising water with any pump, how large should the delivery pipe be to deliver 2,000 gallons per minute say 50 feet vertical? A. The larger the discharge pipe, the easier the work for the pump; for 2,000 gallons a minute the discharge should not be less than 8 inches, and had better be 10 inches. 4. How fast should water be moved through pipes to do it in the right or most economical way? A. The speed of the water through the pipe for a given quantity discharged varies inversely as the square of the diameter, i. e., 2,000 gallons per minute discharging through a 12-inch pipe would have to travel four times as fast to be discharged through a 6-inch pipe. Beyond a speed of 400 feet per minute friction increases rapidly. 5. Would it be economical to put in an electric plant and transmit the power about ten miles and pump wells against a single plant for each well? These wells would be run about three months each year, and my idea is to install a steam plant on the railroad and generate a current and use a motor of about 12 to 20 horse-power at each well. There would be at least a hundred wells I could pump, and each well waters one hundred acres of land, and the owners would pay $5 per acre per year for this work. A. For such a system of well pumps as you describe, a central station distributing electric power to each well would be much cheaper than an individual power plant for each well in first cost of installation, and you would effect a much greater economy in cost of operation by the former means. Large boilers are always more efficient than small, other things being equal, and the economy in fuel alone of generating the total power required at one central station as compared with its generation at one hundred individual stations would go far toward paying for the plant in the first year. Centrifugal pumps, efficient for the depths you mention, are admirably suited for being driven electrically, and by means of high-voltage alternating current (locally transformed by simple automatic apparatus to a safe low voltage if desired) you can distribute any quantity of power over a radius of 10 miles with almost no loss and comparatively low first cost of conductors. 6. Please give me your opinion on this and the raising water problem and oblige me very much. A. One hundred wells watering 100 acres each at $5 an acre—$50,000—sounds like a very remunerative investment. If you have not already done so, we should advise your having made a pulsometer test of the capacity of the various wells before guaranteeing a delivery of 2,000 gallons per minute from them.

(12038) P. R. F. asks: To decide an argument, will you kindly answer the following question through the columns of your paper? Will a perfectly solid or solidified chunk of lead, of its own weight, reach bottom of the ocean at the deepest depth? A. It is very commonly supposed that at great depths in the sea iron ships and similar weights sink no farther because of the pressure, and no superstition is more erroneous. The pressure at great depths is enormous, but water is so nearly incompressible that its density increases almost not at all. At a depth of one mile the density of water is increased less than one per cent, and lead is more than ten times as heavy as water of that density. If a well could be sunk to the center of the earth and filled with water, your piece of lead would go to the bottom with no appreciable diminution of the rate at which it sinks in 10 feet of water by acceleration due to gravity. Further than that, there is no conceivable depth at which lead (or iron or any high specific gravity material) would not sink in water, because it is as compressible as the water or more so, and its density would be proportionately increased.

(12039) J. M. M. asks: Tests made in a furnace-heated house show the air to be dry. A simple hygrometer was used, possibly not very accurate, but near enough for the purpose. The instrument used shows the variations in moisture by the coiling and uncoiling of a spiral formed of some substance easily affected by dampness. A pointer attached moves on a scale, which is intended to indicate the percentage of moisture in the air, and is divided as follows: 100 full saturation, 80 moist, 65 normal, 40 dry, 20 very dry, 0 absolutely dry. In the trials referred to, on a mild day with considerable moisture in the outside air, the pointer would remain about 20 or 25. On a cold dry day, when a brisk fire was needed, it would go to 0. The air from outside, already at a low moisture point in cold clear weather, is by passing through the furnace raised in temperature from 40 to 60 degrees, or more, with no opportunity of taking up the water it would naturally contain at the higher temperature. By many persons such extreme dryness, combined with high temperature, is thought to be detrimental to health, causing colds, throat troubles, etc. One noticeable effect is that a much higher temperature is needed to produce a comfortable feeling of warmth, than would otherwise be required. With plenty of moisture a room will feel comfortable fully ten degrees lower than with very dry air. The small water tanks sometimes attached to furnaces seem to have slight if any effect, not sufficient moisture being taken up by the moving current of air to produce any noticeable difference on the hygrometer. One point in favor of the furnace, however, is that it brings into the house a constant supply of fresh air. A. We published a valuable series of articles on this subject in Supplement Nos. 325, 6, 7, 8, 9. a shorter article devoted more especially to hot-air heating in No. 213, and another on healthful temperature and humidity in No. 1337, with reference to schools, where of course the conditions for growing children are most important. There is nothing unwholesome in dry air, *per se*; you hit the nail on the head when you speak of the air *feeling* warmer with more moisture. The unwholesome part of dry air is that it is not so sensibly hot, and that consequently people remain in a temperature much higher than they are conscious of, and are more liable to chill by change of temperature on going out, The air will always have a natural and therefore healthful amount of moisture if the fresh air duct to the furnace is properly proportioned and kept wide open. The trouble is that many persons think they are not getting enough heat unless the air coming from the "register" (a senseless term, but commonly used) is sensibly hot, and close up the fresh-air duct, thereby restricting the inflow of naturally moist air, so that what is delivered to the rooms is unduly dried. The air will not rise in the pipes at all unless it is warmer than that of the rooms, which is to say sufficiently warm (except in the rare case of a strong wind blowing directly into the fresh-air intake) and the simple practical way to provide sufficient moisture for health is to have an amply large fresh-air intake open to the south or southwest side of the house and to keep it wide open. We cannot express an opinion as to the best system, as circumstances alter cases and the systems are many and various.

(12040) A. S. L. writes: During the snowstorm of last Sunday, the thermometer ranging from 10 deg. to 12 deg. F. above, the snow changed to hail, and rain also fell at this temperature. Notwithstanding that this appears contrary to nature's laws, it is a fact that can be attested to by witnesses that rain fell with the temperature from 10 deg. to 12 deg. F. A. The falling of rain when the thermometer was below freezing showed that the temperature of the cloud above the earth from which the rain came was higher than the freezing point. Hail is frozen rain drops and not crystallized frozen moisture, as are snow flakes. Hail probably started from the cloud as rain and froze in the air. When it is warmer at a higher point in the air, it is called an inversion of temperature. For examples see Davis's "Meteorology," which we send for $2.50.

(12041) B. M. asks: A certain problem is now confronting me, and in a last effort I appeal to you for information. I am about to build a handsome theater to be known as the "Aquarium." On either side of the lobby will be two large glass tanks containing fish of all descriptions. I would like to devote one to deep-sea or salt-water fish, and there is the obstacle of the salt water; and the information I would like to obtain is, will they live in artificially-made salt water? If they will, what should be the proportion of sea salt to water? I have been told that at St. Louis during the Exhibition they had a large collection of deep-sea fish in tanks. How did they get the salt water? A. The experiment of using artificial sea water has been tried in the government aquarium controlled by the Fish Commission, in Washington, D. C., but without success. The best Turk Island salt was employed, and great care was taken that the artificial water should have the same density or degree of saltness as sea water itself. The fish did not thrive, and some valuable ones were lost. It is not known what element sea water possesses that the artificial water lacks, but the result indicates that some necessary element is not crystallized into the salt. Since that test, the Fish Commission has used natural sea water, which was brought from the ocean in tanks. A circulating pump is used, by which the water is continually being taken out of, and forced back into, the tank, passing on the way through a filter which removes the foreign matter and makes the water pure and clear. Air is required to be forced in continually. This is done in two ways. One method is to allow a small stream of water to fall from a height of a few feet, say two to four or five feet, and, in entering the tank, the falling stream carries with it considerable air. This, however, is not generally enough, and artificial aeration is produced by forcing a current of air into the bottom of the tanks through a finely apertured nozzle. For this purpose, a plug of some form of porous wood, such as rattan, is employed, the plug being inserted in the mouth of the air pipe where it enters the tank. You will of course be able to obtain natural sea water without difficulty, and by a circulating pump and an air pump you will easily be able to preserve fish. Since, however, a considerable expense is incurred in purchasing and using an air pump, we suggest that it is possible an efficient substitute might be provided by introducing a series of small pipes into the current of water that is circulated through the tanks, particularly if at some point the current be sent through a single pipe of quite small diameter, so that the current will have a considerable velocity. By curving the ends or nozzles of the small air pipes so that they will lie in the direction of flow of the current, air would be drawn in, and would of course mingle with the water flowing through the tank. We make this as a suggestion simply.

(12042) H. A. E. asks: Will you please tell me the meaning of gage in wire and sheet metal, as 14 gage, 22 gage, etc.? Also the meaning of 10 ounces, 14 ounces, 20 ounces, etc., in regard to sheet copper? A. There is in this country no uniform or standard gage, the same numbers representing different thicknesses of wire or plate in different gages, of which the commonest are the American or Brown & Sharpe (B. & S.), the Roebling or Washburn & Moen, the Birmingham (B.W.G.), and the British Imperial Standard. In 1893 a United States standard gage for iron and steel was established by act of Congress, based on the fact that a cubic foot of iron weighs 480 pounds, a sheet 1 foot square and an inch thick weighing 40 pounds, or 640 ounces, so that a sheet of that size weighing one ounce should be 1/640 of an inch thick, the distinguishing numbers representing a certain number of ounces in weight per square foot and the same number of 640ths of an inch in thickness. Unfortunately, however, there is only an arbitrary relation between the gage numbers and the thicknesses; thus, No. 16 gage sheet weighs 40 ounces to the foot and is 40/640 thick, which happens to be 1/16, but No. 5 gage weighs 140 ounces to the square foot and is 140/640 or 7/32 inch thick, which has no relation to 5, and No. 31 gage, 7 ounces to the foot and 7/640 thick, has no relation to 31. This well-intended measure only added to the existing confusion, although it differs but little from previously existing gages, as shown by the following figures, the thickness of a sheet or wire corresponding to the same number by the different gages being shown in decimals of an inch.

Gage.	B.W.G.	B. & S.	Roebling.	British.	U. S. Standard.
1	0.3	0.289	0.283	0.3	0.281
3	0.259	0.229	0.244	0.252	0.25
9	0.148	0.114	0.148	0.144	0.156
20	0.035	0.031	0.035	0.036	0.037

A joint committee of the American Society of Mechanical Engineers and the Railway Master Mechanics' Association recommends, as a remedy to the existing confusion, the adoption of a decimal gage in which "0.25 gage" can mean nothing but a thickness of 25/1,00 or 1/4 of an inch, and "0.06 gage" nothing but 6/1,00. of an inch, or 1/16 nearly. This has already been adopted by many manufacturers.

(12043) J. S. asks: Is it possible for the temperature to be twice, or any number of times, as warm or cold as any specified degree of temperature? Can this be measured or computed? For instance, how cold is twice as cold as 0 deg. F.? A. In terms of degrees of the Fahrenheit or any other scale, reckoning from the zero point, the question has no answer and no meaning whatever. Degrees of the scale of any thermometer are not to be compared by multiplication or division, excepting those of the absolute scale. This is reckoned from the absolute zero, which is 459 deg. below the Fahrenheit zero. Half as hot as 0 deg. is then — 229.5 deg. absolute F.

(12044) A. T. G. A. writes: In your issue of October 3rd, 1908, T. B., No. 10867, asks why the days and nights are not equal on the days the sun crosses the celestial equator. I have for many years been impressed with the care, patience, and directness of your answers to the many inquiries. It has been the most interesting column of the paper to me. In this one particular case, however, may I suggest you do not include the main reason for the discrepancy? In some almanacs the time of sunrise and sunset is computed for the instant the first glimpse (or the last) of the sun's disk would be seen on the true horizon. Allowance is made for the semi-diameter of the sun and for the refraction of the atmosphere. This would cause the sun to appear a few minutes earlier in the morning and to be seen a few minutes longer in the evening, making the day (sometimes) 8 or 9 minutes longer than it would otherwise be. When this happens during the time of lengthening days (as in March) it would cause the equal days and nights to come earlier, and to come later in September. The matter of semi-diameter and refraction is not taken into account by all almanac computers, some giving the moment when the center of the sun would be on the horizon if there were no atmosphere. In such almanacs the equal days and nights come exactly on the days of spring and autumnal equinox, but only theoretically so. The equation of time would have the effect only of transferring the time of both sunrise and sunset earlier or later, as the case might be, and so would have no effect upon the length of the time of daylight. There would, of course, be a slight effect due to the change in the equation of time between sunrise and sunset, but that would scarcely amount to as much as one minute. Pardon my "butting in" in this matter. My appreciation of the uniform accuracy of your answers in all other cases causes me to feel you will understand the spirit in which this correction is sent. A. We appreciate the substance as well as the spirit of the correction. Our readers will find this matter fully discussed in Todd's New Astronomy, under the topic "Sunrise and Sunset." We send the book for $1.50 postpaid. An almanac should give the moment when the last ray of the sun is seen on the horizon as the time of sunset, and the first ray as the time of sunrise. What all almanacs do give we are not able to say.

(12045) S. B. asks: Will you kindly inform me through the columns of the SCIENTIFIC AMERICAN what the corrosive and electrical resistance of aluminium is, as compared to brass, copper, and tin? A. The specific electrical resistance of the metals you name is as follows: Aluminium 2.98, copper 1.59, tin 13.1, and brass, containing 66 parts copper and 34 parts tin, is 6.3. If you wish to have the data more exactly, we would refer you to Foster's "Electrical Engineer's Pocket Book," pages 134 to 140. We send the book for $5. If by "corrosive resistance" you mean the resistance to the action of acids, etc., we would say that aluminium is acted upon more slowly than any of the others by most chemicals, and tin would be placed next to aluminium, while copper would probably be acted upon more than brass for the above reason by most corrosive chemicals. No figures can be given for any general statement of this sort. Figures would differ for each chemical tested.

(12046) Dr. V. D. B. asks: Will you kindly let me know who was the first engineer that introduced structural steel in the construction of buildings? A. We should say that it would be most difficult, if possible, to answer your question positively. If you refer strictly to steel in the technical sense, its use must be comparatively modern, but the transition from iron to steel in buildings must have been as gradual as it is vaguely defined in manufacture of the metal. There are many iron bridges in Europe more than a century old, one of the oldest being that over the Severn, built in 1776. Possibly you do not use the term "buildings" in a sense to include bridges, but iron could hardly have been used for such a purpose long before its introduction in roof trusses for large spans. That use was commonplace before the introduction of railways, the earliest termini in Europe being so roofed, and we should say that the use of iron imbedded in or in conjunction with masonry would date back a century or more. An article in one of our early SUPPLEMENTS, May 12th, 1877, abstracted from a paper read before one of the engineering societies, refers to the imbedding of iron in masonry as "too old to be patented," even then, which means that it must be more than a century old.

(12047) L. E. B. says: There seems to be a common belief among barbers that a razor after much usage becomes tired. That is, the razor will not keep in condition with the care usually given it. After it is laid away to rest it seems to become all right again. If this is true, what are the causes, and is there any remedy besides the rest cure? A. The only scientific explanation of the benefit of "rest cure" for razors is that honing, and more particularly constant stropping, tend to increase the smoothness of the edge; and whereas this is an advantage within certain limits, the best cutting edge of a razor looks under a microscope like a saw, the better the steel and the edge the more regular the "teeth," and in correct shaving the operation is that of sawing and not slicing off the hairs. However carefully a razor may be dried before putting it away, a certain amount of oxidation takes place, and this in the case of a good razor of homogeneous steel should tend to deepen the "teeth," just as a barrel hoop with an edge one-eighth of an inch thick may by exposure to the weather become so sharpened as to saw wood. This natural process could probably be imitated more rapidly by the action of acids.

(12048) E. K. asks: Would you please inform me which wheels have the tendency to rise off the ground when an automobile is rounding a curve at high speed? The principle is the same on trains, carriages, and trolley cars, is it not? A. When an automobile or any other vehicle is turned sharply in one direction, its momentum tends to carry it straight on. If its speed is sufficient and its front wheels are turned sufficiently sharply, it will turn over on its right side in rounding a curve to the left, the left or inside wheels therefore leaving the ground first. This is readily demonstrated by the fact that the tendency to go straight on or turn over in railroad trains is corrected by the super-elevation of the *outer rail*, throwing the center of gravity nearer to the inner wheels, to keep them down and counteract their tendency to rise.

(12049) R. A. asks: Will you be so kind as to furnish the information as to what number of degrees Fahrenheit is required in the surrounding temperature to cause ice to melt? A. Ice begins to melt the moment the temperature of the surrounding atmosphere rises above 32 deg. F. The reason ice melts so slowly is that it requires more heat units (transferred from the surrounding atmosphere or somehow) to melt ice at 32 deg. to water at 32 deg. than it does to raise the same quantity of water through 1 deg. of temperature, on account of what is called the latent heat of fusion, but that does not affect the temperature at which fusion commences.

(12050) F. A. J. asks: In a SUPPLEMENT for May, 1908, you had a design for small alternating current motor, and I have found it very simple in all but one thing, which is the inductors for the rotor core plate. I do not quite understand if the No. 4 wire which you give for the inductors should be peeled of the entire insulation and laid in without insulation or with the insulation left on the wire. Kindly let me know which is the correct way. A. The inductors in the rotor of the motor of SUPPLEMENT No. 1688 are not made of insulated wire. The holes into which they are put are drilled with a drill 0.213 inch in diameter, and the No. 4 wire is 0.204 inch in diameter. There is no room for insulation unless, as the article says, thin paper is used and glued upon the wire. The wire is bare copper wire. If you refer us to a phrase in a long article like this, you should do so by page and column and part of column, so as to save our time in reading the entire article till we come to the part in question. It is a mistake to suppose that the editor knows all the articles which have been in the paper in all the past. He must find the matter of the inquiry and consider it before he can answer the inquiry. This often takes much time; and if correspondents can save us time they ought surely to do so, since our work is entirely in their interest and is not directly a source of profit to the editor or the paper.

(12051) B. B. M. asks: Will you please inform me what purpose the brushes serve in the Wimshurst electrical machine? That is, whether the brushes cause friction or act as inductors to carry the electricity. A. The rods with brushes at their ends upon the Wimshurst machine act by induction. Suppose a charge upon one of the tinfoil sectors acts inductively upon the sector of the other plate, which happens to be opposite it at the moment and in contact with one of the brushes. That sector and the brush in contact with it will become charged oppositely to the sector, which acts inductively upon it, and the other end of the rod, its brush, and the sector in contact with it will become charged similarly to the sector on the other plate. This action takes place upon each pair of opposite sectors of both plates as they rapidly pass each other. Thus the charge upon the sectors is rapidly built up. You will find a good description of the action of the influence machines in Carhart's "University Physics," vol. 2, which we can send you for $1.50.

(12052) R. H. T. asks: Can you tell me to what extent common water has ever been compressed? A. Pure water is compressed by a pressure of 15 pounds per square inch at the temperature of its freezing point 0.0000503 of its volume. The amount of its compression at various temperatures is given in a table in the book called "Smithsonian Physical Tables," page 83, to which we would refer you. It can doubtless be found in the library of the Polytechnic in your city.

(12053) M. M. asks: 1. Do you know of a London firm which offers a large sum to any one who will invent a method of dispelling fogs? A. We do not know any offer of a prize for a fog-dispelling device. The electrical apparatus of Sir Oliver Lodge has been entirely successful in dispelling fog over small areas, but the large first cost of equipment has prevented its general adoption for larger areas hitherto. 2. I have an idea on which I should like to have your opinion. If the X-ray will show objects through opaque flesh, why cannot it be made powerful enough to show objects through opaque fog? A. The statement that X-rays show opaque objects through the flesh is not quite correct. X-rays cast the shadows of bones, etc., upon a substance which the rays also cause to glow with light. These shadows are thus made visible by the light around them. The eyes are in the dark box of the fluoroscope, and do not see any object but the luminous fluorescent surface of the screen. People commonly say they see the bones, but they do not see anything but a shadow of a bone cast upon the screen. Our eyes cannot see X-rays. They do not affect the optice nerve, and do not excite the sense of vision in any manner whatever.

(12054) J. C. asks: I. If a disk of iron or steel be magnetized, how will the poles be located? The disk is 1/8 of an inch thick and 4 inches in diameter. A. If a steel disk is magnetized, drawing it over a magnet, its poles will be at the opposite ends of a diameter of the disk, near the edges of the disk. If it is magnetized by placing it flatwise between the opposite poles of a pair of magnets, it may be magnetized so that one face of the disk shall be north and the other will be south. 2. Also which will make the most powerful magnet—an iron or a steel disk? A. An iron disk cannot be made into a permanent magnet of any degree of strength. Only steel can be strongly magnetized permanently. 3. I suppose that in an ordinary compass the end of the needle which points north is the south pole of the magnetic needle of the compass. Is this correct? A. Do not confuse yourself about the names of the poles of magnets. In America it is well-nigh universal to call the end of a compass needle which points north, the north pole, and the end which points south, the south pole. This has nothing to do with the kind of magnetism which is resident in the poles; it simply tells the direction the ends of the needle assume when it comes to rest. We also name the ends of all the magnets in the same manner. A pole like the north end of a compass we call the north pole. 4. There is a power located in the north direction which attracts one end of the needle of the compass. Is there any such power located in the south direction which attracts the other end? A. The earth acts as if it were a huge magnet, with a pole in the northern hemisphere, and one of opposite nature in the southern hemisphere, as a general statement. It is impossible form a single magnet pole. The having of a positive pole involves the necessity of having an equal negative pole. One pole cannot exist alone, so far as we are able to control the matter on the earth. The nature of the magnetism in the north magnetic pole of the earth is the opposite of that of a compass needle which is directed toward the north on the earth. That is all it is necessary to say. If we call the north pole of a bar magnet or a compass needle plus, as we do call it, we must say that the magnetism of the earth is negative at its north pole, and positive at its south magnetic pole.

NEW BOOKS, ETC.

ACCURATE TOOL WORK. By C. L. Goodrich and F. A. Stanley. New York: Hill Publishing Company, 1908. Pp. 200; fully illustrated with photographs.

This work produced in the excellent style of the Hill Publishing Company, is conformable with the Hill Kink Books except in the matter of size and arranging the same sort of useful information more in the form of a continued treatise. The developments referred to in a preceding review have increased the importance of the tool-maker's art and also caused the application to many industrial machine shops in order to obtain interchangeability of parts the extreme accuracy, delicacy of finish, and the processes for obtaining them which were formerly used only in watchmaking. Jigs, master plates, and refined test indicators are more and more commonly used, and even the compound microscope with the adjustable cross-hairs arranged as a profile gage for screw threads. The uses of all of these are carefully described and the book, which is admirably illustrated with clear photographs and diagrams, should be as valuable to the practical man as it is interesting to the amateur, the development of these particular refinements having been so rapid that there is practically no literature on the subject. A chapter on trigonometry in the tool room assuages the fears of the non-mathematical workman by the claim that it contains neither equation nor Greek letter, and the practical nature of the work is assured by the fact that the first-named of the authors is a department foreman for the Pratt & Whitney Company.

MODERN POWER GAS PRODUCER PRACTICE AND APPLICATION. By Horace Allen. New York: D. Van Nostrand Company, 1908. Pp. 326; 136 illustrations. Price, $2.50.

The author's aim has been to describe the practical commercial types of products and their application so far as they have been developed while defining briefly the ruling principles of the gasification of fuel which govern design. The result is a compact and complete work of reference for the investigator and the practical operator of gas producer plants, if, perhaps, a little condensed at the expense of clearness in places for the interested amateur. Many of the economies shown by the substitutions of producer gas for steam plants in industrial works are very remarkable. The figures given for corresponding economies in weight and space occupied per horse-power for marine engines are not so large as some recent claims have contended, but in fuel economy alone, i. e., in the greater distance run for a given quantity of fuel, the results more than warrant the growing attention to this method of ship propulsion. The author gives a brief chemical analysis of fuel and gas necessary for intelligent study of the operation of gas plants and of the direct determination of the heating value of fuels by calorimeter tests. A useful chapter is also added describing briefly all the patents issued on producer gas accessories from which investigators can see in how far their work is overlapping that of others.

FREEHAND AND PERSPECTIVE DRAWING. By H. E. Everett and W. H. Lawrence. Chicago: American School of Correspondence, 1909. 8vo.; pp. 125; ill. Price, $1.

This volume, like the rest of the series of the Correspondence School, is intended especially for self-instruction and home study, and it appears on the whole to fulfill this requirement although its "foreword" applies rather obviously to the series in general rather than to this work in particular. The opening paragraphs on drawing, while beautifully put and in no way too technical, are probably a little beyond the depth of the class of students for which the correspondence school is primarily intended, but the instruction itself is perfectly clear and sound, and also has the merit of being original. The author of the first part has wisely adopted the freehand perspective exercises of A. R. Cross, which could hardly be improved upon. The explanations of perspective are as clear as possible to anyone who is familiar with descriptive geometry, but might perhaps have been expressed in terms a little simpler for the benefit of those who are not. To the careful student there is, however, in this volume all the material necessary for the obtaining of a working knowledge of freehand and perspective drawing.

THE COMMERCIAL HANDBOOK OF CANADA. Heaton's Annual. Heaton's Agency, 1909. 12mo.; pp. 400. Price, $1.

Without an inch of wasted space and with no pretensions to being literary or entertaining, this volume makes its fifth annual appearance more complete than ever, packed with useful information from cover to cover and in the most condensed form consistent with clearness. It gives particulars of all branches of the public service, government officials, members of the Senate, House of Commons, and local legislatures, lists of banks and branches, insurance and trust companies, railway and steamship lines, patent and trade-mark regulations, regulations affecting foreign corporations, weights, measures, and money values and their corresponding values in the systems of all foreign countries. Nothing could be more complete than the information as to customs regulations and tariffs, and the proportionate imports and exports of all commodities, which should be invaluable to export merchants in the United States having dealings with Canada. The handbook also gives full but concise information compiled from official reports on agriculture, commerce, finance, fisheries, forests, manufactures, and mines, and a gazetteer of all towns of over 1,500 population, their existing industries, shipping facilities, power rates, and inducements offered to or especial opportunities for new industries.

THE FLUTE AND FLUTE-PLAYING IN ACOUSTICAL, TECHNICAL, AND ARTISTIC ASPECTS. By Theobald Boehm. Translated and annotated by Dayton C. Miller, D.Sc. Cleveland: Published by Dayton C. Miller, 1908. Pp. 100. Price, $1.50.

While much has been written about the flute, the writings of Boehm, the inventor of the modern flute, are not well known; this is especially true of his second book, which is here presented. There is need, therefore, of this work, in which is given as complete a description as is possible of his flutes and instructions for handling them, and instructions upon the art of playing the flute with a pure tone and a good style. Boehm urged that an English translation be made, for "then all that I have done in sixty years will be known." For the present publication the translator has received the permission and hearty approval of Theobald Boehm and his sisters, of Munich, grandchildren of the inventor of the flute.

MARS AS THE ABODE OF LIFE. By Percival Lowell, New York: The Macmillan Company, 1908. 8vo.; pp. 288. Price, $2.50.

The Mars of Prof. Lowell is not as yet the Mars of most astronomers, partly because Prof. Lowell, unlike other astronomers, has devoted the better part of his life to a careful study of the ruddy planet, and is therefore a partisan specialist, and partly because his antagonists are not willing to accept his ingenious deductions. Prof. Lowell's argument is briefly this: Mars is a planet which is fast drying up. The only water there to be found is gathered at the poles in the form of ice and snow. If the planet be inhabited, the chief concern of the inhabitants must necessarily be to conduct this polar water to those arid regions which could be made to blossom if they were irrigated. Hence the "canals" which Prof. Schiaparelli originally discovered, and the number of which has grown astonishingly under Prof. Lowell's eye. Lowell's arguments in favor of the artificial origin of the canals are their remarkable straightness and the fact that they converge apparently with intention in well-defined spots. His theory stands or falls with the artificiality of the canals, and it is just here where most astronomers differ with him. His reasoning is reasoning by analogy, because he constantly compares the conditions on Mars with conditions on the earth. Whether or not Prof. Lowell's views be accepted, it must at least be said that they explain more simply than any other theory the phenomena of our nearest planetary neighbor. In spite of much adverse criticism, he has adhered unswervingly to his views. Prof. Lowell has a happy gift of presenting his discoveries in such an interesting way that even the skeptical critic must admire the skill with which he has prepared this book. The astronomical reader will find some sixty pages of notes of a mathematical nature, which will enlighten him on those phases of the subject that could not be discussed in the body of the work because of its popular character.

HANDBUCH FÜR HEER UND FLOTTE. Enzyklopädie der Kriegswissenschaften u. verwandter Gebiete. Unter Mitwirkung von zahlreichen Offizieren, Sanitätsoffizieren, Beamten, Gelehrten, Technikern herausgegeben von Georg von Alten, Generalleutenant z. D. Berlin und Leipzig: Deutsches Verlagshaus Bong & Co., 1909.

This is the first installment of what promises to be an excellent military and naval encyclopedia. Many of the standard works on military science are antiquated, for which reason an attempt to publish a book abreast of the times should meet with a favorable reception. From this first installment we judge that the complete work will discuss in alphabetical order subjects relating to the training and use of troops according to modern tactics, transportation and commissary facilities, military hygiene, military medicine, naval affairs, co-operation of army and navy, and the latest advances in military science in general. An admirable feature of the articles is the brief bibliographies by which they are concluded, and which render it possible for one to refer to original sources for more complete knowledge. Naturally, a very large portion of the work will be devoted to the technical advances that have been made in recent years. The history of the art of war will be discussed in illuminating articles. The "Hand Book" is to appear in nine volumes, of 900 pages all told, and is issued periodically.

Legal Notices

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SMALL HOUSE NUMBER *of* AMERICAN HOMES AND GARDENS

THE artistic and inexpensive house is the chief demand of the home seeker of to-day. For that reason the April, 1909, number of American Homes and Gardens will be a **SPECIAL SMALL HOUSE NUMBER.**

This issue will contain a vast amount of valuable information for the prospective home builder. It will tell him how to select a country site, how the various rooms of the house should be planned; the style of architecture in which the house should be designed; the material of which it may be built; the kind of plumbing fixtures to be used; the heating system to be selected; the choice of the hangings for the walls doors and windows; appropriate furniture for the home; the interior decoration of the home: and the laying out of the grounds surrounding the house, as well as the planting of them.

THE ARTISTIC EXPRESSION OF THE SMALL HOUSE is well explained in an article by Francis Durando Nichols, illustrated with fifty engravings showing exterior and interior views and floor plans of a group of model houses of small size and small cost.

PLUMBING FOR A SMALL COUNTRY HOUSE, by John A. Gade, is a very important subject. No part of a house needs greater attention than the laundry, kitchen and bath room. Hence the economic and convenient placing of the plumbing fixtures, the kind to use, and the cost of the same are matters of interest to all prospective home builders.

THE MAKING OF AN IRIS GARDEN, by Samuel Howe, is an illustrated article showing how a swamp or lowland can be developed and transformed into a beautiful iris garden.

DECORATIVE FEATURES IN THE SMALL HOME, by Alice M. Kellogg, presents in a brief way with ten illustrations artistic schemes of covering the floors and walls of the house, harmonious and appropriate hangings for the doors and windows, with numerous suggestions for the decorating of the various rooms of the house.

A GROUP OF MODEL MOTOR HOUSES FOR THE SMALL COUNTRY PLACE, by Ralph de Martin, forms two pages of illustrations and sets forth the best designs for a small motor house suitable for the accommodation of one motor car and with sufficient space for a work bench.

HOME-MADE NOVELTIES FOR THE COUNTRY HOUSE, by Mabel Tuke Priestman, treats of the conversion of unlikely things into useful articles, and the illustrations show the results.

THE EVOLUTION OF THE SMALL HOUSE PLAN, by Joy Wheeler Dow, is an important article by a well-known architect on the economic planning of a small house, costing from $2,500 to $8,000. The plan and the arrangement of the rooms is the first thought given to the house and is one in which the layman should be most interested.

A FORMAL GARDEN AND PERGOLA, DESIGNED BY AN AMATEUR, by Alexander R. Holliday, informs the reader how an amateur planned and laid out his garden and how he built his pergola. Illustrated with plans and scale drawings.

PROPER FURNITURE FOR THE SMALL HOUSE, by Esther Singleton, with illustrations showing the artistic and appropriate furniture for the house, and the proper position in which it is to be placed, together with an accurate treatment of the fireplace and mantel.

THE USE OF CONCRETE IN THE BUILDING OF A SMALL COUNTRY HOUSE, by Benjamin Howes, is a timely and comparatively new subject, and is one in which much interest is shown at the present moment. The article is profusely illustrated with fifty engravings showing exterior and interior views and floor plans of small houses of various styles of architecture in which concrete is used with artistic results.

THE HEATING APPARATUS FOR THE SMALL COUNTRY HOUSE, by Allyn Frogner, is the title of an article treating in a practical manner one of the most important features of a small country house. How to heat and what is the cost? That is a question which has been well answered for the three respective systems of hot air, steam heat and hot water

PROBLEMS IN PLANNING THE GROUNDS OF A SMALL COUNTRY PLACE, by Charles D. Lay. Mr. Lay has explained in a very concise form how the grounds around a small country place may be planted at a very low cost, and enumerates the best and most effective shrubs and plants to be used.

This **SMALL HOUSE NUMBER** will contain 165 illustrations covering 52 pages, which will be inclosed in a striking colored cover.

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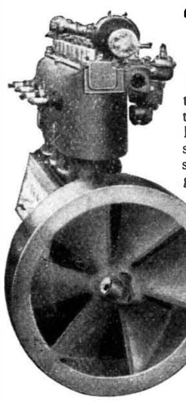

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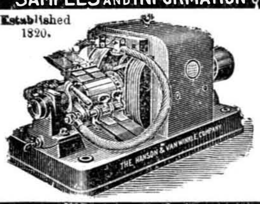

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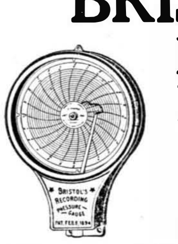

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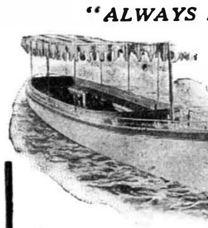

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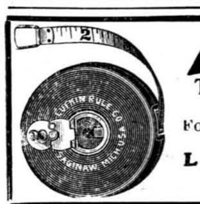

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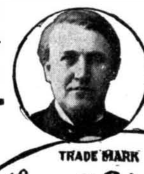

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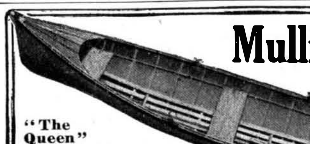

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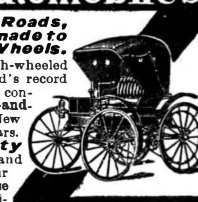

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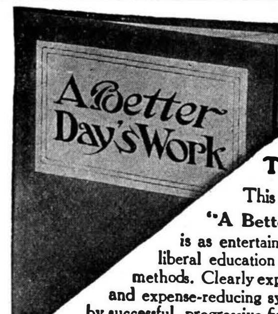

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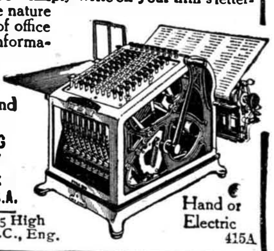

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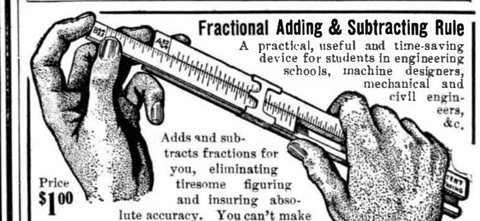

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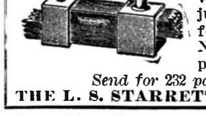

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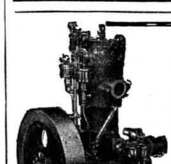

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