SCIENTIFIC AMERICAN

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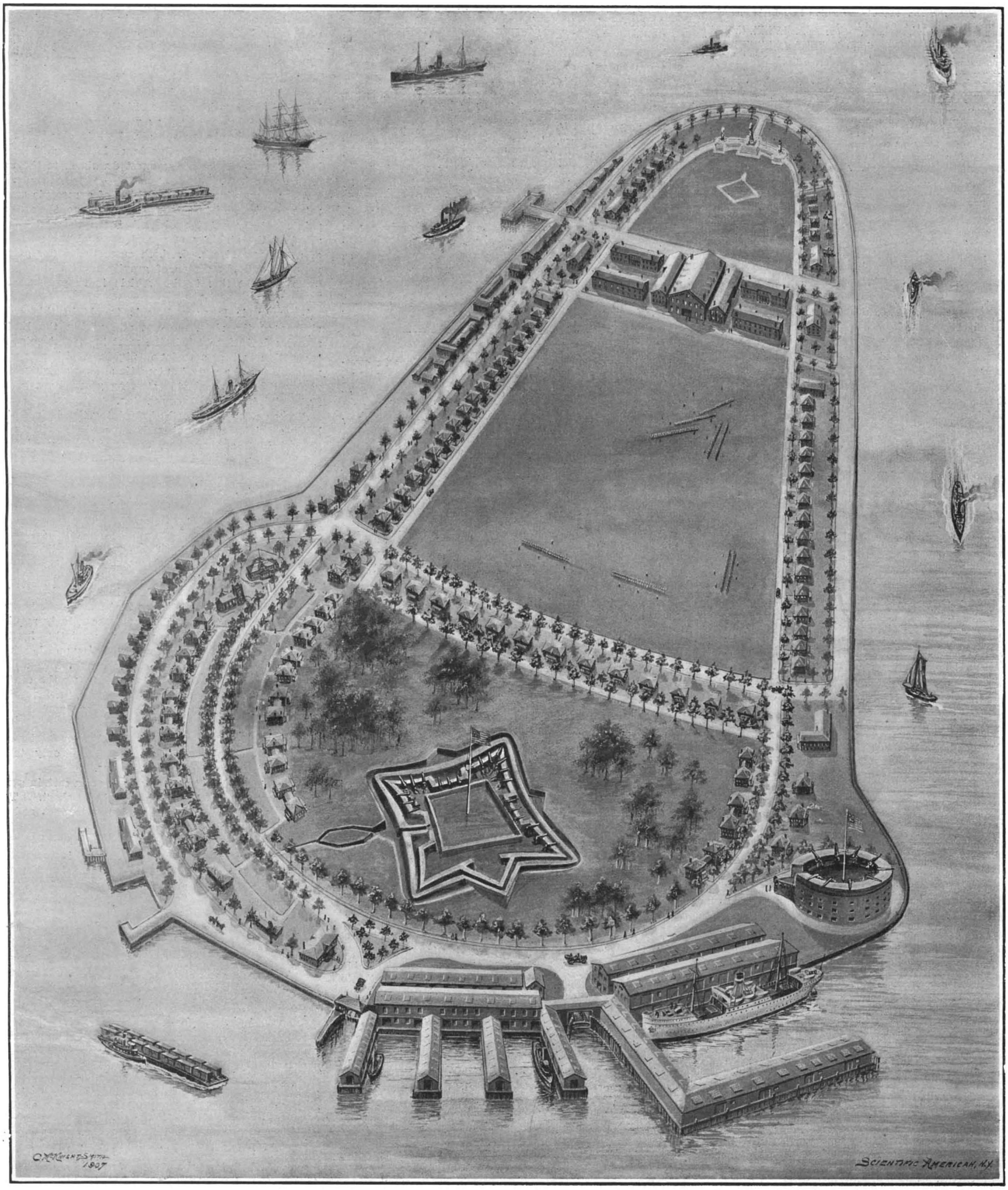

Bird's Eye View, Looking South, of Governor's Island as It will Appear When the Present Plans Are Carried Out. As Completed, the Island Will be Three Times Its Present Size, 101 Acres Being Now in Process of Reclamation by Means of Sea Walls and Dredging. It Will Accommodate a Regiment of 1,200 Men.

ENLARGEMENT AND RECONSTRUCTION OF GOVERNOR'S ISLAND MILITARY POST.—[See page 395.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, NOVEMBER 30, 1907.

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.

LIGHT ON THE QUEBEC BRIDGE DISASTER.

The voluminous testimony of the Consulting Engineer of the Quebec bridge, which fills several pages of one of the contemporary engineering journals, is, to say the least, very disquieting. It is as yet too early to pass any opinion upon the merits of the case; common fairness demands that judgment be suspended until the testimony of the bridge company has been given. It is evident, however, from the statements of the Consulting Engineer, that the enterprise labored under two serious drawbacks, namely, a scarcity of funds, and the absence of any chief engineer of the bridge, present on the ground, and possessing the authority to act instantly in those cases of emergency which are certain to arise during the prosecution of a work of this magnitude.

It is evident that, as matters shaped themselves, the duties of Chief Engineer devolved upon the Consulting Engineer, a gentleman of unquestioned ability and experience; but whose age is well on to threescore years and ten, and whose physical disabilities were such as to prevent his making any visit to the work. Foreseeing the necessity for expert engineering inspection, both at the works of the bridge company and at the site of the bridge, he earnestly advocated, in the earlier stages of the work, the training or selection of a body of expert inspectors, possessing the necessary technical knowledge to see that, both in the shops and at the bridge, the work was done with strict adherence to the best practice, and capable of dealing with the emergencies, which inevitably arise during the construction of unprecedented engineering structures. According to his testimony, he met with only partial success; and it is evident that, at least as far as some members of the inspection and erecting staff were concerned, he did not consider that the engineering work was in the hands of men who were quite up to the expert requirements of work of this stupendous magnitude and difficulty.

One is astonished to learn that he had to make complaint upon such absolutely vital points as the fit of the pins in the eyebars and connections, and the accuracy of the butt joints in the posts and other compression members. His detailed story of the discovery of the eccentricity in the bottom chord; the making light of it by the engineer in charge; and the tardy and roundabout measures taken to stop all further additions to the weight on the bridge, read more like the story of the building of some county bridge than the record of the erection of the greatest work of bridge engineering of the century.

TRAIN FERRIES FOR THE ENGLISH CHANNEL.

The scheme for tunneling the English Channel has again been defeated by the strong military and political considerations which, for a period of thirty years, have effectually delayed the construction of this much-needed work. Englishmen have always realized that their insular conditions placed them at a great advantage, as compared with their neighbors across the Channel, whose contiguous frontiers necessitate the maintenance of huge standing armies. They consider that the opening of a tunnel beneath the English Channel would constitute a weak point in England's maritime defenses, and rob her, to a certain extent, of the seclusion which the sea affords. To an outsider it certainly does look as though the chances of invasion by tunnel would be exceedingly remote; that is, provided that proper defenses were maintained at the English landing, and the necessary mines for destroying, or inlet gates for flooding, the tunnel were prepared, and at all times carefully maintained. To render the tunnel effectual for pouring troops into the island would necessitate a naval expedition sufficiently powerful to overcome the Channel fleet, and the landing of an army of sufficient strength to hold the portal permanently against the British land forces, which, in a few hours, would be concentrated on the spot. However, since the British government will have none of the tunnel, its construction is indefinitely postponed.

Meanwhile the Calais-Dover crossing, in spite of the improved channel steamers which have been placed on the route during the past few years, continues to be a source of no little discomfort to passengers to and from the Continent. The swift tides and heavy winds which prevail, kick up a nasty cross sea, which is trying to any but the most seasoned traveler. There is now some probability that the problem will be solved by Americanizing the passage, to the extent of instituting a service of large train ferries, of the kind which have been doing such excellent service for many years in this country. These ferries are large and powerful vessels of steel construction, which are capable of taking a whole train of cars at one load, and transporting them from rail to rail without necessitating any change of cars, or any disturbance whatever of the passengers. The system has been brought to such perfection in the United States, that in one case, on the Great Lakes, a trip of sixty miles is made by this means. The Channel crossing is about 21 miles in length, and is made in about one hour's time. If the train ferries were put in service, it would be possible to enter the berth of a sleeper in London and remain undisturbed until the train reached Paris or any other desired destination on the Continent. The proposal has received the sanction of the President of the Board of Trade, and is not likely to excite any opposition on the part of the military authorities.

NATIONAL SWAMP RECLAMATION.

The success of the national irrigation law in causing the opening up of waste arid bad lands in the West for agricultural purposes through systematic irrigation, has been so marked that a movement is now begun for the improvement of swamps and waste low lands in the several States by the reverse operation of drainage, to be carried on under the supervision of either the Interior or Agricultural Department or both combined.

The movement is being furthered by the National Drainage Association, located in Washington, D. C., which has supported a special bill introduced at the last session of Congress by Senator Flint of California known as Senate bill No. 6626, and favorably reported from the United States Senate Committee on Public Lands.

The general purpose of the work to be carried on under federal supervision is most commendable and should appeal strongly to the best interests of the citizens of all the States; for in some States, notably those bordering on the Atlantic coast, the extent of marshy, swampy lands is too vast to warrant the State's making appropriations for their general improvement and redemption. In other words, the land improved would not stand the tax necessary to pay for an improvement on such a mammoth scale. The United States by assisting the States with its credit and engineering forces in swamp drainage and reclamation on well-defined regulations, will enable the State and local communities to secure the benefit resulting from such work practically without the necessity of laying a burdensome tax.

The conditions of the Flint general drainage bill are very similar to those of the Irrigation Law. By cooperation between States, corporations, or individuals and the Secretary of the Interior, drainage projects will be carried on by the federal government. But prior to entering into such works it will be necessary for the States to pass local legislation before the cooperation can be put into effect. When this stage is reached the Secretary of the Interior is empowered to advance the necessary funds at three per cent per annum for ten years, taking a lien upon the lands to be drained. It has been found that the cost on the average for irrigation is $28 per acre, subject also to an annual tax for the users of the water.

The Secretary of the Interior has reported on a large drainage project, now under survey on the Minnesota Indian reservation, that the lands can be drained at the cost of $3.25 per acre.

The government reports show that there are approximately eighty million acres of swampy lands. It is alleged that if these were drained and made habitable, they would afford (divided into forty-acre farms) homes for twenty millions of people. Not only this, but the agricultural value would be large, inasmuch as these lands would grow profitable crops with no difficulty, while their nearness to local markets would enable the owner readily to dispose of the produce.

Aside from the agricultural value of reclaimed lands is the abolishment of their pestilential character, the elimination of mosquito propagation, and the riddance of malaria, resulting in the production of a more general healthful condition over the entire country. The remarkable transformation in the Panama zone obtained by scientific drainage is a shining example of what can be done to promote good health conditions. A special convention of delegates from the several States was held by the National Drainage Association in Baltimore, Md., on November 25, 27, and 28, to discuss the subject of swamp reclamation and its furtherance by national aid. It would seem as if such a philanthropic scheme of marsh reclamation would and should command universal support.

THE USE OF THE GYROSCOPE IN CONNECTION WITH AIRSHIPS.

Two practical applications of the gyroscope have been recently suggested, namely, the steadying of vessels, and the balancing of railway trains running on a single rail. Now a third possibility of utilizing this interesting instrument is discussed by C. L. von Lilienbach in La Conquête de l'Air.

As the gyroscope has been found to insure the stability of the two kinds of oscillating vehicle referred to, it might be employed as well in connection with vessels sailing through the air. In this connection it should prove the more valuable, as lack of stability is known to constitute the greatest drawback to the use of the aeroplane.

After suggesting that some kind of gyroscopic apparatus may be used in the Wright aeroplane, the author points out the great analogy between the conditions affecting the stability of aeroplanes and the stability of a "monorail" car. In both cases the center of air pressure and the center of gravity must fall on the same straight line if the vehicle is to preserve its balance.

However, it is very difficult to obtain this coincidence at the right moment and within the limits actually desired, which is the most important point in connection with aeroplane flights. Neither reflex rudders, nor the use of automatic sliding weights, nor finally the front and side steering gears, have given full satisfaction in this connection.

A more efficient method of obtaining the desired stability consists in arranging the supporting surfaces in pairs behind one another, the practicability of this principle having been demonstrated by Prof. Langley. A similar system has been recently employed in France by Bleriot.

According to Lilienbach's suggestion, the gyroscope could be used in steadying the aeroplane. This would prove valuable, not only in connection with ordinary aeroplanes, but even with the Langley double-aeroplane airship. Flying machines of the latter type, to which most experts ascribe the best chances of final success, possess a great stability in mid-air by sliding like sleds on an air cushion, so that only linear inertia has to be accounted for. They will accordingly require the addition of a gyroscope utilizing rotative inertia only in the case of slow flight, in starting and landing, and during storms. In any case the gyroscope would augment the safety of the flight by fixing the center of gravity of the apparatus, thus exerting a favorable influence on the speed of the motor. In fact, the axial position of the gyroscope seems to be of no importance, for, by reason of its vertical or horizontal rotation, it offers a uniform resistance only to a lateral displacement of the apparatus.

It may be said that propellers possess a certain gyroscopic action, especially if the axis is short. The blades of the screws should obviously be thin and of especially light material, on account of the centrifugal force. The propeller actuating the aeroplane thus contributes, by its rotation, to increase the stability of the airship, and when there is only one propeller, a slight tendency to rotation of the airship in an opposed direction will be observed. Two propellers rotating in opposite directions, however, compensate each other, and can be arranged either on the same shaft behind one another or symmetrically, side by side. The former construction is more simple, since the other requires a rigid transmission; the latter, however, is the preferable. Von Lilienbach suggests arranging with three or four pairs of very slightly curved vanes, two additional pairs of symmetrical propellers, a separate motor, and a dovetail. In order to increase the stability of this arrangement a gyroscope should be added.

It should be said that an Austrian and a German inventor a few years ago suggested the use of gyroscopes in connection with airships, and that a similar idea has been patented by Etrich and Wels, but abandoned during construction. The subject of the application of the gyroscope to the aeroplane has been discussed both in the columns of the SCIENTIFIC AMERICAN and SUPPLEMENT.

The direct application of jets of dry steam to a gravel bank through the agency of driven pipes has been found to be an efficient method of thawing frozen gravel.

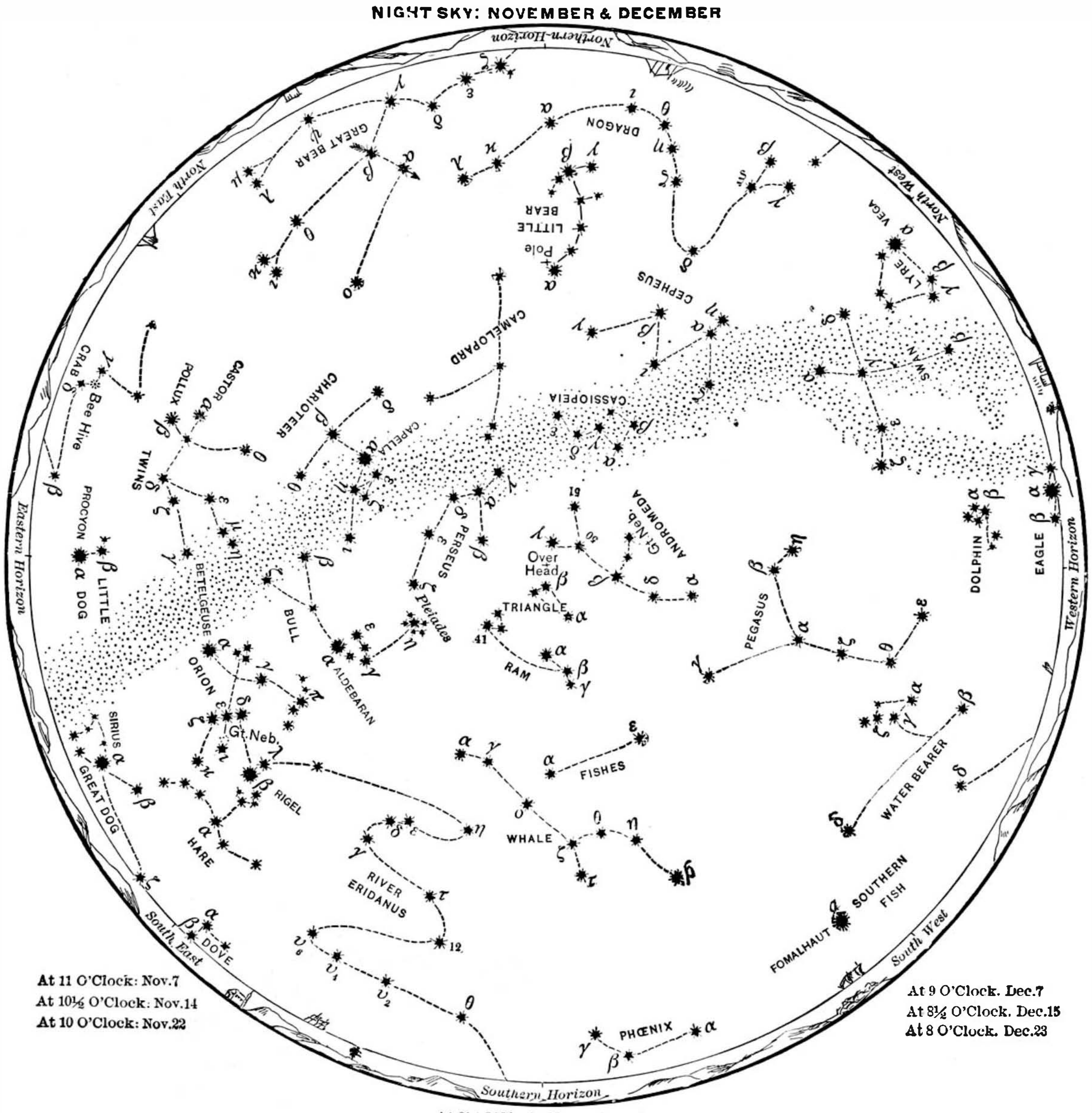
THE HEAVENS IN DECEMBER.

BY HENRY NORRIS RUSSELL, PH.D

Mellish's comet, of whose discovery we spoke last month, has already passed its nearest approach to the earth, and is now receding rapidly both from us and from the sun, so that it will not long remain visible. At its best it was only a diffuse, hazy spot of light, but was fairly bright for a telescopic comet, and easily seen in a small telescope.

There has been considerable popular discussion lately about certain bright spots that have been seen on Saturn's rings. The rings are at present so situated that we see their dark side; that is, the one on which the sun does not shine. They are consequently invisible, except for the thin edge, which can be seen in large telescopes as a faint and exceedingly delicate line of light, extending out on each side of the planet. On this line there appear brighter "knots" or "condensations," two on each side of the planet, symmetrical with respect to it, as was announced a few weeks ago from the Lick Observatory.

This phenomenon is, however, not new to science, and in fact an explanation of it was given by Prof. Bond of Harvard rather more than fifty years ago, substantially as follows:



In tne map, stars of the first magnitnde are eight-pointed, second magnitude, six-pointed; third magnitude, five-pointed; fourth magnitude (a few), four-pointed; fifth magnitude (very few), three-pointed, counting the points only as shown in the solid outline, without the intermediate lines signifying star rays.

The rings of Saturn are thin plane sheets, most probably less than 100 miles in thickness, though 168,000 miles in diameter. They do not, however, form an unbroken sheet, but are composed of three divisions—an outer one, about 10,000 miles wide, separated from the second by a dark space of 1,600 miles; a second, about 16,000 miles in width, brighter than the first; and this shades gradually into the third, which is faint and partly transparent; doubtless because the particles which compose it are so far apart that we can see through between them.

We are looking at them at present almost, though not quite, edgewise; our distance from the plane of the rings being only about 1/80 of the distance of the planet.

In consequence, as we look at the part of the rings which is nearly in front of the planet, we see only the illuminated outer edge of the outer ring. The outer edge of the second ring is also illuminated by the sun, but we do not see it, for it is concealed behind the dark inner edge of the outer ring, which appears to overlap it, since the actual gap between them is so narrow. But when we consider a series of points apparently farther from the planet, it is easy to see that we will be looking more and more obliquely across the narrow gap between the rings, so that it will look wider, until finally we can see the bright edge of the second ring through it. In the same way we see the inner edge of the outer ring, behind the planet, through the same gap, but only when we look across it very obliquely. The combination of these two (which are too close together to be seen separately) accounts for one of the brighter "knots" on the faint line of the rings. Its distance from the planet's center should evidently be equal to the apparent diameter of the division between the rings, and there will be another similar bright spot on the opposite side of the planet, at the same distance.

The inner edge of the second ring accounts for the other pair of bright "knots" in a similar fashion.

To see them satisfactorily requires a large telescope and good atmospheric conditions, so that they are all beyond the range of most amateur observers.

THE HEAVENS.

The winter constellations, which form probably the finest group in all the skies, are now appearing. Orion is pretty well up, about east-southeast. The line of his belt points upward toward Aldebaran, and downward to Sirius, rather more accurately than our map would indicate.

Procyon in the Little Dog, Castor and Pollux in the Twins, and Capella in the Charioteer, make up a second line of bright stars to the northward of the first. Perseus and Andromeda are overhead, with the Ram (Aries) and the small but ancient constellation of the Triangle. In the south are the large but faint star groups of the Fishes, the River Eridanus, and the Whale, which can best be identified by aid of the map. The variable star Mira, which is lettered *o* in the last constellation, is now a little past maximum and still visible to the naked eye.

The southwestern sky contains three bright objects—the star Fomalhaut and the planets Saturn and Mars. The former is in Aquarius (the Water Bearer) south of the middle of the great square of Pegasus. The latter is in the same constellation, a little farther west, and can be told by his red color.

Pegasus and the Dolphin are in the west, and the Swan and the Lyre in the northwest. Of the circumpolar constellations, Cassiopeia is almost overhead, Cepheus below her toward the northwest, the Little Bear and the Dragon below the Pole, and the Great Bear coming up in the northeast.

THE PLANETS.

Mercury is a morning star all through the month. He is best visible during the first week, near his elongation, which occurs on the 1st. At this time he is in Libra, and rises nearly two hours before the sun, so that he can easily be seen.

Venus is evening star in Scorpio and Sagittarius, but is so far south that she is not at all conspicuous, though she sets about an hour and a half later than the sun.

Mars is in Aquarius. He is moving rapidly eastward among the stars, and overtakes Saturn on the last day of the year, when the two planets are less than two degrees apart.

Jupiter is in Cancer, and rises about 8:30 P. M. in the middle of the month. Saturn is in Aquarius, and is in quadrature with the sun on the 13th, and comes to the meridian at 6 P. M.

Uranus is in Sagittarius, too near the sun to be seen. Neptune is in Gemini, approaching opposition, which occurs early next month.

THE MOON.

New moon occurs at 5 A. M. on the 5th, first quarter at 9 P. M. on the 11th, full moon at 1 P. M. on the 19th, and last quarter at 6 P. M. on the 27th. The moon is nearest us on the 6th, and farthest off on the 22d. She is in conjunction with Mercury on the 3d, Venus on the 6th, Uranus on the 7th, Mars and Saturn on the 11th, Neptune on the 20th, and Jupiter on the 23d. The last conjunction is fairly close. At 7 P. M. on the 22d the sun reaches its greatest distance south of the celestial equator, and enters the sign of Capricorn, and, in the phrase of the almanac, "Winter commences."

Princeton University Observatory.

ELECTRIC SUNSTROKE.

On board a cruiser that was recently undergoing repairs at Portsmouth, it was necessary to pierce a hole in the armor of a turret. The usual mechanical processes employed in such cases were so slow that a torpedo officer asked for permission to cut the hole by means of an electric arc. What this process consists of is well known; one pole of a source of electricity is joined to the mass of steel to be cut; the other pole is connected with a large carbon having an insulated handle which the operator holds. The carbon is placed in contact with the metal and an electric arc is formed, melting the metal at the points where the carbon is successively presented. This undertaking, although not uncommon, caused a great deal of curiosity among the crew and drew a large number of spectators. Everything went well, and the steel of the armor, under the action of the current, melted like ice.

But the next day all the men who were present at the operation, were either half blind or terribly burned. The officer who had directed the current, had the skin of his face completely puffed up, and of a leathery color; from it ran a serous liquid like that from a blister occasioned by a burn. Several sailors who were at quite a long distance from the turret had their sight so badly affected that they had to be treated in the hospital, lest they should lose it entirely.

This was a characteristic case of electric sunstroke.

It is known that in the most common and least severe form, sunstroke consists in a redness accompanied by an irritating burning sensation that manifests itself on the parts of the body that have been exposed to the sun. Sometimes, if a person has remained for a long time under a very hot sun, the burning becomes a pain. The red, tumefied skin looks like a case of erysipelas; later, little blisters, full of a clear liquid, may appear on the injured portions. It was for a long time thought that these blisters due to the sun were burns; but it is not so; they are not present in the burns that workmen have received when exposed to very intense heats. They are produced by the light of the sun alone. If this light is reflected by snow, it becomes particularly dangerous, and more than one Alpine climber has learned this to his disadvantage. On the mountains, on glaciers, or on fields of snow, the tourist may receive severe sunstrokes even with a cloudy sky and a cold atmosphere. These are true "sunstrokes in the shade" produced by the chemical rays of light.

The electric arc, rich in chemical rays, particularly so when produced between certain metals, can give rise, as we have seen above, to the same symptoms that the sun is able to produce. Therefore, it is extremely necessary to protect one's self when one is exposed to a powerful arc or to the light of a mercury vapor lamp inclosed in quartz glass, which is permeable to ultra-violet rays. Ordinary glass employed in the manufacture of Cooper Hewitt lights stops the dangerous chemical rays sufficiently to render their effect unnoticeable.—Cosmos.

News has been brought by the United States revenue cutter "McCulloch" that the islands that recently appeared in the Bogostoff group, described in the Scientific American of October 26, 1907, and which were named McCulloch Peak and Perry Peak, have been destroyed through volcanic subsidence.

THE NEW BRIDGE OVER THE WISSAHICKON AT PHILADELPHIA.

BY J. A. STEWART.

One of the most striking types of recent bridge engineering is that which is being constructed by the city of Philadelphia over the Wissahickon Creek in one of the most charming sections of Fairmount Park. The bridge is modeled after the beautiful Luxembourg bridge in the Duchy of Saxony, near the borders of Germany, and closely follows the graceful outlines of its foreign prototype. Work on the bridge is well advanced. It is expected that it will be opened for traffic early next year. By its construction, a somewhat sequestered section will be opened to general traffic, and a much-needed direct line of travel supplied from Germantown to Roxborough. The bridge in itself constitutes a noteworthy addition to the growing list of artistic, architectural viaducts of the United States.

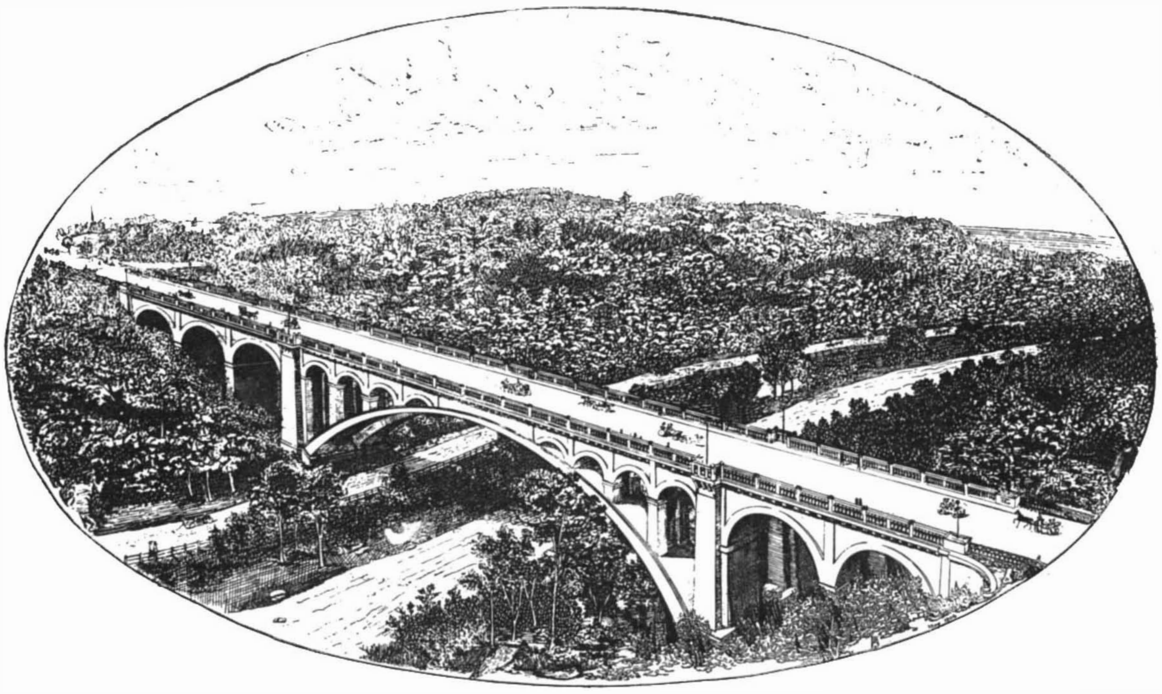
The special features of the bridge are the heavy masses entering into its composition; the uncommon size of the great central span, the longest concrete arch in the world, and the third longest masonry arch of any description in existence; and the method of construction.

The problems most difficult of solution centered about the weight of the structure, and the isolated section to which materials had to be transported. A total weight of 50,000 tons of concrete is represented in the construction, all of which great mass had to be hauled by wagon a distance of a mile and a quarter. The ribs on the arch rings alone weigh about 8,000 tons. Other difficulties to be encountered were involved in the great depth of the ravine, and the height of the bluffs, east and west, which are linked by the bridge.

The grade of approach from Germantown is 4½ feet per 100, descending Walnut Lane, necessitating a cut of about 20 feet. On the west side there has been considerable filling in to make the grades as easy as possible. The grade on the bridge is 1½ feet per 100.

The magnificent semicircle of the arch, from which the wooden superstructure has recently been removed, rises to a height of 147 feet, towering above the tallest trees in the valley, and extends over the rocky bluffs, a clear span from pier to pier of 233 feet. The general plan of the bridge is that of twin supporting arch ribs, floored across the top; a plan followed through the five approach arches, as well as the main one. Over each main arch rib the floor is carried on eight pairs of relieving arches. The entire length of the bridge is 585 feet. The span of the approach arches (of which two are on the east and three are on the west) is 53 feet each. The eight relieving arches are 20 feet clear. The main arch piers rise 80 feet above the water, and 100 feet above the rock.

Three segments of circles form the main arch. It has two ribs or rings, each 21 feet 6 inches wide and 9 feet 6 inches thick at the springing line, and 18 feet wide and 5 feet 6 inches thick at the crown. Each of these carries ten vertical cross walls. The spandrel arches, holding the spandrel walls, rest on piers supported by the main arch, and are also semicircular in form. They are 3 feet 6 inches wide and 1 foot 3 inches thick at the crown, decreasing from 2 feet at the spring. The thickness of the cross walls varies slightly, but in general approximates 2 feet. This variation constitutes the adjustment of the dead load on the arch made necessary by the varying height of the spandrel piers due to the grade of the roadway.



Walnut Lane Bridge Over Wissahickon Creek.

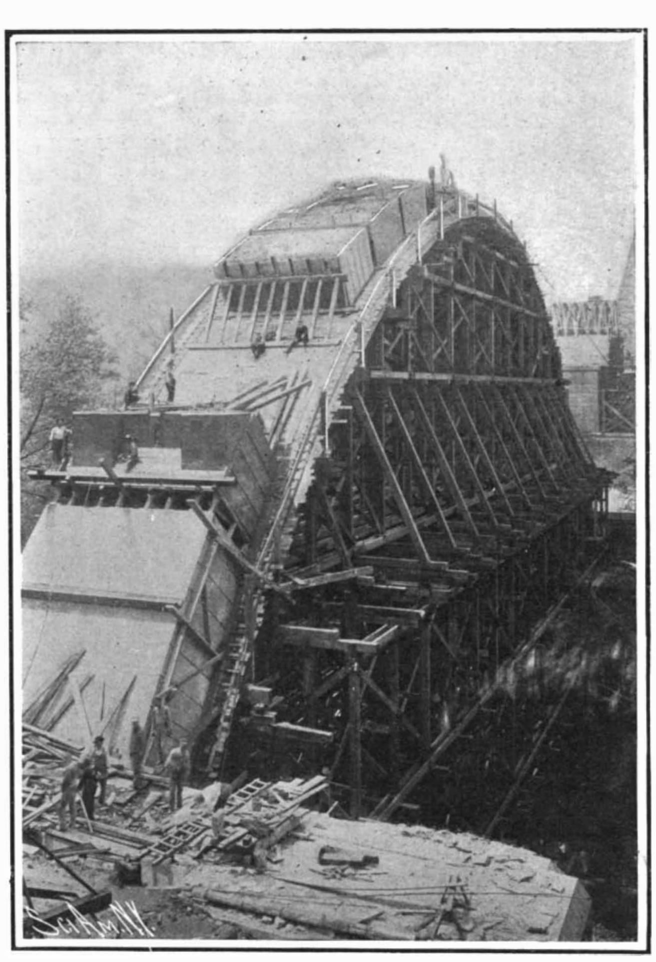
In the building of the main arch the usual order of construction was reversed. First, concrete was placed at the crown in order to consolidate the falsework. The arch was constructed in blocks, or loose voussoirs, distributed about over the falsework in order to spread the weight and prevent deformation of the falsework. The whole of the arch ring was thus placed until seventeen key spaces were left, which were scattered over the falsework to permit the complete compression of the falsework before the keying, or closing. By this means, the arch ring was not subject to any bending strains which would have existed under the old method of constructing arches, and which would have had a tendency to produce cracks.

When the voussoirs had fully shrunk and all settlement had taken place in the falsework, the seventeen keys were concreted as nearly at the same time as possible. After a period of thirty days, the centering was struck by slacking the wedges. This work proceeded from the middle toward each end. Eight men with sledges in six hours lowered the falsework sufficiently to free the arch. This was so successfully done as to cause a settlement of but ⅛ of an inch of the concrete at the crown of the arch.

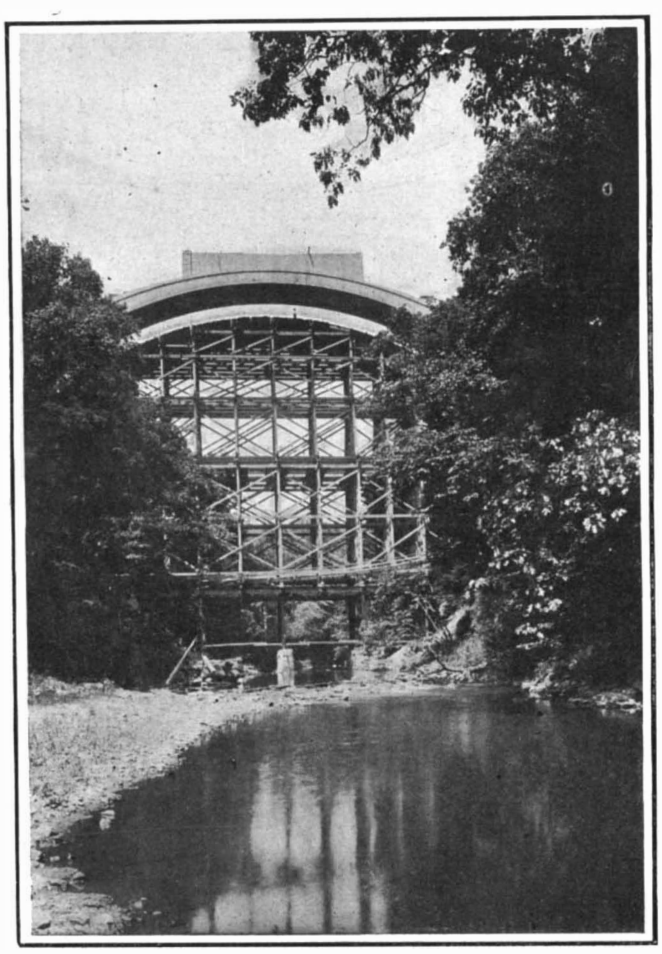
As soon as the falsework was clear of the first arch rib, the anchor bolts which connected the transverse bents to the concrete falsework piers were removed. A 35-ton ball-bearing jack was set horizontally against the rear end of the bottom sill of each transverse bent of the falsework, or substructure, reacting against blocking secured by the anchor blocks in the concrete piers. The jacks were simultaneously operated by two men each, and pushed forward the falsework and substructure (having an estimated weight of 900 tons) on the rollers at the rate of 34 feet in three days.

The voussoirs were then anchor-bolted to the concrete piers as at first, and the upper and lower sections of falsework raised on the wedges on both sides until the lagging was at the required position for the second arch rib. The concrete work was then continued as for the first rib.

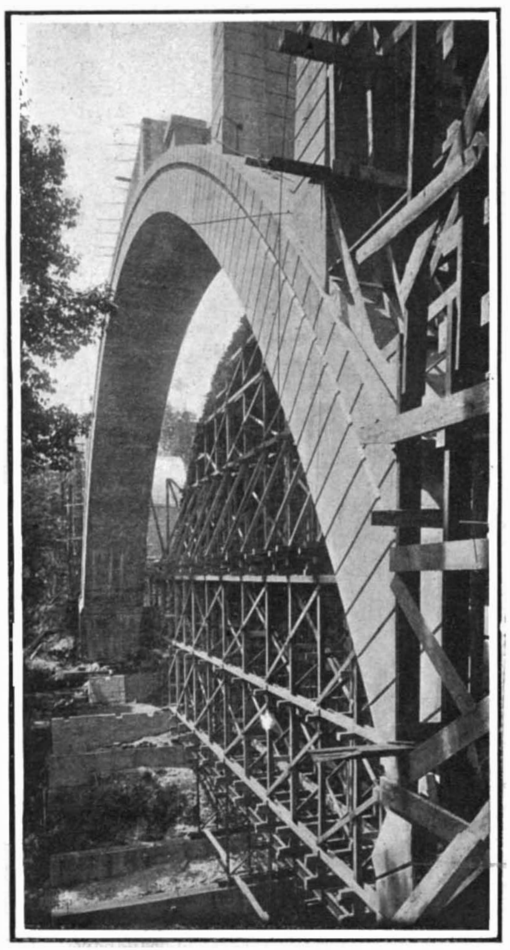
Expansion joints are provided at each intersection of the spandrel walls with the cross-walls on the piers. These joints are locked with a tongue and groove 2 inches deep and the surfaces of the concrete separated by a layer of asbestos felt ⅛ inch in thickness. At the spring of every spandrel arch, is placed a strip of asbestos felt covering the front half of the ring, to accommodate the hinge action attending the rise and fall of the main arch because of temperature changes. The entire bridge is of concrete. Such steel as is used for reinforcement is deeply imbedded in the material, so that no metal is anywhere exposed to view. The bridge floor is carried on the spandrel walls; and is a combination of steel I beams, steel reinforcing rods, and concrete. The beams measure respectively 15 inches and 20 inches. The latter are riveted to the former and the 6-foot spaces between are filled with



Falsework in Position, Showing Method of Construction.



Side View, Showing the Splendid Arch.



End View. Falsework Pushed Aside.

THE NEW BRIDGE OVER THE WISSAHICKON AT PHILADELPHIA.

concrete forming jack arches. The floor of the bridge is paved with asphalt, 3½ inches of asphalt being placed on a 6-inch concrete base over a 12-inch layer of cinders and ¼-inch coating of coal tar. The driveway will be 40 feet wide between the curbs when completed, thus affording ample space for carriages outside the two car tracks which will cross the bridge. The sidewalks will be of granolithic construction, 8 feet wide, without obstructions in the shape of trolley or electric light poles along the steel-bound curbs. The parapets are openwork concrete balustrades of classic design.

The 884 balusters are the only parts of the structure not concreted in position. They measure about 23 inches long and 10 inches square, and are cast vertically in cast-iron molds at the rate of twenty daily by a gang of five men. When twenty-four hours old they are taken out of the mold and scrubbed, being afterward immersed in water for one week. In this way a very hard, smooth, gray surface is produced, with sharp corners. This surface closely resembles handsome cutstone work, and does not crack nor chip. The bottom of the balusters is recessed to engage a projection in the coping to which it is bonded by a vertical steel dowel.

The reinforced concrete handrail is cast in position on top of the balusters. Asbestos felt filling is used in the expansion joints set between the ends of the 22-foot rails and the balustrade piers. In this way crushing and distortion are prevented. Similar means have been employed in other bridges built by the same designer.

The composition of the concrete used is 1 part cement, 2 parts coarse sand, 5 parts of ¼ to ¾ inch crushed stone; with imbedded flat stones of not less than oneman size placed radially close together. The surface of the concrete is cleaned so as to expose the grit and thus resembles stone in color and texture.

The cost of the construction is a little over a quarter of a million dollars.

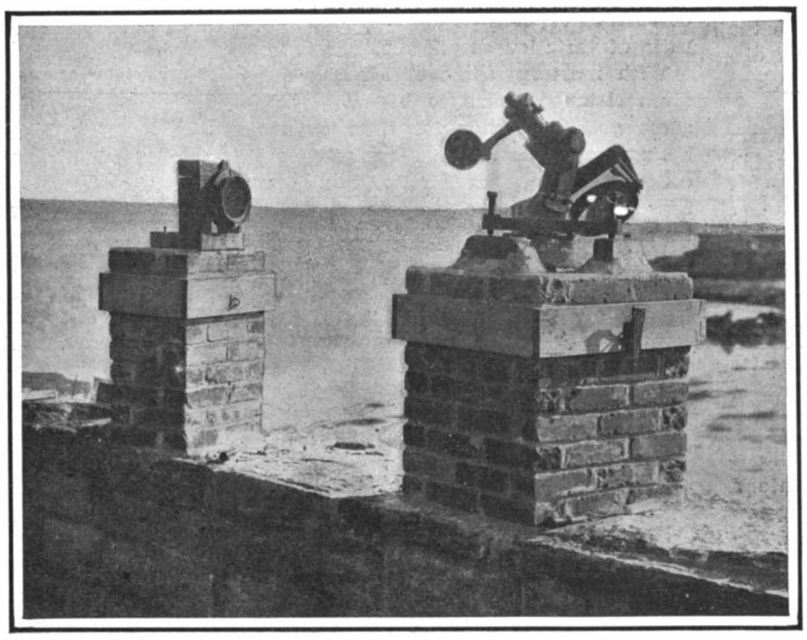
THE TRANSIT OF MERCURY.

BY S. A. MITCHELL, PH.D., AND JOHN NEILSON, COLUMBIA UNIVERSITY.

A splendid series of photographs of the transit of Mercury across the face of the sun was obtained by the writers under rather trying circumstances. On the morning of November 14 the sun rose beautifully clear, and through the early morning haze a magnificent group of sunspots that had been on the sun for four or five days were clearly seen with the naked eye. Before a telescope could be pointed at our giant luminary, clouds had gathered and obscured it from view. These grew thicker and thicker, and by 7:30 (the sun rose about 6:45) quite an early winter's snowstorm was raging. While this snow probably delighted the small boy and brought up to his mind visions of coasting, it did not rejoice the hearts of the astronomers to an equal degree, for each minute of the storm meant just so many minutes less for observing the passage of Mercury in front of the sun.

At 8 o'clock the clouds showed no signs of breaking away, and as the transit was scheduled to end at 8:50 A. M., it looked pretty hopeless. But at 8:25 the clouds cleared as quickly as they had gathered, and for the twenty-five minutes remaining there was a perfect blue sky. A series of ten photographs were made.

For the sole purpose of photographing the transit, a temporary observatory had been erected at Larchmont on the shore of Long Island Sound. The instrumental equipment, kindly loaned by the United States Naval Observatory at Washington, consisted of a cœlostat, carrying a plane mirror, and a photographic lens five inches in diameter and forty feet in focal length. The light from the sun, after being reflected in a horizontal direction by the mirror, passed through the lens, and was brought to a focus on the photographic plate forty feet distant. Exposures were made by a narrow slit driven quickly across in front of the plate. The whole apparatus thus made a huge camera forty feet in length, which differed from the ordinary camera or telescope in that there was no tube or bellows. Each plate was exposed for the one-thousandth part of a second.



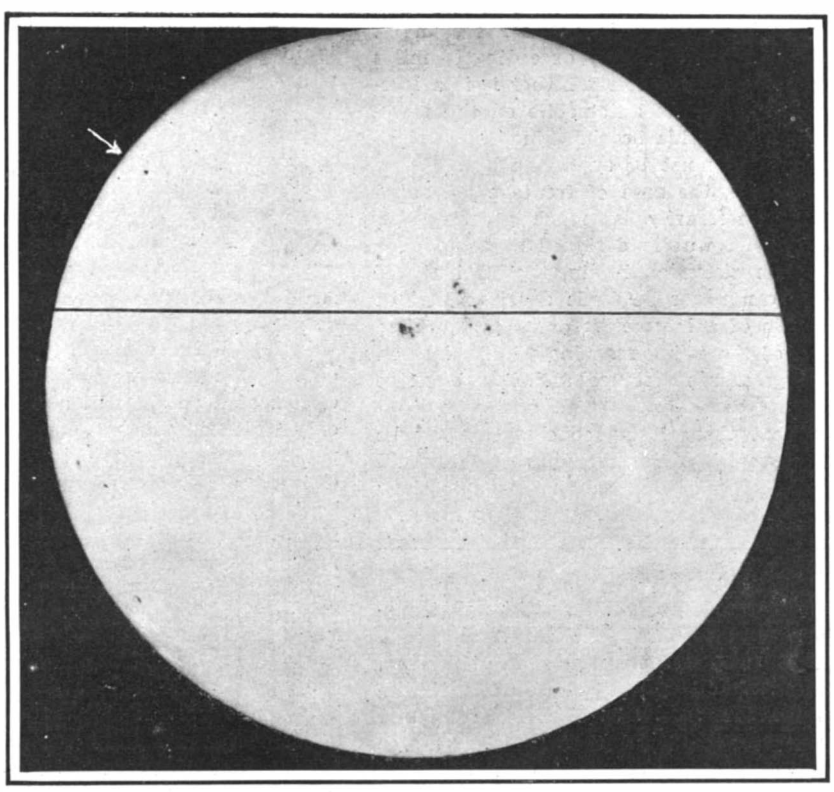
Apparatus With Which the Transit of Mercury Was Photographed.

The plate is in a building 40 feet away.

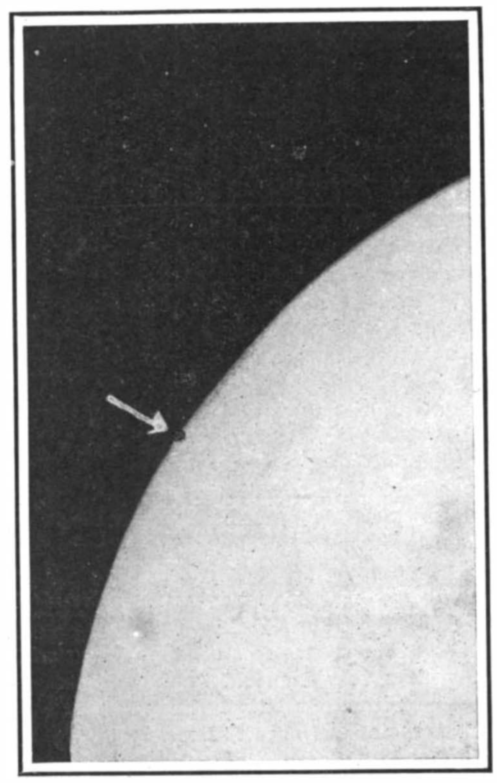
The developed negatives show the sun in splendid focus a little more than four inches in diameter. Mercury is easily visible as a small spot close to the edge of the sun. Its rapid motion is seen by a comparison of the two photographs taken at 8:27 and 8:48 A. M.

Second in importance to Mercury is the splendid group of spots near the center of the sun. This spot group is over 100,000 miles in diameter, a fact easily tested by comparing with the sun, 866,000 miles in diameter.

The horizontal line was photographed on the negative for measuring purposes. The illustration on the left is the sun as it appeared at 8:27. The spot group, dark in the center and shaded toward the edges, is shown in splendid detail. Likewise are to be noted the spots near the edge of the sun. Mercury appears as a small dot on the left-hand side above the horizontal line and near the sun's edge. The second illustration, which is an enlarged view of a portion of the sun, shows Mercury as it is moving off at 8:48. It may be seen just on the edge of the sun, making a nick in it.



Mercury Nearing the Sun's Edge at 8:27 A. M. Note the Spot Group 100,000 Miles in Extent.



Mercury Showing as a Nick in the Sun's Limb at 8:48 A. M.

THE TRANSIT OF MERCURY.

Although not nearly so important nor so rare as transits of Venus, those of Mercury have an importance of their own. The last transit of Venus was that of 1882, and it was very widely observed, in order to find the exact distance in miles of the earth from the sun. The next transit of Venus will be in the year 2004, but it will have no real importance to any of us now living on earth. Mercury last crossed the face of the sun in 1894; the next transit will be in 1914. The smallest planet of the solar system, the nearest to the sun, and the one with the quickest period, Mercury has some peculiarities of motion which have cast a little doubt on the exactness of the law of gravitation, the great fundamental principle which is the foundation of exact astronomy. Transits are observed in order more correctly to determine the planet's orbit, and so test this question, which is in reality one of the great astronomical problems. In addition these transits give a means of finding out whether the earth is a good timepiece, i. e., whether it is rotating uniformly on its axis. Prof. Simon Newcomb, from an investigation of all recorded transits, suspects certain small irregularities in the earth's rotation. These technicalities can be tested only by the slow and arduous process of measuring the photographs under the microscope, and comparing their results with those of former transits. It is too early to say what discoveries have been made from this latest transit of Mercury.

Examination of Handwriting.

It is remarkable how little use has been made of chemical or photographic methods in the examination of handwriting, especially in cases where the evidence of the expert has been inconclusive, and where, perhaps, the point in dispute might easily have been settled by the use of special reagents or of the camera.

Notwithstanding a general similarity in the composition of many commercial inks, the characters made with each on paper can usually be differentiated, and it is even possible sometimes to distinguish between writings done with the same ink but at different periods. When the dried writing done with these different inks is tested with various reagents, pronounced differences will usually be observed.

Erasures may be detected by treating the surface of the paper with distilled water and noting whether the absorption is greater in one part than another owing to the sizing having been removed at the same time as the writing. Skillful forgers have been known to replace the sizing by rosin and glue, and this may be detected by treating the paper first with hot water and then with alcohol, and again examining the surface. Traces of a prior writing may also in some cases be made apparent by the use of an intensifying reagent, such as potassium ferrocyanide.

Any mechanical erasure on the surface of the paper, which may hardly be shown by the greater transparency of the spot, is made much more apparent when photographed by transmitted light, the place then appearing as a blot. The slight spreading of the ink over the fibers of the paper from which the sizing had been partially removed might be all but invisible to the eye, and yet be plainly revealed in the roughened edges of the strokes in an enlarged photograph. Slight differences in the forms of letters or figures become enormous in the enlargement, and the addition of a "y" to "eight," for instance, or the change of "o" into "9" is readily detected.—Knowledge.

In addition to the above-mentioned methods, the microscope offers an effective means of detecting forgeries.

Correspondence.

A Proposed Competition for Inventors of Flying Machines.

To the Editor of the Scientific American:

After carefully studying the problems of mechanical flight for fifteen years, and noting the reports of experiments as they have appeared in your columns during that time, I venture the following suggestion in the hope that it might accelerate our progress. It must be assumed that the large prizes offered to the first successful aviator are offered in good faith; yet many of them have been offered for some years without being claimed or even competed for. If the amount of one or more of these prizes could be made available to conduct proper experiments, I believe the problems would be speedily solved. Designers of airships, even more than other classes of inventors, are without funds to reduce their ideas to practical forms.

To meet this difficulty, I would invite the inventors to submit their designs in a competition in which competent mechanical engineers should be judges. The contest should call for good drawings and complete specifications clearly setting forth the invention or plan. Contestants should be permitted to summarize the objections likely to be offered, and to point out how they have met them in their inventions. By way of prize, financial aid should be extended to the inventor whose design seemed to the judges most practical and most likely to succeed if actually constructed. The right could be reserved to reject all plans submitted, which could be returned to the inventors without being made public unless with the inventor's consent. The donor of the prize could also reserve the right to participate in the patent fights and other profits of the successful competitor.

This plan is respectfully called to the attention of those newspapers which have offered rewards for successful flight. It is worthy the attention also of any person of means, who might desire to promote the science of aerial navigation, and to share in the profits which may be made by the persons lucky enough to secure valid patents on the successful invention.

Denver, Col., October 29, 1907. J. F. Lawson.

Flying Machine Economics.

To the Editor of the Scientific American:

I read with much interest the articles pertaining to flying machines, which appear so frequently in the Scientific American. There seems to be a great difference in the estimate of the power required to propel the machines of different inventors in proportion to their weight. There is also a great diversity in the estimated velocity at which the different machines will fly, and this difference in velocity is not accompanied by a corresponding difference in power developed.

To illustrate: In the last number of the Scientific American appears an article by the Paris correspondent, descriptive of the machine designed by Henri Farman. The weight of the machine, including the pilot, is 1,100 pounds; the speed, 3(miles an hour; power of the motor, 50 horse-power; area of aeroplane, 561 square feet.

In the same article we have a description of the machine designed by A. V. Rowe, giving data and estimates as follows: Weight, 450 pounds; speed, 40 miles per hour; motor, 6 horse-power; area of aeroplane, 480 square feet.

In reading such descriptions, the thoughful seeker after facts can draw either of the following conclusions: that the data pertaining to flying machines have not yet reached a scientific basis and that we have no trustworthy "flying machine economics," or if there is such a science, the inventors of flying machines seem to be entirely ignorant of its principles.

In the two cases cited, one machine weighs 22 pounds to the horse-power and the other 75. The first has approximately 2 pounds to the square foot of aeroplane, while the latter has less than 1 pound to the square foot, and the machine with the relatively large area of aeroplane and small motor has one-third more speed than the one with the relatively small aeroplane and higher powered motor.

Is it true that there are no data obtainable that can furnish a fairly accurate theoretical basis for the experimenter to work upon? Can we rely upon the statement on the authority of Langley, that "a 1-horse-power engine can carry 208 pounds through the air at 40 miles per hour"?

Let us analyze that statement. At 40 miles an hour, the velocity is 3,520 feet per minute. 1 horse-power, or 33,000 foot-pounds, would exert a thrust through 3,520 feet of $\frac{33,000}{3,520}$, or 9.375 pounds, or less than 10 pounds.

Now, to use a hypothetical illustration, is it true that a kite weighing 208 pounds can be made to fly in a 40-mile breeze, with a pull on a horizontal kite-string of less than 10 pounds? That is what the statement amounts to, and there are a great many that are somewhat skeptical as to its truth. Now, it seems to some of the readers of flying machine literature that there has been enough experimental work done to establish what might be regarded as the fundamental principle of aeronautics with quite a degree of certainty. The principles of greatest importance, and seemingly the easiest to discover, would be the following:

First. What form of air propeller is most efficient, and what is its efficiency?

Second. What form of aeroplane has greatest lifting power, and what is its lifting power at different velocities for each horse-power expended in propelling it through the air?

Third. What is the air resistance per square foot of surface exposed at a given velocity, and what the ratio of variation at different speeds?

With most inventors of airships the conception of air resistance seems to be very peculiar. They assume great efficiency for their propellers and great lifting power for their aeroplanes, which means, of course, great air resistance, but at the same time, they expect the machine to move through the air at tremendous speed, with relatively little power expended, which means small air resistance.

The most striking example of the latter anomaly is furnished by the designer of an airship a picture and description of which you will find inclosed. The weight is given as 100 tons; speed, 300 miles an hour approximately; and carrying capacity, 100 passengers; fare from Chicago to New York, or say 900 miles when the trip is made in three hours, $10 per passenger. In this example we can deduce the cost of fuel, and hence the size of the motor, from the data given; that is, the gross receipts for the trip.

Now, we know it would require a constant lifting power of 100 tons to keep such a machine floating in the air, and whatever may be the method of suspension, the apparatus would necessarily present a very large area of cross-section frontage to offer resistance to rapid horizontal motion through the air. Therefore, to force such a structure through the air at a velocity of 300 miles per hour would require an expense for fuel out of proportion to the small carrying capacity and consequent income of the machine.

While there is a great deal that we do not know about flying machines, in contemplating the future there are at least two predictions that can be made with a high degree of certainty; first, a flying machine will never be able to carry a given weight of paying load a given distance as cheaply as it can be carried on wheels; second, the speed of a flying machine equipped with the same power will never be equal to that of a vehicle on wheels, either rolling over steel rails or a smooth hard road surface. The chief obstacle to high speed is the air resistance. By high speed we mean a velocity exceeding 60 miles an hour. This is true no matter whether it is a locomotive on steel rails, or an automobile on the wave-swept course on the Florida beach. Since the weight of the flying machine must be supported by an aeroplane or other device, the area of frontage presented to the air must necessarily be much greater than that of a machine on wheels designed so as to offer the minimum air resistance. Again, the efficiency of an air propeller can never be made equal to that of the driving wheels of a locomotive or an automobile; hence the speed of the flying machine will be less on account of the greater resistance and less effective driving power.

I am aware that these latter conclusions may be criticised by designers of flying machines, but I would like to know what explanation can be given to show that they are not correct. F. E. Stanley.

Yosemite Waters to be Conserved.

A plan is on foot to conserve the waters that supply the Yosemite and Bridal Veil Falls so that each will flow three months more per year than at present. These falls usually go dry about August. By building reservoirs in the headwaters of Bridal Veil and Yosemite creeks, it is believed that sufficient water can be stored to maintain the flow over the falls until late in October. A preliminary survey indicates that the project is an entirely feasible one.

Ordinary white phosphorus being very poisonous and injurious to handle, other forms of the element have been sought. Red amorphous phosphorus, which is not poisonous, is readily prepared by heating the ordinary variety to 250 deg. C. in a closed vessel under pressure, or excluded from air and water. It has not the same qualities, however, as the white crystalline variety. A red crystalline form, recently discovered in Germany, is made by heating to boiling a ten per cent solution of white phosphorus in phosphorus tribromide. This is not poisonous and is an efficient substitute for white phosphorus in making matches. As certain European countries have forbidden the manufacture and sale of the white variety, amorphous phosphorus and safety matches are coming into general use.

The Current Supplement.

Of the minerals composing the group called mica, practically only two are commercially valuable for their physical properties. Of these two varieties only one is found in deposits of commercial value in the United States. In the current Supplement, No. 1665. Douglas B. Sterrett discusses these deposits in a thorough article. Dr. Alfred Gradenwitz tells how sensitiveness of photographic plates may be determined mechanically. Gas-engine valves is a subject upon which E. F. Blair writes instructively. Much interest is manifested among English tin miners in a new process of concentrating ores by oil. The English correspondent of the Scientific American describes this process at length. The last installment of Mr. Morrison's treatise on the development of armored war vessels is presented, the subject being modern American armor. Building a transatlantic liner is the subject of an article by the Berlin correspondent of the Scientific American, the vessel selected being the "Kronprinzessin Cecilie." Various methods of recovering rubber from wastes are described. Another technological article of interest is one on verde antique finish, its rapid production, and the method of obtaining the various shades. Dr. Lee de Forest writes on the audion, his new receiver for wireless telegraphy. The eucalyptus trees of Australia are technically considered by Henry S. Smith.

Dr. Charcot's Antarctic Expedition.

About the end of next July, Dr. Charcot, the French explorer, who recently passed two years in the Antarctic exploring the great continent there, expects to again continue his work already begun. The French Académie des Sciences, and other learned bodies, are urging the French government to pay a part at least of the $160,000 that the expedition to explore this continent, which is as large as Europe and Australia combined, will cost. The remainder left unpaid by the French government will be raised by private subscription. The explorer will spend two years at the work. Although exploration is the main aim of Dr. Charcot, a great deal of time will be spent in carrying on investigations to substantiate the theories set forth by Prof. Gaudry, of the Académie, who holds that the discovery of fossils in Patagonia destroys a great many of the formerly-held ideas concerning the progress of evolution. He says that "this development does not appear to have had the same continuity in the two hemispheres, and it is to further discoveries in the Antarctic that we must look for a solution of that great problem, the origin of life."

The discovery of Dr. Nordenskjold, who found fossil imprints of tropical plants in the Antarctic, proves that there was once in the neighborhood of the South Pole a rich and abundant vegetation. The ship that is to carry the expedition to their working ground was especially built for it at St. Malo. It will be a vessel of 800 tons burden, and have 500 horse-power engines capable of producing a speed of eight knots. A supply of 230 tons of coal and 120 tons of miscellaneous material will be taken for the voyage. Thirty men, nearly all of whom took part in the expedition two years ago, will comprise the crew.

An Important Change in Editing the Official Gazette of the Patent Office.

Owing to the constantly increasing number of patents issued each week in the United States, all the claims of a patent will appear in the Official Gazette only when they do not exceed five in number. Where patents have more than five claims, only five of the claims will be printed, and the number omitted will be indicated. Henceforth it will not always be possible to ascertain from the Official Gazette all of the features covered by a patent if the patent is issued with more than five claims. If a public library with the monthly volumes containing the complete copy is not accessible, it will be necessary to obtain a copy of the patent. As the number of copies of patents printed each week is limited, the supply is rapidly exhausted.

Following the statement made by Sir William Ramsay that a solution of copper sulphate in distilled water shows in the spectroscope the characteristic red line of lithium when placed in contact with the emanation from radium, comes the report that the German chemist Dr. Theodore Grosse has succeeded in breaking up the element platinum. He for a number of hours subjected potassium carbonate, maintained at a high temperature in a platinum vessel, to the action of an alternating current between platinum electrodes. After some time, the electrodes became coated with a deposit of charcoal-colored crystals, and gave evidence of having been attacked, both the electrodes and the containing vessel losing weight. On extracting the melt, a brown powder free from carbon or potassium was obtained. Although both the crystals and the powder gave solutions from which they were precipitated by hydrogen sulphide, the presence of platinum could not be detected.

THE ENLARGEMENT AND RECONSTRUCTION OF GOVERNOR'S ISLAND.

It too frequently happens that in the reconstruction of public works, those who plan and build take too limited a view of the possible developments of the future, with the result that all too soon the ever-rising tide of population and industry again overflows its accommodations. No such mistake, however, has been made by the government in planning the enlargement and reconstruction of the military post at Governor's Island. A careful study of the drawing on the front page of this issue, showing a bird's eye view of the island as it will appear when the great works which are now under way are completed, should satisfy the most skeptical that the plans of the government to establish at Governor's Island one of the greatest military posts of the world are in a fair way to be realized.

Governor's Island, lying to the southeast of the lower end of Manhattan Island and not far from the Brooklyn shore, is a familiar spot, not merely to New Yorkers, but to all of the many millions who have occasion to enter or leave the United States through the port of New York, or as residents have occasion to sail on the waters of the Upper Bay.

It was in 1794 that Governor's Island was established as a military post, and shortly thereafter the now historic walls of Castle Williams began to rise on the westerly extremity of the island. The castle, we are glad to learn, will be included in the scheme of reconstruction, and another structure of historic interest which will be permitted to remain is Fort Jay, which crowns the summit of the island. From the center of the fort there will rise as a crowning architectural feature a large water tower, whose architecture will conform to that of the surroundings. Two other historic structures which will be permitted to remain are the Chapel of Cornelius the Centurion, and the South Battery built many years ago for the protection of the Buttermilk Channel. Outside of these four buildings the government will make a clean sweep of the other structures, all of whose interest is purely of a sentimental, and certainly not of an architectural character. The museum, the regimental headquarters, and in fact every residence on the east side, will be swept away, as will also the homes of the officers, including the really handsome old mansion at present occupied by Gen. Grant.

The most notable work in connection with the reconstruction is the enlargement of the island by the addition of over 100 acres at its southerly end. For this work Congress appropriated $1,100,000, and the additional ground is being secured by building two long masonry sea walls, starting from opposite sides of the island and converging in a southerly direction to finish in a bold semicircular sweep. The inclosed area is being filled in by dredges, and it is expected that in three years' time work will be complete and a total area of 101 acres added to the present island. Upon the whole island, as thus enlarged, the government has planned to erect all the buildings necessary for the accommodation of a full regiment, including the homes for the officers, barracks for the men, and all the buildings incidental to the work of the headquarters of the Department of the East.

Commencing at Castle Williams, and extending along the southerly front of the new portion of the island, there will be a long row of twenty-eight buildings, including the prison guard, the corps barracks, the home of the hospital sergeant, and a handsome hospital building. Beyond these, and flanking the easterly side of the great parade ground, will be seventeen separate houses for the accommodation of the regimental officers. A similar row of seventeen homes will flank the parade ground on the westerly side. To the north of the parade ground will be thirteen handsome villas for the accommodation of the commanding officer and other senior officers of the regiment, including the captains, majors, surgeons, etc. On the south the parade ground will be bounded by buildings for the accommodation of the enlisted men to the number of 1,200. These barrack buildings will be of great size, and nothing has been left undone to provide the men with every convenience and comfort common to this class of building. The parade ground, as thus inclosed, will be the finest in the country, with a length of 1,700 feet and a breadth varying from 1,400 feet at its northerly end to 900 feet along its southern boundary. To the south of the barrack buildings will be a large athletic field, 600 feet in length and from 800 to 300 feet in width. Around the athletic field, and corresponding in position to the regimental officers' quarters, will be the separate homes of the non-commissioned officers.

The northerly portion of the grounds, or what is practically the present island, will be occupied by a fine semicircular park, the center of which will continue to be occupied by the present Fort Jay, with its new reservoir and water tower; while around the park, and fronting upon a great semicircular driveway encircling the northern end of the island, will be other homes of the department and staff officers. On the northeast side of the island and 400 feet distant, with a broad driveway and an avenue of trees between, will be another group of officers' quarters, flanked by a stately mansion built for the accommodation of the commanding general. On the northwesterly side of the island, fronting the southern end of Manhattan Island, will be some of the largest and most important structures included in the new scheme of reconstruction. Among these will be a large two-storied building for the quartermaster's department, a medical supply depot, and many other buildings for the ordnance and engineers' department. There will be two new ferry slips, one for passenger and the other for freight service, between which there will be four piers at which lighters and small freight-carrying craft will unload the vast amount of quartermaster's supplies which will be brought to the island for shipment to our distant possessions. One of the most important improvements will be the construction of a basin of sufficient size to accommodate at any one time two of the largest of our transport ships. It is expected that the reclamation of the 101 acres at the southern end of the island will be completed within three years' time, when the work of erecting the buildings and preparing the grounds will be energetically prosecuted.

Luminous Frogs and Crabs.

The flesh of most sea fishes and other marine animals becomes more or less luminous within a day or two after death. The light is emitted, however, not by the flesh itself, but by certain bacteria which can be collected from its surface, and which are of common occurrence in sea water. A similar appearance, due also to the presence of luminous bacteria, is often presented by meat. These bacteria are harmless to human beings, as they cannot live at a temperature above 76 deg. F., and the temperature of the human body is 98 deg. F., but living cold-blooded animals can be inoculated with luminous bacteria, with surprising results. The Russian physiologist Tarchanoff inoculated frogs with luminous bacteria obtained from the Baltic. The bacteria multiplied in the blood, and caused the entire body of the frog to emit light. The luminescence, which was especially intense in the tongue and other soft parts, continued three or four days. Similar phenomena have been observed to occur naturally in cold-blooded animals. A few years ago the French naturalist Giard found among the sand hoppers that swarmed on the beach at Wimereux one which, instead of hopping, crawled slowly over the sand and glowed brightly. On examination, the body of the little crustacean was found to be filled with luminous bacteria. When other sand hoppers were inoculated with its blood, they also became luminous, gradually lost strength, and soon died, but continued to glow for several hours after death.

The observed cases of luminescence in earthworms, mole crickets, and other cold-blooded animals not normally luminous, are probably to be attributed to a similar infection with luminous bacteria or luminous fungi.

Capt. Amundsen to Attempt to Reach the North Pole through Bering Strait.

Capt. Raold Amundsen has recently stated that he intends to make another start for the North Pole in 1910. He said: "My head is full of plans for my next expedition, though none of them have been fully worked out or finally decided upon. I have decided, though, to make my next trip through Bering Strait rather than by the eastern route selected by Commander Peary. It is probable that I shall also take with me about the same number of men, seven, and possibly stay for the same length of time in the North."

Capt. Amundsen, during the three years that he spent in the North while on his last expedition, definitely located the magnetic pole and succeeded in navigating the Northwestern Passage.

Earthquakes and Petroleum Fields.

In a paper recently presented to the French Academy of Sciences, M. Tassart points out an interesting connection between petroleum layers and seismical phenomena.

A thorough examination of the location of petroleum fields has brought out the following facts:

1. All petroleum fields situated in recent strata are confined within regions of maximum seismical activity or in their immediate vicinity.

2. Petroleum fields are but rarely found in ancient strata, within seismical zones.

3. Those petroleum fields which are situated outside of such zones belong to ancient strata and were formerly the seat of a lively seismical activity.

Error Corrected.

Through an oversight, the name of the firm of architects that designed Mr. Thomas A. Edison's concrete house was given as "Manning & Macneille." It should have been Messrs. Mann & Macneille.

THE PETERS SELF-REGISTERING ELECTRIC TARGET FOR RIFLE RANGES.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

At the Bisley rifle meeting in England last year, great interest was centered in a new type of target that has been invented by Lieut.-Col. George A. Peters of the Ninth Toronto Light Horse for the automatic indication by electrical agency of the effect of shots. This apparatus has been designed for the purpose of securing an immediate and accurate record of the shot fired, dispensing with the necessity and cost of constructing a mantelet for the protection of the markers, and also with the attendance of markers, two of whom are ordinarily required in the operation of the usual balanced type of target. In this self-registering electric target there is a face-plate of solid steel which, through the agency of certain mechanical devices distributed over its posterior surface, is capable of responding in sections. When a bullet strikes any part of the target, the corresponding unit behind the plate is set in operation, in such a way that an electric circuit is closed, and a disk on the corresponding part of an indicator or annunciator, similar to that employed in connection with electric bells, is exposed at the firing point. The apparatus illustrated in the accompanying engravings is designed for use in indoor or miniature ranges, but the principle of design and the operation are precisely the same as in those for use on outdoor ranges.

The main framework of the target is composed of a pair of substantial upright standards connected by cross-beams, and furnished with bases which are firmly bolted to a square horizontal platform of heavy timber. In the case of those adapted to miniature range practice, as illustrated, the target is carried upon a heavy iron pedestal. The target itself is swung upon the standards by means of a rocking frame, the front arms of which are mounted on pivots near the four corners of the plate.

The rocking frame is designed upon the principle of a parallel ruler or a system of parallel motion levers by means of which the plate as a whole can be raised and lowered in the direction of the arc of a circle having a radius equal to the length of the anterior arms of the rocking frame—this length is also equal to the radial length of the hammers—without altering the vertical position of the frame. By this means the plate may be brought nearer to or removed farther from the back plate supporting the hammers without disturbing the vertical position. The presence of the rocking frame enables the target to be made adjustable as regards sensitiveness for various ranges, weights, and velocities of different ammunition, while it is also through the movement of this section that the working integrity of all parts of the target may be tested.

The target plate is constructed of three layers of chrome steel, alternately hard and soft, as adopted in the laminated construction of burglar-proof safes. When the range exceeds 100 yards, but little impression upon its surface is made by the bullets.

The plate supporting the moving hammers is composed of mild steel about ¼ inch in thickness, and is rigidly bolted to the cross-beams between the standards. It is pierced by a series of oblong slots for the reception of the hammers, which are supported by pairs of lugs or brackets obtained by simply bending up the strips of plate from the sides of the slot. The number of hammers adopted varies according to the size of the target. The target required for indoor or miniature range practice is only 15 inches in diameter and 37 hammers are employed, while in a target 4 feet in diameter 61 hammers are required. The hammers are placed in concentric circles about the central hammer, which corresponds to the "bull's eye," there being 6 hammers in the "inner" circle, 12 in the "magpie" circle, 18 in the "outer" circle, and an additional circle of 24 outside of these which are grouped for working purposes with the hammers of the "outer" circle. In a 6-foot target for use at 500, 600, and 800 yards, respectively, which is the largest yet made, and which has recently been installed at the Toronto Rifle Ranges, the same number of hammers as in the 4-foot target is utilized, the hammers being placed farther apart. Each hammer is supported upon the back plate by a pivot which passes horizontally through it near its rear extremity, and rests simply by its own weight upon the lugs or brackets already described. Thus each hammer can easily and readily be removed by hand when required for examination or repair.

The opposite end of each hammer is provided with a rounded head, and this rests normally against the rear face of the target plate. The backward motion of the hammer, however, is regulated by means of a shoulder which insures that the center of gravity of the hammer piece is always in front of its supporting pivot, so that after being driven backward by the impact of the bullet striking the target plate it immediately falls back into its normal position against the target plate.

The end of the hammer projecting beyond the point where it is pivoted is provided with a tail or spur which projects almost vertically upward, when the hammer is in the normal position. When, however, the hammer is forced backward by the impact of the bullet, this spur moves in a circular direction backward and establishes sliding electrical contact, with a slender insulated brass spring connected by wire with the annunciator. This contact continues through a length of time corresponding to the end of the rearward movement of the hammer, and also to the beginning of its return movement. It will thus be seen that a length of contact is obtained which is considerably in excess of that required to cause the corresponding indicator upon the annunciator to drop. One of the leads of the electric cable is soldered to each brass contact, while earthing is obtained by soldering the wire to some portion of the supporting plate, thereby forming a complete electrical circuit broken only between the hammer spurs and their respective brass springs. The battery is located at the annunciator end of the cable. When one hammer or more is moved and an electrical connection established, the corresponding magnet or magnets on the annunciator are energized and the indicator or indicators fall, recording the result of the shot fired.

The annunciator is constructed of galvanized iron with a weather-proof case and incloses a number of electro-magnets arranged in concentric circles to conform to the arrangement of the hammers of the target. Each of the electro-magnets when energized operates a very simple form of corresponding gravity drop. The groups of indicators in the respective rings carry the customary scoring numbers. The annunciator is equipped with a restoring mechanism which is operated by a strong magnet, so that after the drop or drops have fallen, the simple pressing of a button resets the apparatus.

When a bullet strikes the plate, no appreciable movement of the whole results from the impact, but the impact sets up a bulging over a certain circumscribed area, around the point where the missile strikes. Should this point be immediately opposite one of the hammers, that hammer only will be forced backward. At the same time it is obvious that the area to which any hammer will respond will be circular in outline, and it is equally obvious that the disposition of the hammers must be such that the circular areas must overlap one another, so that no dead spaces are left, which would be irresponsive to the impact of the bullet. Therefore, should the bullet strike the target in the space where two hammer areas overlap, both corresponding hammers will be affected and driven back, and their corresponding indicators on the annunciator will fall. Similar results will attend the striking of the target at those places where three and even four fields of influence overlap, so that it is possible for four indicators to be exposed as the result of one shot. At first sight this circumstance might appear to militate against the utility of the apparatus for scoring purposes, but as a matter of fact it assists appreciably in the localization of the shot. For instance, in a target having 37 hammers, if it were required that each shot should be responded to by the fall of one drop only, then there could be only 37 points of localization; but when it is remembered that the location of each shot is approximately opposite the hammer when only one drop falls, and in the case of the bullet hitting the target mid-way between two hammers when two indicators fall, and so on with three and four drops, the number of points of localization becomes considerably increased, aggregating over 150 different points. The degree of accuracy of localization by means of this apparatus will be readily appreciated when it is remembered that in regard to the "bull's eye" alone there are thirteen different localizations that can be automatically indicated in the circular area 7 inches in diameter at a range of 200 yards. Ricocheting shots, which often enter into the scoring with the canvas targets, are with this apparatus eliminated, since they have not sufficient momentum when finally striking the target to force the hammer back far

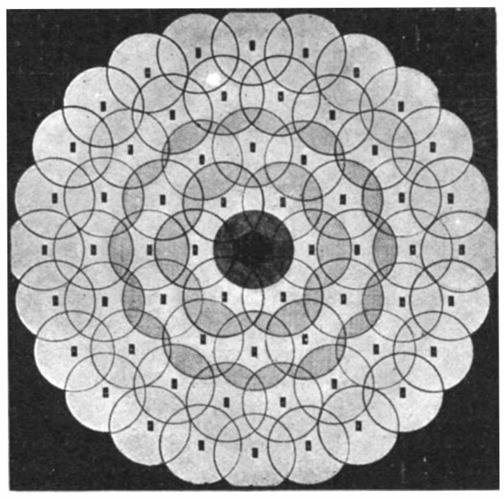


Diagram of the Recording Zones; the Black Spots Represent Individual Hammers.

enough to make the necessary electrical contact. At the present time, all "bull's eyes" are placed on an even basis in scoring, and in rifle competitions "ties" often result, simply because there is no fair way of discriminating between the marksman who strikes the dead center of the "bull's eye" and the one who strikes it upon the circumference of its area. With this apparatus, however, it is quite easy to make such distinctions with perfect fairness. Owing to the overlapping of the respective fields of influence, instead of there being only four zones corresponding to "bull's eye," "inner," "magpie," and "outer," respectively, there are seven distinct fields.

Upon rifle ranges where a series of targets may be required, each target is provided with its own annunciator at the firing line, but a cable with a single set of wires will suffice for an unlimited number of targets, provided there are as many wires in the cable as there are hammers or groups of hammers in any one target, besides a ground wire for each target. Thus a range having 10 targets and 37 hammers upon each would require a cable with 47 wires. This equipment would enable all the targets being in operation at the same time without any possibility of one interfering with the other, since it is apparent that each annunciator will only respond when the circuit is completed through its own ground wire. For protecting the cable from stray bullets it should be buried at a depth of about 8 inches.

THE NESTS AND NURSERIES OF INSECTS.

BY PERCY COLLINS.

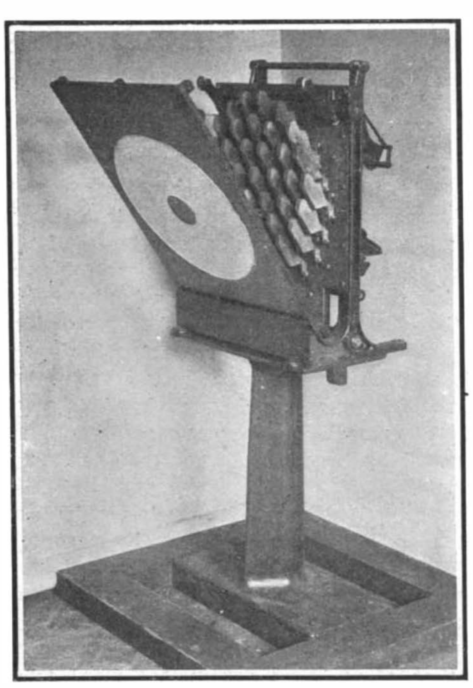
An insect emerges from the egg as a grub, or caterpillar. As such it enters upon a period of active existence, when its chief business in life is the assimilation of nourishment; and not until it has lain dormant for a while as a pupa or chrysalis does it assume the perfect, winged state. These middle stages of an insect's life—the grub and pupa—may be regarded as its babyhood. Moreover, the insect is almost always an orphan, its parents having expired soon after the egg was deposited; so that the young insect must depend mainly for protection upon the seclusion of some kind of nursery, formed either by its own early efforts, or by the instinctive labors of its parents. These retreats range from mere tunnels beneath the surface of the ground to wonderfully wrought structures formed from a special material manufactured by the insects themselves. To search for and to examine these varied nests and nurseries is one of the most pleasant country pastimes.

We will pass over the burrowers in the soil, and the tunnelers in wood, both rotten and sound. A word may be said, however, respecting those insects which pass their babyhood within fruit and vegetables, often much to the annoyance and loss of the horiculturist. We may take for an example the well-known pest, the codling moth—an insect which attacks all the best kinds of apples. The moth lays its eggs singly upon the very young apples—one to each fruit. As soon as the grub hatches, it tunnels inward and makes for the core, upon which it chiefly feeds. Many of the apples known as "windfalls" have been attacked by these grubs, and the pests may be discovered merely by splitting the fruit open with a knife. If undisturbed, the little caterpillar eventually makes its way out of the apple, and concealing itself in a cranny of the bark, changes to a chrysalis. This insect is troublesome not only in the United States, but wherever apples are grown. In Tasmania it is especially dreaded, and the legislature has passed an act for its repression.

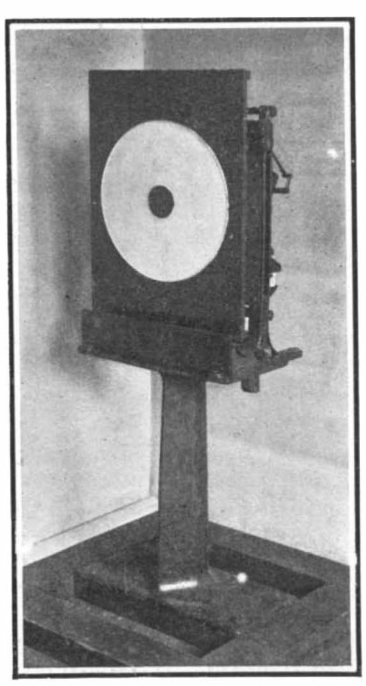
The grubs of other small moths actually mine between the outer skins of leaves, subsisting upon the green tissue, which they gnaw away. That these insects are exceedingly minute is manifest by the fact that the leaves within which they feed and find shelter are not much thicker than stout paper. Many leaves are thus attacked, the various kinds of bramble being specially liable. Sometimes the workings of the caterpillars are seen in long, tortuous galleries; at others, the inner tissue is eaten away over considerable areas, and blister-like blotches result.

We may now pass to those insects which gain shelter by means of secretions from their own bodies. Good examples are the so-called "spit" or "cuckoo-spit" insects. The immature insects form strange patches of frothy moisture upon leaves and twigs; and these are virtually liquid nests. Within, the owner sucks the juices of the plant upon which it finds itself, inserting its tiny beak beneath the bark of the stem. Ultimately, when it becomes adult, it abandons its frothy home, and lives a dry and active life as a fully developed "hopper." Scientifically speaking, it belongs to the great order *Homoptera*. Many of its near relatives, especially those of tropical countries, have the power of secreting a waxy substance, thus supplying their persons with a protective disguise. Something of the kind is seen in the case of the well-known and much-dreaded "woolly aphis," a pest which does so much damage to apple trees. There can be little doubt that these secretions, whatever their character, are a provision of Nature whereby the insects are hidden from the sharp eyes of birds and insectivorous creatures in general.

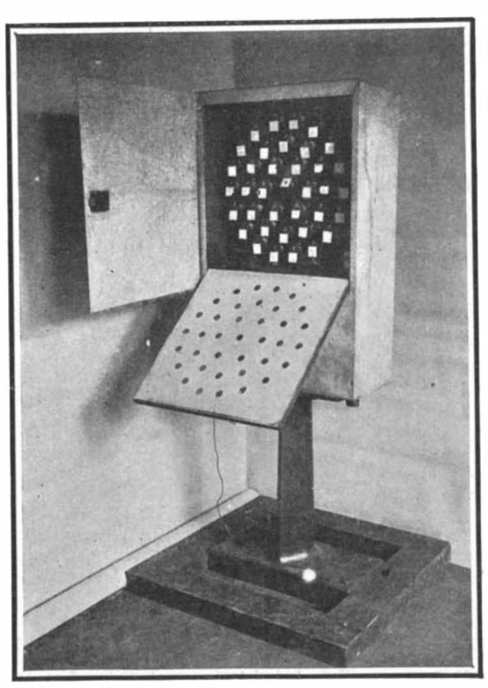
We now come to case-making insects, which form a small but interesting group. The best known, perhaps, are the aquatic grubs of the caddis flies. As soon as the young larva emerges from the egg, it sets



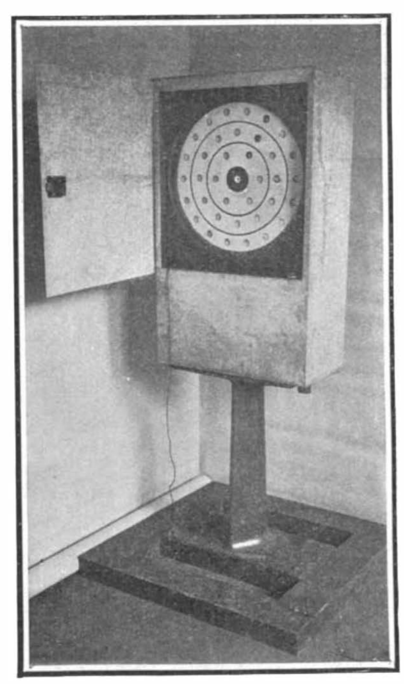
The Chrome-Steel Target, Showing Arrangement of the Recording Hammers.



The Peters Electric Self-Registering Target.



The Electro-Magnets Operating the Gravity Drop Indicators for Recording the Shots.



The Annunciator Constructed of Galvanized Iron.

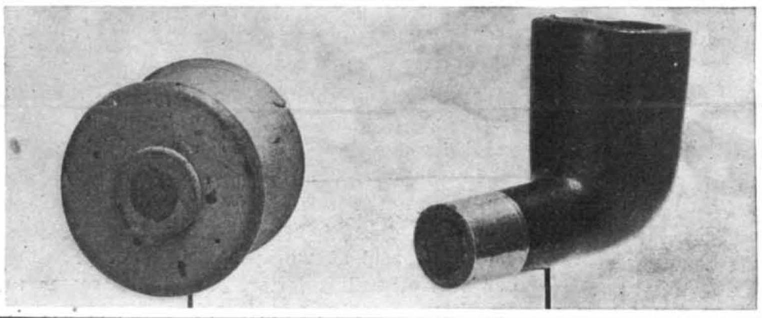
THE PETERS SELF-REGISTERING ELECTRIC TARGET FOR RIFLE RANGES.

about collecting material for its case—or, in other words, the nursery in which it may lie secure from the attacks of other water creatures. Different species of caddis flies select different materials, though what governs their choice is not always possible to say, though at times it is obvious that they take whatever material is most abundant upon their particular stream bottom. Some choose small fragments of stick or reed, others make use of tiny stones, while still others gather together small shells, caring not whether their rightful owners have, or have not, abandoned them. Eventually, when the period of feeding is complete, the grubs close the entrance of their cases, and change to pupæ therein.

But caddis flies are not the only insects which form protective cases. The habit is shared by certain moths, belonging to several families. The tiny caterpillar of the "cloth moth," for example, builds for itself a cylindrical case from fragments of the cloth upon which it feeds, as may be observed—alas! too frequently—without crossing the threshold of one's own home. The caterpillars of other moths, outdoor species this time, make their cases of lengths of grass, stick, or reeds, fixing the material together with a silk lining. Of some such moths, the females are wingless, and remain in their cases throughout life, actually depositing their eggs therein. Thus the old nursery of the mother becomes a place of protection for the eggs until they hatch in the following season.

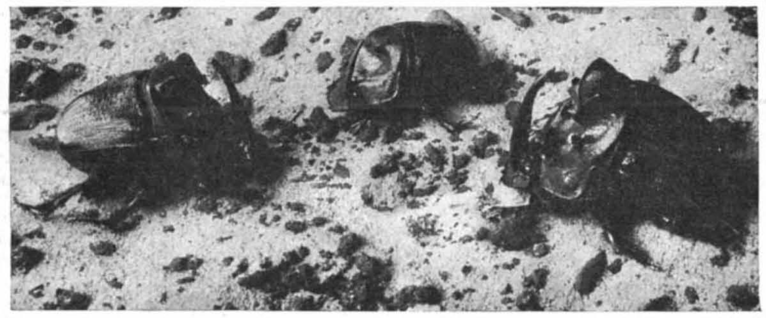
Among moths, too, we find that many caterpillars which dwell habitually in company construct a common nest, or tent, for the benefit of the community. Such is the well-known American tent caterpillar, the moth being responsible for a good deal of damage in orchards and gardens. The tents are really nests of silk spun among leaves and twigs. In them the caterpillars dwell when young, and to them they resort for shelter in rainy weather, and at night, even when they are older grown. Allied species, which pass through the winter in the caterpillar state, construct hibernacula, or winter sleeping places. These are often conspicuous among the branches during the cold months of the year. If torn open, they reveal a surprising thickness of spun silk, forming a dense, non-conductive wall. At the center of the mass lie from thirty to fifty tightly-packed caterpillars, waiting for the return of the warm weather, when they will resume their feeding.

Up to the present, we have seen only how immature insects provide nests and nurseries for themselves. But not infrequently both food and a safe retreat are provided by the parent at the time of egg-laying. At a few such cases we may now glance, taking first a typical species of burying beetle. In the course of a country ramble one often comes upon a dead bird, mouse, or some such carcass. On turning it over with a stick, several burying beetles may usually be discovered at work. Their method of procedure is as follows: The dead body being found, the female deposits her eggs upon it. She appears to be endowed with an instinct which tells her just how many hungry grubs the particular carcass will support, and she lays her eggs accordingly. Then both the male and the female beetle commence the interment. They scoop away the earth from beneath the body, which gradually sinks into the ground. In the

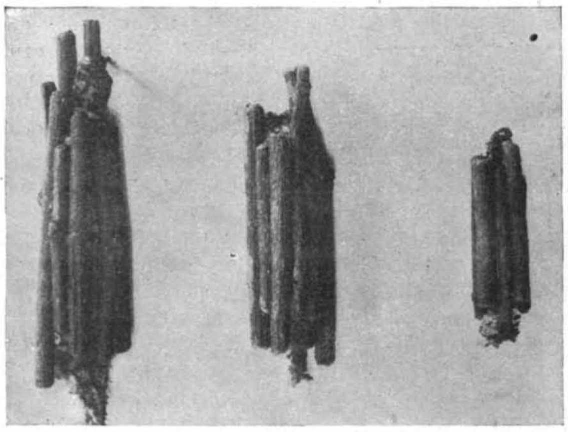


Common Articles the Holes of Which Have Been Filled With Clay and Used as Nests by a Solitary Wasp.

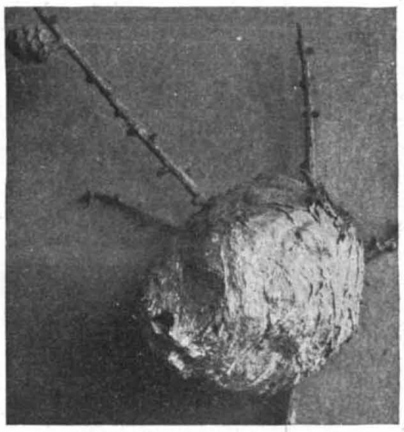
Bramble Leaf Tunneled by a Small Caterpillar.



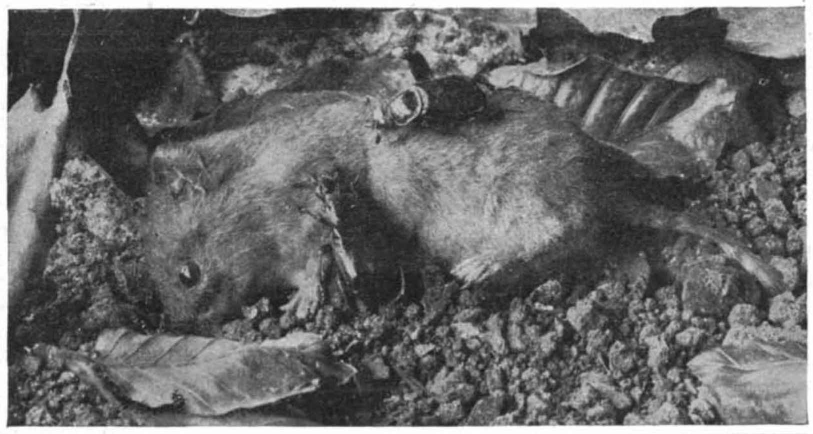
Brazilian Dung Burying Beetles. This Class of Beetle is Found in Most Quarters of the Globe.



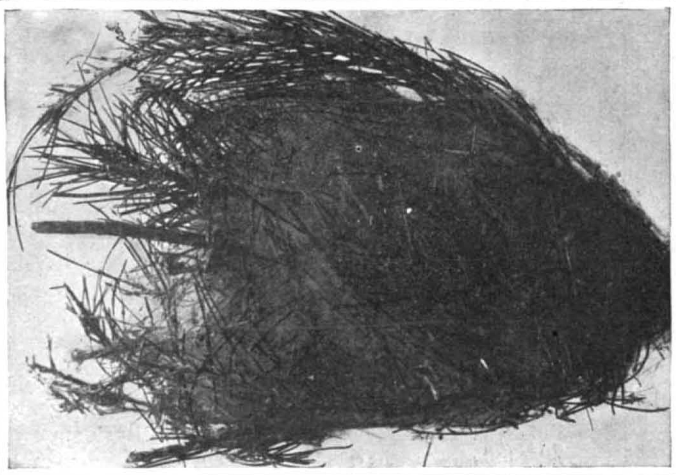
Cases Made by Caterpillars From Short Twigs.



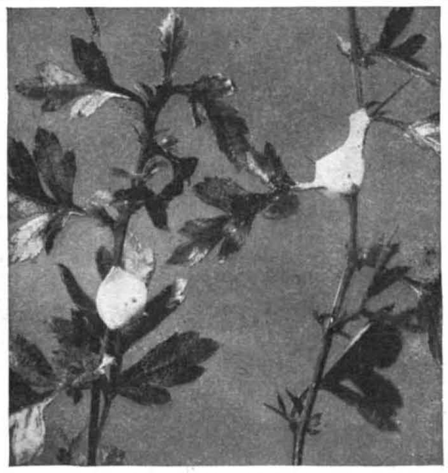
Woodpaper Nest of Tree Wasp.



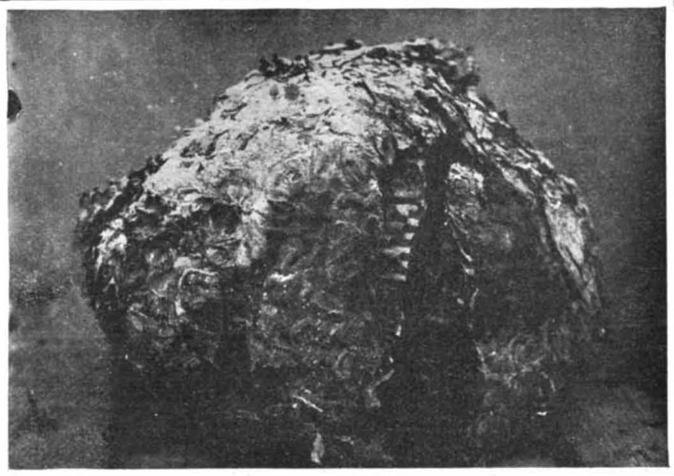
Burying Beetles of the Genus Necrophorus at Work on a Mouse.



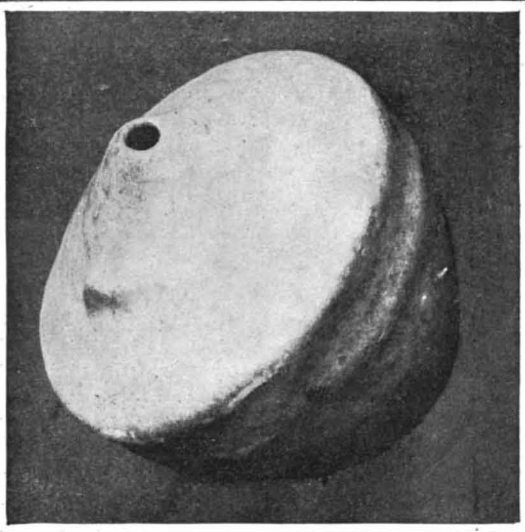
The Winter Sleeping Place of a Colony of Caterpillars.



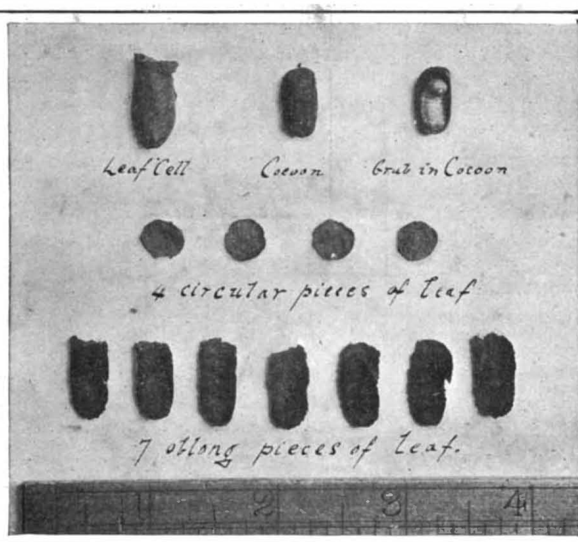
Froth of the "Cuckoo Spit" Insects.



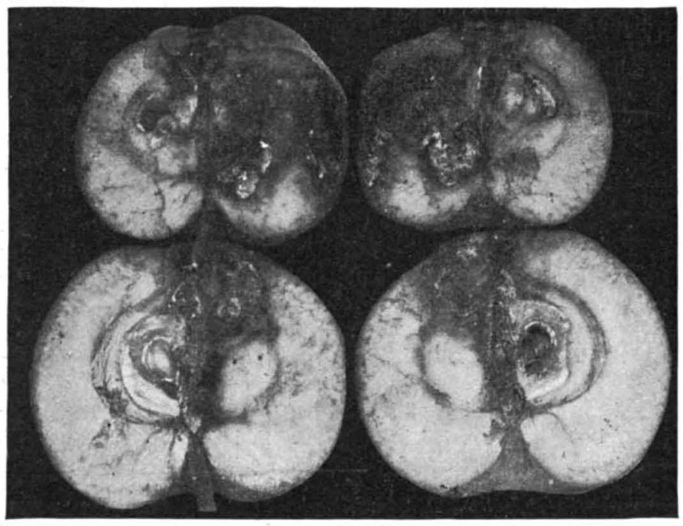
Nest of an Underground Species of Wasp.



Brazilian Tree-Wasps' Waterproof Nest.



Details of the Cell of a Leaf-Cutter Bee.



Apples Infested by Grubs of the Codling Moth.

THE NESTS AND NURSERIES OF INSECTS.

case of a rabbit or a rat, or any such large animal, many pairs of beetles combine their labors; and when the ground beneath is soft, the interment is often completed in a surprisingly short space of time. Thus when the young grubs hatch from the eggs they not only find themselves surrounded by abundant food, but are able to consume it secure from the attacks of birds and other grub-eating creatures, to which they would be exposed upon the surface of the ground. Incidentally, it is worth noting that these insects are capital scavengers, for they hide away rotting matter in the best of all deodorizers, Mother Earth. In like manner a vast number of beetles act as scavengers, and at the same time provide food for their offspring, by burying the droppings of animals. The scarab, or sacred beetle of the Egyptians, is one of these; but hundreds of allied species, in almost every country of the globe, have similar habits. They make balls of the refuse matter, lay an egg in the center of each, and then roll the balls about in the sun to harden. Finally, a hole is bored in the ground, and the ball is buried therein. When the grubs hatch, they feed upon the manure; thus not only sustaining themselves, but mingling the valuable nitrogenous matter with the soil.

But of all insects, the most careful parents, the most accomplished nest builders, are certainly the bees and wasps. Both groups of insects are subdivided, according to their habits, into social and solitary species. The latter know nothing of joint labor, each female constructing and provisioning a few cells, or nurseries, in which to place her eggs; the former dwell together in colonies and build elaborate nests. But in all species the instinct of nest building is highly developed, while the material employed varies as much as the manner in which it is shaped into the required form.

A typical solitary nest-builder is the leaf-cutter bee, of which a number of species have been described, each using a different kind of leaf, or the petals of flowers. The species to which we will turn our attention employs the rose leaf for its architecture. The insect first searches for a rotten beam or fence, into which she tunnels, readily chipping away the soft wood with her powerful jaws. She then repairs to a rose tree, and cuts from a leaf an oblong portion. This she does as quickly as an experienced tailor cuts cloth, and with equal accuracy. The portion of leaf is then conveyed to the tunnel, one or more pauses being made by the bee for rest should the distance be great.

The insect now carries the portion of leaf to the extremity of her tunnel, treads it into place, and immediately returns for a second piece. The process is repeated until the bee is satisfied that the requisite number (usually seven) of pieces has been cut and put into place in the form of a thimble-shaped cell. This cell is then partially filled with a mixture of pollen and honey, upon the summit of which an egg is laid. Four circular pieces of rose leaf are then cut by the bee, and pressed down to form a cover for the cell; and when one cell is complete, the insect goes on to construct others until her tunnel is filled.

Each grub, when it hatches, finds itself in a snug little nursery, secure from enemies, and supplied with the exact amount of food requisite for its needs. When it has eaten what the cell contains, it will be ready to spin its cocoon and assume its pupa form, and will require no more nourishment until it emerges as a mature winged insect.

This is merely a typical example of a solitary Hymenopteron. Innumerable other species abound in summer, and each has its own way of providing nurseries for its progeny. Some small kinds of solitary wasps build with mud in holes, and if they can find a hole ready made, they willingly make use of it. In most museums we may see specimens of such nests fitted into the hole in a reel of cotton, a pipe stem, or some such homely article. But if the reader will take the trouble to examine discarded domestic objects of this kind which have been lying long in an outhouse, or upon a garden heap, he is quite likely to find these wasps' nests for himself, and may have the satisfaction of hatching out the wasps in due season.

It is, however, among the social wasps that we find the most wonderful builders; we find, too, a most remarkable physiological difference between the insects themselves. Solitary wasps and bees are merely divided into two sexes—males and females; but among social species we find not only males and females, but also a large percentage of imperfect females, known as workers. These workers, although they are capable of laying eggs, and do at times lay them, are said invariably to produce males, or drones. They of course bear no direct part in the perpetuation of the species, but they constitute a powerful labor factor in the insect community of which they are members, and it is owing to their ceaseless labors that the marvelous nests, consisting of thousands of cells, are built up and repaired.

Much has been written respecting the habits of social bees, so that we may devote our remaining space to a brief consideration of social wasps as typical of communal nest builders in general. Unlike bees, many kinds of which pass the winter in their nests, sustaining life upon the provisions which they have collected during the summer, wasps succumb before the increasing cold of autumn. But from this merciless scourge of mortality a few wasps escape. These are the "queens" of the next season. They pass the winter in some warm cranny, and when the spring arrives, each one comes forth from its hiding place, and seeks a suitable position for the nest that is to be. This found, the queen repairs to a fence or tree trunk, and with her jaws rasps off a bundle of wood fiber which, when moistened with saliva and kneaded, forms the paper-like substance of which the nest is entirely constructed. For just as bees have, so to speak, invented a special nest-building material which we call wax, so wasps have acquired the habit of preparing for the same purpose a rough, but very durable paper.

The queen-mother lays the foundation of the city with her own hands—or, rather, with her own jaws. She attaches a sort of stalk of wood paper to a chosen support. This may be the branch of a tree, a root in a cavity below the ground, or a beam in a garden shed. The choice of locality varies with the species of wasp. But the stalk prepared, the queen proceeds to construct a few shallow cells, in each of which she lays an egg. After this she continues to form more cells, and to lay more eggs; and ere long she has to feed the young grubs which have hatched from the first batch laid, so that her time is fully occupied. Soon, however, some of the grubs turn to pupæ, and the pupæ to perfect wasps—worker wasps, which take over the labor of the young colony. Thus, the city grows rapidly, until the vast nest, with its thousands of cells, comes into being.

In conclusion, special attention may be called to the durability of the wood-paper manufactured by the wasps. Even in the case of the frailer nests built in the open by tree wasps, the power to withstand the effect of rain is very great; while the nests of the tropical species seem designed to resist the heaviest downpours. Such a nest is shown in the accompanying photograph. It was cut from an orange tree in Brazil, and its smooth exterior resembles thick cardboard.

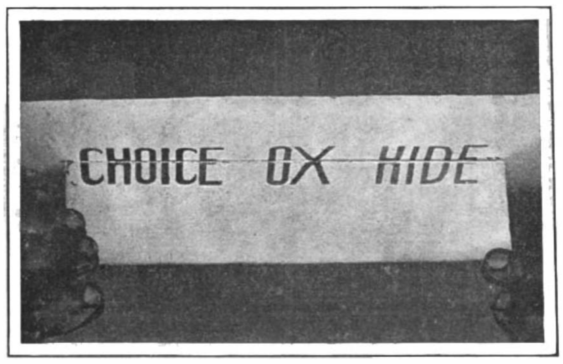
SOME EXPERIMENTS WITH A MIRROR.

BY GUSTAV MICHAUD, COSTA RICA STATE COLLEGE.

Ask your friend whether he can decipher the following sign, which you pretend to have read over the shop of an Armenian shoemaker.

The Mysterious Script.

He will probably tell you that he is not conversant with Oriental languages. Tell him that the sign is written in good English and, while he smiles incredulously, lay a frameless mirror perpendicularly on the mysterious script, right across the quotation marks. The result is shown.



Its English Translation.

We understand at once that the reflected image is the faithful copy of the written half, and we consequently believe that if we were allowed to see in a mirror our pencil, our hand, and the paper on which we write we would have no more trouble in writing and reading what we have written than if we were directly watching our pencil at work. This is too bold an inference, and the following experiment shows how far it is from being true:

Ask your friend to write anything he chooses, with the condition that he shall see his hand and read the script in the mirror only. With the help of a few books arrange the mirror and the paper as shown herewith.

A Case of Temporary Illiteracy.

The writer sets at work, but will not probably go farther than the first letter. His hand seems to be struck with *paralysis agitans*, and unable to write anything but zigzags.

You take his pencil and write rapidly and correctly in the same conditions. Your secret can be told in a few words: First, close your eyes; as long as you strive to follow the pencil in the mirror, your efforts to write are vain. Second, write in printed capitals and make no attempt to write anything but the pseudo Armenian sign and a few other sentences which participate of the same characteristic. What is that characteristic? It is not hard to find. Find it.

The peculiar inversion of objects viewed in a mirror is of course the cause of the difficulty felt in reading or writing. The writer is left free to write from left to right, but finds that while he is so doing, the mirror upsets his letters. There is an entirely distinct kind of inversion which can be best observed with the help of a mirror. The most suitable time for the making of the following experiment is after a meal the menu of which included soft-boiled eggs. Take an egg shell and trim it with scissors so as to reduce it to a half shell. In the hollow bottom, roughly draw with your pencil a cross with pointed ends. Bore a hole, about the size of a pea, in the center of the cross. Place yourself so as to face a window, the light falling upon your face, not upon the mirror which you hold in one hand. Close one eye. Place the shell between the other eye and the mirror, at a distance of two or three inches from either, the concavity facing the mirror. Through the hole in the shell look at the mirror as if this were some distant object. While you are so doing, the concave shell will suddenly assume a strongly convex appearance. You may then examine it directly in all its parts; no amount of auto-suggestion will allow you to get rid of the illusion. To destroy it, it becomes necessary either to open both eyes or to withdraw the shell away from the mirror. The nearer the shell to the mirror and the farther the eye from the shell the more readily comes the illusion.

An Extraordinary Inversion.

SOME EXPERIMENTS WITH A MIRROR.

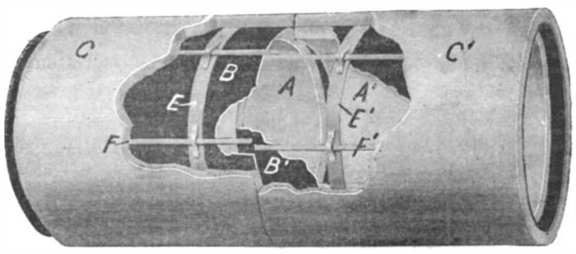
The hole in the shell acts as a diaphragm, and its position, at some distance from the eye, favors the localization of the luminous pencils in the crystalline lens. Those which are emitted by the marginal parts of the egg are refracted exclusively by the marginal parts of the crystalline lens. They are more bent and give smaller images than the pencils which are sent by the center of the shell. The decreasing scale of reproduction from the center of the shell to its periphery offsets the influence of distance on the appearance of images of points situated on the anterior or posterior parts of the shell.

In a recent issue of the Railroad Gazette Mr. A. Stucki presented some very interesting data on the relative costs of steam and gas power, basing his estimates on conditions obtaining in Pittsburg, and assuming a plant of 1,000 horse-power. He stated that the cost of 1,000 horse-power per year would be $13,125, a high-speed non-condensing engine being used, and $8,625 in the case of a triple-expansion condensing engine. The cost of the coal used was taken at $2.50 per ton. With natural gas at 15 cents per 1,000 cubic feet, 1,000 horse-power per year would cost $4,500, while if producer gas made from Pittsburg coal were used, the cost of the same amount of power would be $3,675.

Patent Department

AN IMPROVED FORM OF REINFORCED CONCRETE PIPE.

Pictured in the accompanying engraving is a water pipe consisting of a sheet-iron cylinder provided with an outer and inner lining of concrete. The pipe is made in sections, and the iron cylinders are electrically welded to each other. The concrete is reinforced by circular bands and longitudinal bars. Altogether, the structure is particularly adapted for conducting water under high pressure. In our engraving two pipe sec-

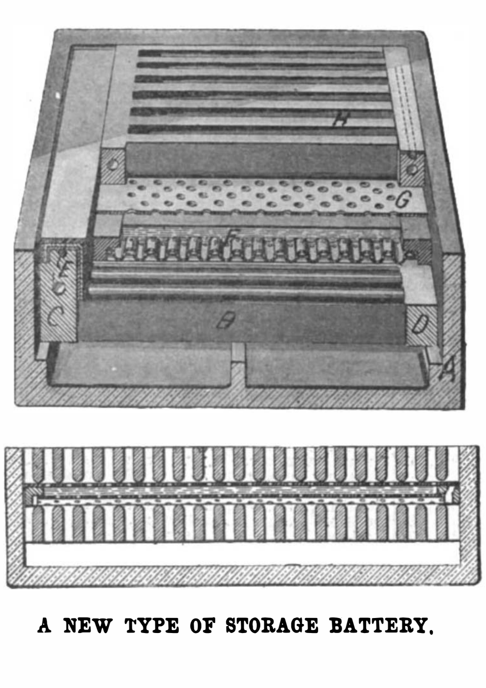


AN IMPROVED FORM OF REINFORCED CONCRETE PIPE.

tions are shown ready to be welded. The inner lining of one of the pipe sections is shown at *A* within the sheet-iron cylinder *B*. The outer coating *C* ends flush with the right-hand end of the cylinder *B*, while the lining *A* at this end is inset, forming a recess. It will be noted that at the left-hand end of each pipe section the metal cylinder projects beyond the face of the inner and outer linings, and is adapted to enter the recess formed in the right-hand end of the adjacent pipe section. Fitted over the cylinder *B* are a pair of bands *E*, which are cut to form straps, under which the reinforcing bars *F* are secured. In joining up a pipe the adjacent sheet-iron cylinders *B* and *B'* are welded together electrically on the inside, after which the joint is cemented up. Thus the entire pipe consists of a continuous metal cylinder, which is thoroughly protected by a dense coat of concrete on all sides. There is no danger of leakage, and the smooth inner concrete lining will permit a larger flow of water under a given head than a riveted pipe. This concrete lining also insures freedom from "tuberculation," which trouble materially reduces the area and carrying capacity of the ordinary iron pipe. The danger of collapse incident to unbraced steel conduits is obviated by the strength of the concrete arch. The bands or bars may be increased according to the pressure the pipe is required to sustain. Pipes of this type have been built to stand a 300-foot head of pressure. The improved pipe has been patented by the Reinforced Concrete Pipe Company, of Jackson, Mich.

A NEW TYPE OF STORAGE BATTERY.

Storage batteries as usually constructed are comparatively heavy and the yield of ampere hours is very small per pound of active material used. The accompanying engraving illustrates an improved storage battery which provides for considerable increase in electrical storage capacity, and a material reduction of the weight of this cell. The battery consists of a glass cell, *A*, formed with a central rib and ledges on the side walls adapted to support the positive electrode, *B*. This is in the form of a carbon grid comprising the longitudinal bars *C* and *D* connected by a series of cross bars. In the upper face of bar *C* a conductor *E* is imbedded. This conductor is held in place by means of a zinc cap electroplated on. The zinc is covered by a coat of paraffin. Resting on the positive electrode *B* is a frame which carries on its under side a corrugated plate, *F*, made of hard rubber. Supported on the upper side of the frame is a flat plate *G*, also of hard rubber. Between these plates a chamber is formed which is filled with asbestos. The plates *F* and *G* are perforated to provide escape for the gases generated. The fiber wall serves to mechanically assist in keeping the different solutions of the cell separated. Resting on the plate *G* is the negative electrode *H*, which is also preferably made of carbon in the form of a grid. This grid is also provided with a conductor imbedded and sealed in place. The chamber beneath the positive electrode *B* is completely filled with carbon tetra-chlorid, bromoform, chloroform, or any liquid solvent of bromin of which the specific gravity is greater than a solution of zinc bromid which is thereafter poured into the cell to fill the interstices and cover the greater portion of the upper electrode. In charging the battery, zinc from the zinc bromid solution is deposited upon the electrode *H*, and bromid is liberated at the electrode *B*, and since it is of higher specific gravity it falls to the surface of the carbon tetrachlorid, or other solution used, said solution having the property of extracting bromin from the bromid solution. When the cell is completely charged the spaces between the lower carbon electrode are filled nearly to the top with a solution of carbon tetra-chlorid and the bromin liberated from the zinc bromid at this point. When the cell discharges the bromin is withdrawn from the solution of carbon tetra-chlorid and the zinc deposited on the negative electrode is combined therewith to again form zinc bromid. Mr. Homer E. R. Little, of 1403 Webster Avenue, New York, N. Y., is the inventor of this storage battery.


A NEW TYPE OF STORAGE BATTERY.

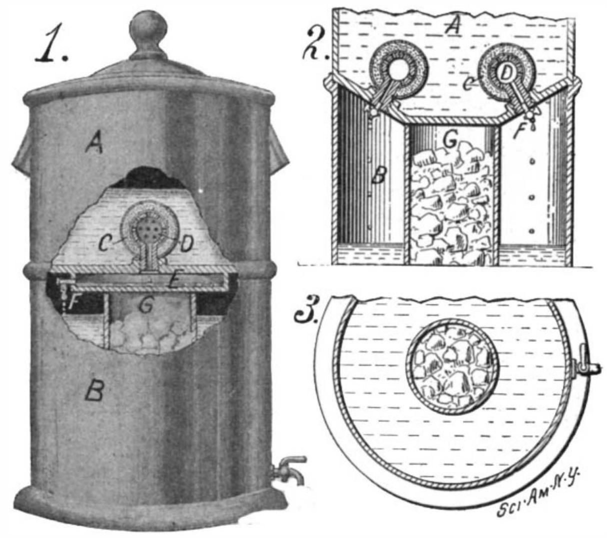
Brief Notes Concerning Patents.

A report received from the United States consul at Gothenburg, Sweden, announces the invention of a miniature head telephone, which it is said will be of great value not only to telephone operators, but to persons whose hearing is defective. The invention is that of the chief of the Swedish government telephone department. The receiver measures one-half by five-eighths inch; and over the diaphragm may be screwed a cover continued into the ear-tip. The connection to the receiver may be a fine flexible cord, no heavier than an eyeglass cord. No helmet or other attaching device is required to hold the receiver in place.

In the operation of large office buildings and similar establishments, there is a constant demand for keys. Where locks of the pin-tumbler cylinder type are used, this is a serious matter, for the keys are not interchangeable as with the ordinary kind, and there is no chance of finding a stray key in a bunch which will open a lock. New keys must be made constantly. Then again the flat keys used on the modern locks are difficult to duplicate, so that the services of a lock-smith or at least a good mechanic are required. A very ingenious and effective device to meet this condition has been recently invented. It is a key-filing jig, a neat little apparatus consisting principally of a plate 2¼ by 2½ inches, and means are provided for securing a pattern at one point with the key blank directly above it. A gage-pin with a vertical and horizontal movement travels in a slot between the two keys, and this is also provided with the means of being secured at any point. The bottom end of the pin being placed in the cutting of the pattern key, acts as a guide for cutting the blank without any possibility of cutting too deep into the blank. Two of these pins are furnished with each jig to meet the different demands of the work, but only one pin is used at a time. With such assistance, anyone who can handle a file can make a key with little trouble.

COMBINED WATER HEATER, FILTER, AND COOLER.

One of the drawbacks to the use of the ordinary water cooler without a separate ice chamber is the great danger that disease-producing bacteria, like typhoid and other germs, may be liberated from the melted ice and contaminate the drinking water. To provide means for preventing this and, further, to provide means for sterilizing water suspected of being contaminated, and then filtering and aerating such water, the combined water heater, filter, and cooler herewith shown has been devised. The device comprises two vessels adapted to be placed one above the other. The upper vessel *A* is the boiler, and is separate from the lower vessel *B*, which serves to cool the water. In the vessel *A* there is a filter consisting of a perforated shell *D*, over which filtering material *C* is placed. The water in the vessel *A* filters through this material into the shell *D*, and thence drips into a chamber *E*. At one side of this chamber or pan there is a stop cock *F*, which may be opened to permit the drip of the filtered water into the cooler *B*. As the water drips into the pan *E*, and thence into the vessel *B*, it is thoroughly aerated. In the center of the vessel *B* is a cylinder, in which ice is placed. This serves to thoroughly cool the water in vessel *B*, which may be drawn off, as desired, through the usual stopcock. In use, before placing the vessel *A* over the cooler, it is set on a stove or range to boil the water, and thus sterilize it. In Fig. 2 another construction of the vessel *A* is shown. The pan *E* is dispensed with. The bottom of the vessel is provided with a flat surface at the center, to permit its resting conveniently on the top of the range; but the outer portion of the bottom is inclined. Several filter shells are used, and are provided with stopcocks which project from this inclined

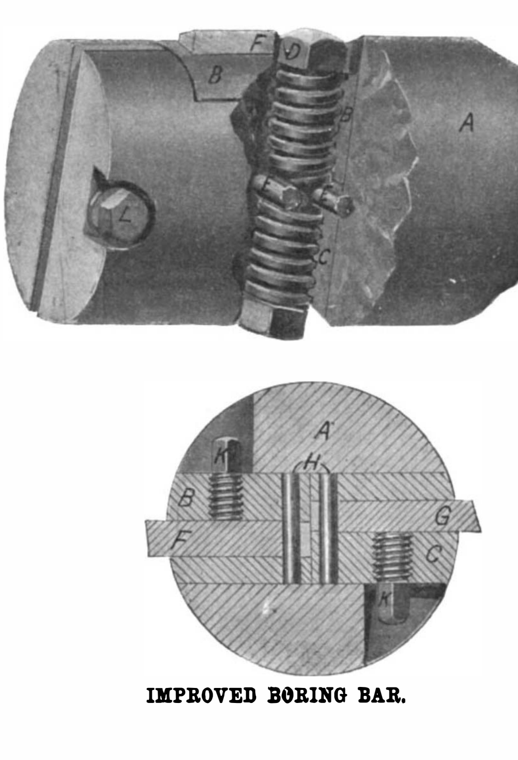


COMBINED WATER HEATER, FILTER, AND COOLER.

portion. By means of this construction the dripcocks are free from contact with the top of the range when the water is being boiled. The use of several filters increases the filtering capacity. A patent on this improved device has been granted to Dr. P. A. Aurness, Minneapolis, Minn.

IMPROVED BORING BAR.

The boring bar, which is shown in the accompanying engraving, is particularly adapted for use in boring out car wheels to fit the latter to the axle instead of the axle to the wheels. The device is of very simple construction and provides means whereby the tool-holding blocks may be quickly and accurately adjusted, as the work proceeds. The boring bar is indicated at *A* in the engraving, which shows only the lower part of the tool. In this bar is a transverse slot adapted to receive a pair of blocks, *B* and *C*. A screw, *D*, passes through these blocks. That portion of the screw which passes through block *B* is cut with a right-hand thread, while the portion engaging block *C* is formed with a left-hand thread. To prevent longitudinal movement of the adjusting screw *D* it is retained by means of a pair of rods, *E*, which pass through the bar *A* and fit into an annular channel in the center of the screw *D*. The block *B* is formed with a transverse slot to receive the cutting tool, *F*, and similarly, the block *C* carries the cutting tool, *G*. The pins *H* in the blocks *B* and *C* prevent the cutting tools from being moved too far inward. The cutting tools are clamped in the required position by means of screws, *K*. A slit extends from the end of the bar *A* to the transverse slot in which the blocks *B* are held, and by means of a screw *L* the opposite sides of the bar *A* may be drawn together to clamp the blocks in set position. Whenever it is desired to adjust the cutting tools it is merely necessary to release the screw *L* and then by turning the screw *D* the blocks *B* and *C* may be adjusted toward or from each other, carrying their respective cutting tools *F* and *G* inward or outward to the required degree. The ends of the blocks *B* and *C* are beveled and rounded so that when the screw *L* is tightened the blocks will be clamped at the ends as well as at the sides. A patent on this boring bar has been secured by Mr. William Chase, Jr., Indianapolis, Ind.


IMPROVED BORING BAR.

RECENTLY PATENTED INVENTIONS.

Of General Interest.

SPUD AND HOISTING FRAME FOR EXCAVATORS.—J. P. KARR and J. D. RAUCH, Logansport, Ind. As the result of long experience in use of certain excavators the inventors have devised and put in successful use a construction of frames whereby defects are avoided and advantages gained. The composite frame is made up of a vertical main, or "spud" frame, a so-called A-frame and braces therefor, together with various attachments of these individual frames. They have found by actual practice that the frame produced is strong and light and one in which strains are so distributed that it remains rigid while hoisting the heaviest loads.

LOCKING DEVICE FOR SEAT-GUARDS.—S. E. JACKMAN, New York, N. Y. The object of the present invention is to provide a device for seat guards of a car, boat or a like vehicle, traveling over an incline or a switch-back railway, such as is used in pleasure resorts, exhibition grounds and the like, the guard being arranged to insure perfect safety to passengers seated in the vehicle by preventing them from accidentally opening the guard during travel. It relates to locking devices such as shown and described in the Letters Patent of the U. S., formerly granted to Mr. Jackman.

Machines and Mechanical Devices.

INDICATOR FOR TYPEWRITING MACHINES.—H. A. DEWING, San Buenaventura, Cal. The object here is to provide an indicator arranged to indicate the exact point at which the character to be struck will appear on the paper, at the same time indicating the exact line above the scale at which the type will strike, thus permitting the operator to quickly manipulate the machine in filling in blanks, writing on ruled paper, and correcting errors or omissions and when the carriage is raised to see at a glance at what point the next character will appear.

MARINE PROPULSION.—F. C. BENNING, Mezpique, La. This inventor proposes to arrange a pair of floats spaced apart between which an endless belt is arranged mounted on pulleys the shaft of one of which is designed to be driven by any suitable power. The pulleys at their peripheries are given a zigzag form to present pockets alternately at each side, his idea being that in this way the pulleys will be readily freed from any debris.

Prime Movers and Their Accessories.

STEAM-GENERATOR.—H. COX, Abraham, Utah. The invention relates to water tube steam boilers. The object is to provide a generator, devoid of undesirable flat surfaces, internal stays, stay bolts, braces, and the like, and arranged to compensate for the unequal expansion and contraction of the boiler relative to the steam drum, and to permit convenient access to various parts for removing scale, sediment, etc.

Railways and Their Accessories.

FENDER.—J. A. SAGE, Stryker, Ohio. The fender in this patent is connected with the adjacent truck of the car in such a manner that as the truck turns in going around a curve it will impart a lateral, swinging movement to the fender. The patentee provides a novel cushion to the rear of the fender and above the same, and has a special construction of raising and lowering means for the fender whereby the throwing of a hand lever will raise the fender while the motorman may with his foot depress a releasing device for instantly lowering the fender.

RAIL-CLAMP.—P. A. BONIS, New York, N. Y. In the present patent the invention has for its object the provision of means simple in construction, effective in operation, and durable in use, adapted to enable a rail to be securely held on its supporting ties, and to be readily applied thereto or detached therefrom.

Pertaining to Vehicles.

SPROCKET WHEEL AND CHAIN.—R. S. MCINTYRE, Riverside, Cal. The present application is a division of one formerly filed by Mr. McIntyre, under title of "Automatic driving gear." The object is to produce a sprocket wheel and chain which will operate efficiently to transmit a rotary movement, and, further, to provide a construction which will insure that the chain will not become displaced from the wheel.

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

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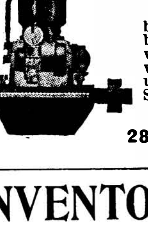

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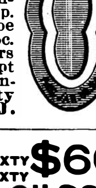

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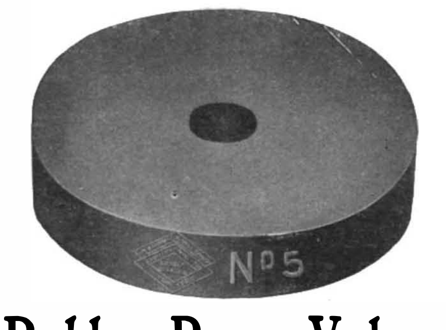

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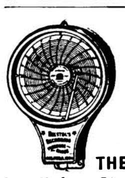

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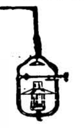

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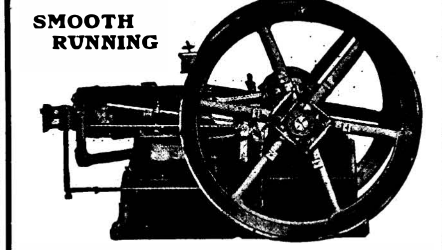

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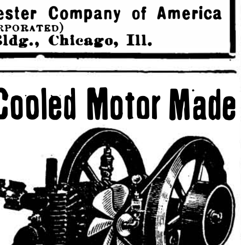

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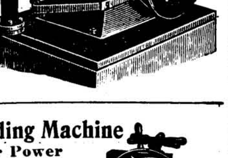

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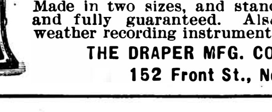

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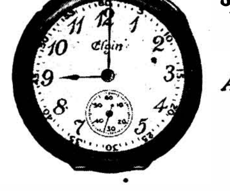

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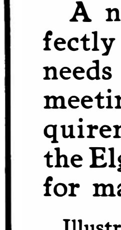

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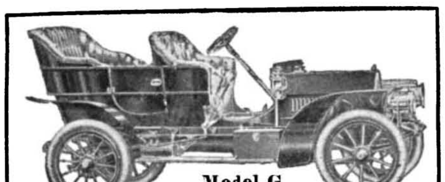

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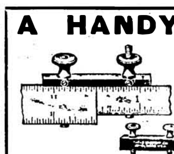

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