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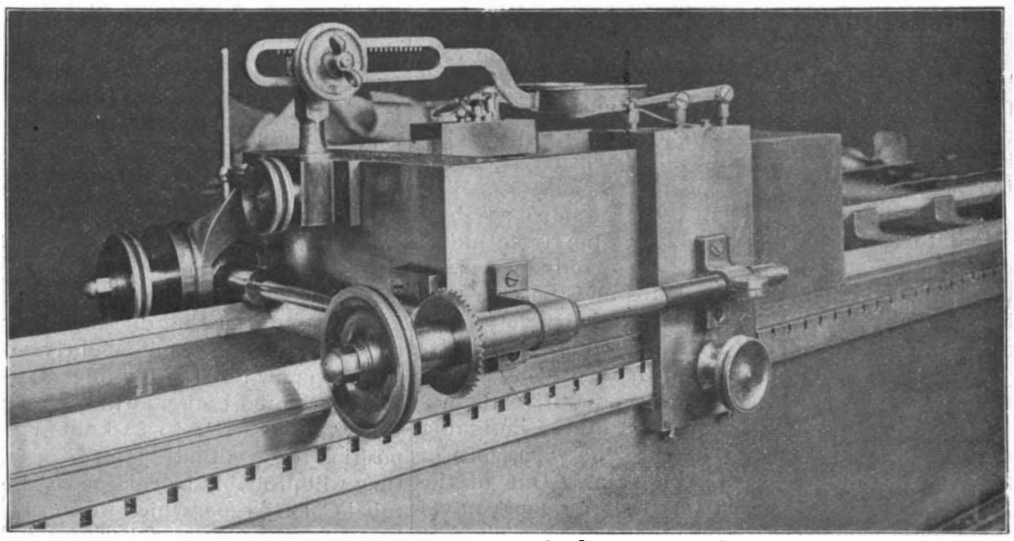
## MEASURING AND TESTING INSTRUMENTS USED IN THE MANUFACTURE OF NAVAL ORDNANCE.

BY E. J. PRINDLE.

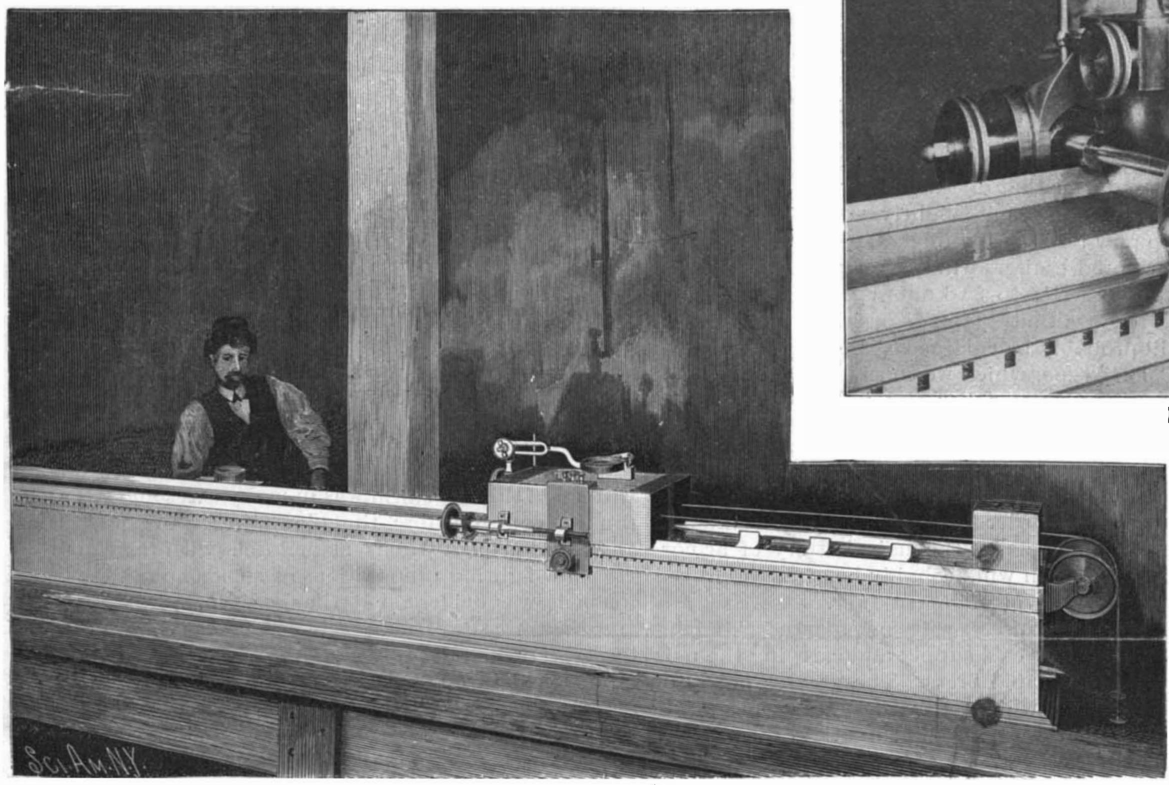
When one considers that, to be of any practical value, a naval gun must direct its shot in the comparatively short distance of, at most, 30 feet so exactly that, after traveling 2 miles, it will strike within a circle 20 feet in diameter, some idea may be had of the great accuracy with which such guns must be constructed. This high degree of precision is obtained by the use, in connection with the finest of machine tools, of methods which represent the highest development of machine shop practice, a most delicate sense of touch, and measuring and testing instruments of the greatest obtainable accuracy.

In the construction of its measuring and testing appliances the Naval Gun Factory, at Washington, D. C., has shown much originality. The work done in these shops is suffi-

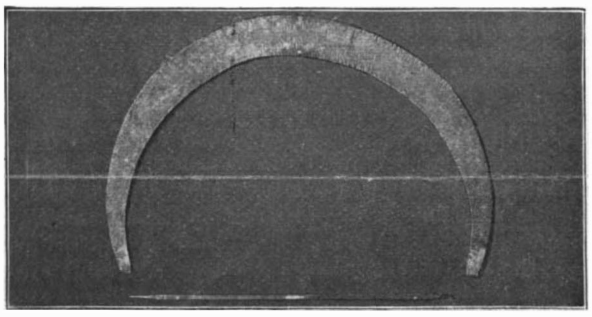
(Continued on page 117.)



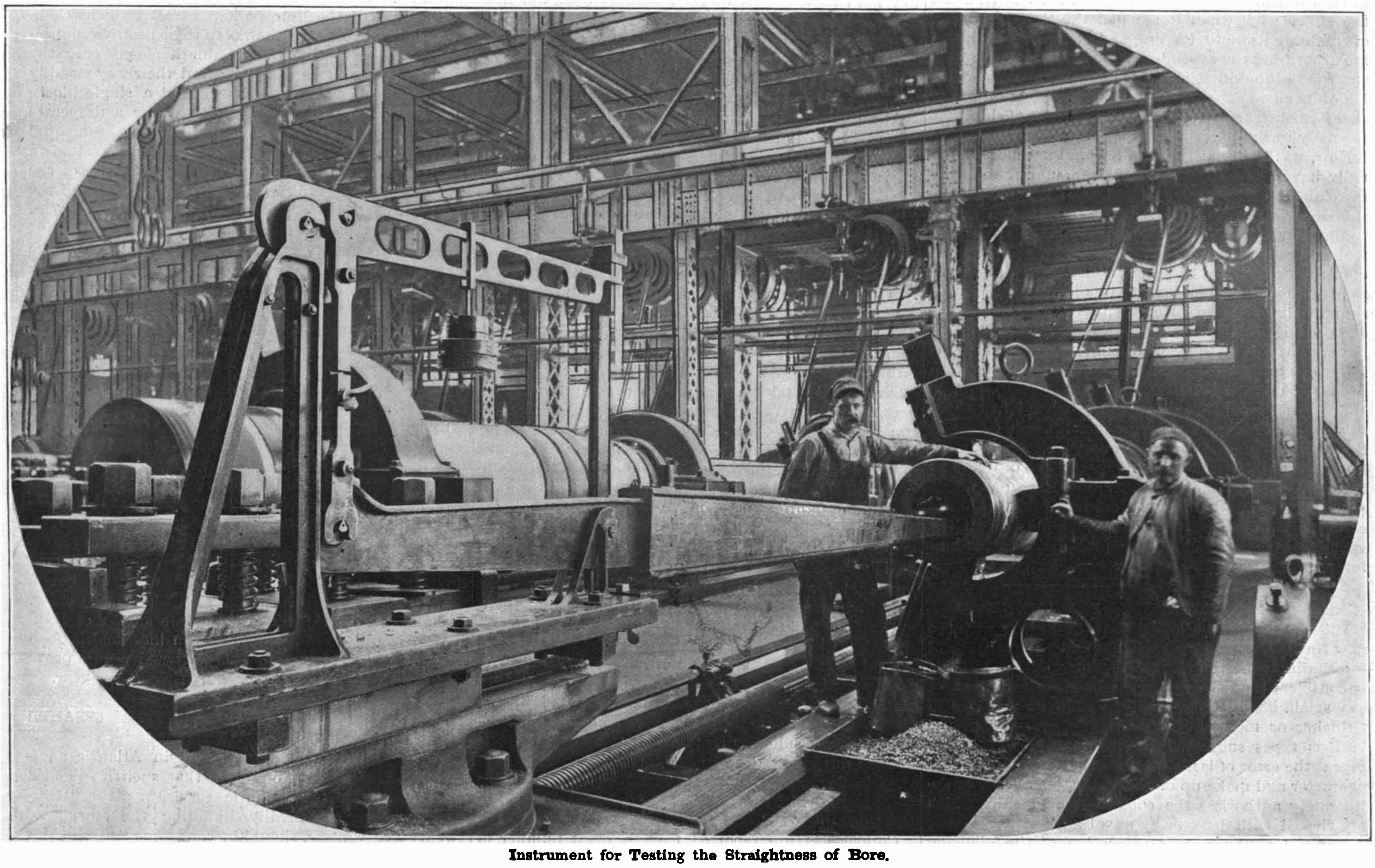
The Adjustable Head of the Measuring Machine.



The Measuring Machine for Testing Length of the "Points."



Snap Gage and Point.



Instrument for Testing the Straightness of Bore.

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Scientific American.

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NEW YORK, SATURDAY, FEBRUARY 25, 1899.

## CONGRESS AND THE TECHNICAL BUREAUS.

The fact that in this advanced age of warship construction we should be committed to the building of four vessels of the ancient monitor type simply proves that there are some subjects with regard to which the two Houses of Congress ought to rely entirely upon the judgment of the technical bureaus.

The question as to what types of ships are best suited to the needs of the navy is a purely technical and professional question which can only be decided by the men who design the ships and the men who handle them. Naval architecture is, perhaps, the most complex and difficult of all the exact sciences. Its problems are complicated by the fact that because of the long periods of peace and the comparative absence of the practical test of war, much of the designing is done on theoretical lines. Hence the experience of the late war was of inestimable value. One of the earliest lessons we learned was that for most naval operations the monitor is worse than useless. The fact had long been suspected and Admiral Sampson proved it when he took the monitors with him on his cruise to the eastward in search of Cervera. They kept down the speed of his fleet to five knots an hour on the way to San Juan, and when he reached his objective point and commenced to bombard they made such poor gun-platforms that the gunners were unable to hit anything. In his report of these operations Admiral Sampson condemned the monitors, and in doing so was indorsed by every officer of the new school who witnessed the misbehavior of these embryo craft during the war.

When the time came for the Naval Board (which is an expert board) to make recommendations for new vessels, it very naturally called for ships of a modern type—battleships, cruisers, and torpedo boats. The bill authorizing the construction of these ships passed the House; but when it reached the Senate, instead of confining itself to its proper function of authorizing or refusing the expenditure necessary for the construction of the ships, it undertook to ignore the opinion of its naval experts by inserting in the bill a provision for constructing four of the very type of ship that the navy was practically unanimous in condemning.

Now, we think that the Senate could not more effectually have stultified itself than by assuming to know more about a purely professional matter than professional men themselves. It is certain that such an assumption will always result, as in the present case, in foolish expenditure of the public moneys. The truth of the matter is that these gentlemen, in their admiration of the monitor, are guilty of a kind of fetish worship, for they will not bring themselves to believe that a craft which did such sensational work in the sheltered bays and rivers of the South cannot contend successfully with modern battleships in the vastly altered conditions of modern warfare.

The tendency of Congress to go beyond its proper sphere by setting up its own judgment against that of the technical bureaus or boards by which it is advised is greatly to be regretted. Any attempt to do more or less than control the expenditure of the sums necessary for construction will almost inevitably, as in the case of the monitors, reflect unfavorably upon the good sense of Congress and be prejudicial to the best interests of the country at large.

## THE NAVAL BILL FOR 1899.

It is sincerely to be hoped that in dealing with the new Naval Bill, Congress will not make the mistake of interfering with the technical features of the bill. If it considers that the appropriations are too great or too small, it will be perfectly within its province in reducing or increasing the number of ships of the various types suggested by the Board; but it will repeat the error of last year if it calls for changes in the character and make-up of the ships themselves, or deliberately authorizes the construction of ships which are viewed with disfavor by naval authorities.

The bill calls for the construction of the following vessels: Three sea-going battleships, to carry the heaviest armor and most powerful ordnance for vessels of their class upon a trial displacement of 13,500 tons. They are to be sheathed and coppered and have the highest practicable speed and great radius of action.

Three armored cruisers of about 12,000 tons trial displacement, carrying the heaviest armor and most powerful ordnance for vessels of their class, to be sheathed and coppered and have the highest speed and steaming radius.

Six protected cruisers of about 2,500 tons trial displacement, sheathed and coppered, to have the highest speed compatible with good cruising qualities and great radius of action. The armor for these vessels is to cost not more than $545 per ton.

The provisions of the bill, as far as the new ships are concerned, show the effect of the new foreign policy upon which we have entered. We can no longer be content to design vessels of a purely coast defense type. The acquisition of the far distant Philippines has necessitated the construction of vessels that are capable of steaming for long distances and arriving at our new possessions in a serviceable condition, with clean bottoms, an ample supply of stores and ammunition on board, and enough coal to enable them, if need be, to go into immediate action. Hence it is that all the new vessels are to be sheathed and coppered, and are to carry specially large supplies of coal, and consequently there is an increase in displacement. The battleships are to be 1,000 tons larger than the new "Maine," and over 3,200 tons larger than the "Oregon." Their speed will probably be 18½ knots and their coal supply from 2,000 to 2,500 tons with close stowage. It is not likely that the armament will be increased over that of the new "Maine," which is already equal to, if not slightly superior to, that of any ship now built or building.

The armored cruisers will be magnificent vessels of 12,000 tons and 21½ to 22 knots speed. We are in a position to state that in the disposition of their armor they will probably be enlarged vessels of the "Christobal Colon" type, which we consider to be to-day the best type of vessel for her size in the world. They will have a complete water-line belt, above which will be a central citadel extending from the belt to the main deck with complete athwartship bulkheads, in which will be carried a powerful battery of the new 6-inch smokeless powder rapid-firers. The bulkheads will inclose the turrets for the main battery of armor-piercing rifles, which will probably be of an improved rapid-firing 8-inch type of great power.

The protected cruisers will be enlarged "Cincinnatis," with a larger coal supply and carrying the new smokeless powder rapid-firers. The greater power of the new weapons will render these six cruisers far more formidable than the "Cincinnati" or her sister the "Raleigh."

The total amount carried by the bill is $44,158,605, a large sum on the face of it; but not so large if we bear in mind that it represents the insurance upon our new possessions and the merchant fleets which we expect to place upon the seas in the coming years.

## THE MINERAL RESOURCES OF THE PHILIPPINE ISLANDS.

At a time when information regarding our new possessions is so much in demand, the memorandum by George F. Becker, of the United States Geological Survey, on the mineral resources of the Philippine Islands, will prove of great interest and value. The pamphlet, which will be given at full length in the next issue of the SCIENTIFIC AMERICAN SUPPLEMENT, covers all the main discoveries in the geology of the Philippines which are of economic interest. The data was obtained from various sources, including unpublished records in the Spanish Mining Bureau, mine reports by the late William Ashburner, verbal information obtained in Manila, and from various technical publications.

The valuable minerals, as far as present knowledge goes, are confined to about a score of the islands. Luzon heads the list with deposits of coal, gold, copper, lead, iron, sulphur, marble, and kaolin, while coal and gold are the two minerals most commonly found in the other islands. The Philippine Islands coal is a highly carbonized lignite, analogous to the Japanese coal and that of the State of Washington, but not to the Welsh or Pennsylvania coals. It is thought that the native coal might be made to supplant the English or Australian coal for most purposes. Petroleum is found in Cebú, where a concession has been granted, and there are evidences of natural gas, while oil and gas are reported on Panay.

Gold is found in a vast number of localities in the archipelago. It is generally detrital and found in watercourses or stream deposits now deserted by the currents. There are placer deposits, some of which are worked in a crude way by the natives, and some of the gravels are adapted to hydraulic mining. In one of the islands a gold quartz vein has been worked which is six feet in thickness and has yielded from $6 to $7 to the ton.

Copper ores are reported from a great number of localities, northern Luzon containing a copper region of unquestionable value, where the ore has been smelted by the natives from time immemorial. Other of the deposits are described as veins of rich ore 23 feet in thickness.

A lead mine has been partially developed near the town of Cebú on the island of that name, while at Torrijos, on Marnidugue, a metric ton of argentiferous galena is said to contain 96 grammes of silver, 6 grammes of gold, and 565·5 kilogrammes of lead.

Iron ore exists in abundance in Luzon, Caraballo, Cebú, Panay and probably in other islands. The finest deposits in Luzon are near Camachin, where wrought iron is produced and manufactured into plowshares. Charcoal pig might be produced to some advantage in this region, but the lignites of the archipelago are probably unsuitable for iron blast furnaces.

Of non-metallic substances, sulphur deposits abound in Luzon and other islands, while marble of fine quality occurs in the island of Romblon and in the provinces of Manila and Marong. There are concessions for mining kaolin in Laguna province, and the pearl fisheries in the Sulú archipelago are said to form an important source of wealth.

Taken altogether, the above statement, coming from an official source, establishes the fact that the Philippine Islands have a solid mineral as well as agricultural value. When the pacification of the islands is effected, a promising field will be open in the exploitation of the actual extent and value of these resources.

## TRANSPORTATION IN THE RECENT SNOWSTORM.

When we consider what a splendid series of weather prognostications is sent out to the railroad companies by the United States Weather Bureau, we think that the immediate blockade which follows a snowstorm of more than usual severity is, in many cases, quite inexcusable. The receipt of the warning of a snowstorm should be followed by the placing of "snow-fighting" trains, with plows and properly trained and equipped crews, at stated intervals along the main lines, whose duty it should be to pass to and fro over their own sections of the line. Had this been done on the great trunk lines which enter New York city, they would have been able to keep at least the suburban tracks clear and prevent the drifts from accumulating. Instead of this the storm was in many cases allowed to run its course before the plows were sent out. To any railroad man who is acquainted with the elaborate snow-fighting preparations of some of our Western roads, it was evident that the New York, New Haven and Hartford Railroad, for instance, could have readily kept open its suburban lines, had the company sandwiched in an occasional snowplow between its regular and frequent passenger trains. Instead of this the company appeared to be content to let its suburban service come gradually and inevitably to a standstill.

In the city the most significant fact was the contrast presented between the two systems of traction in use on the lines of the Metropolitan Street Railway Company. The cable cars, thanks to their positive connections by cable to the full available horse power at the power stations, were able to grind their way steadily through the heavy snowdrifts without a single blockade; but the underground trolley, after a desperate struggle with its old enemy, had to give up the unequal contest. It is only fair to state that the breakdown was not due to failure of the electrical features of the system so much as to the fact that the adhesion of the driving wheels was destroyed by the accumulation of snow on the rails. Generally speaking, there was ample power at the motors, at least in the earlier stages of the storm, and it was not until most of the snow had fallen that the old trouble of short-circuiting and clogging of the conductors was experienced.

While the underground trolley is inferior to the cable in a snowstorm, it surpasses it under every other condition of service, and the delays in winter storms do not equal the ever-recurring breakdowns to which the cable is liable at any time of the year.

Every snowstorm of any severity that strikes New York city suggests the immense advantages that would be afforded by an underground system of rapid transit, which would of course be entirely unaffected. A suggestion of this is afforded by the fact that it was the underground mail tubes that saved the local postal service from a blockade. According to the Assistant Postmaster, the tubes made possible the delivery of large quantities of mail which under the old mail wagon service would have been delayed in the main office. An underground railway running the length of Manhattan Island would have been an inestimable boon during the many storms of this winter—it would prove an inestimable boon indeed at any time of the year.

## THE SINKING OF THE WHITE STAR STEAMER "GERMANIC."

Everyone who takes any interest in Atlantic navigation will feel a pang of regret that such a splendid veteran of the transatlantic service as the "Germanic," after successfully buffeting the storms of twenty-five winters, should be condemned to sink ingloriously while at her moorings in the port of New York. The accident is attributable indirectly to the bitter cold and the storms of the last few days. When the ship made fast at her pier, her deck, sides, masts, and rigging were coated with many tons of ice, the weight of which, being placed so high above the waterline, materially affected though not endangering the stability of the ship, especially as the unloading progressed. On Monday, while she was coaling from barges alongside, she had a heavy list to starboard, which increased ultimately to 8 degrees, when coaling was discontinued on the starboard side and carried on through the port side, the starboard ports being left open. At 9:30 P. M. a heavy gust of wind careened the ship to port, and assisted by the weight of the ice aloft, heeled the vessel sufficiently to let the water in by the coal ports. After an unsuccessful effort had been made to close the ports the ship righted herself and took water in by the starboard ports also. Before anything could be done to save her, the vessel was down on the mud.

Cofferdams are being built around ports and hatchways, and an effort will be made to pump the ship dry. The wrecking company are fully confident of their ability to float her within in a few days.

The "Germanic" was the pioneer vessel of the modern type, and since her maiden trip in 1875 she has crossed the Atlantic 600 times, covering a total distance of about 1,800,000 miles, or sufficient to carry her around the world on a great circle 75 times. She has carried some 60,000 saloon and 200,000 steerage passengers, and to the credit of her builders and officers it can be said that she has never, in all the twenty-five years of her service, met with a serious mishap. In 1894 she was re-engined and refitted at a cost of $250,000, and to-day she is faster by a knot per hour than she was a quarter of a century ago.

## THE HEAVENS IN MARCH.

BY GARRETT P. SERVISS.

The first month of spring witnesses the retreat of the constellations which formed the glory of the midwinter nights. The early evenings of March are not entirely deprived of the presence of Sirius, Orion, and their splendid attendants, but these stars are on their downward way, and, as they approach their setting place, they do not sparkle with the dazzling beauty that characterizes them when they are mounting from the east or crossing from the meridian in the crisp air of January or December. At 9 o'clock P. M., in the middle of March, they are all in the western half of the sky, while far less brilliant star groups occupy the zenith and the east. Leo is near the meridian, with Hydra stretched across the south, and the quadrilateral of Corvus rising well above the eastern hills. Behind Corvus come the leading stars of Virgo, while Arcturus glows redly in the northeast, and the Great Dipper is conspicuous between Arcturus and the pole.

### THE PLANETS.

Mercury is an evening star, reaching its greatest elongation east of the sun on the 24th, when it will set nearly two hours after sundown. It should be easily seen in the western twilight for several days before and after that date. It may interest those who wish to test their powers of vision by trying to see the markings on Mercury to learn that at the Flagstaff Observatory the magnifying power usually employed in studying that planet and Venus is only 150 diameters on a 24-inch telescope. But diaphragms are employed to cut down the aperture to three or four inches, with great gain to clearness of seeing when such bright objects are to be viewed.

Venus is a morning star, and still brilliant, although gradually losing magnitude as she retreats from the earth. She rises between 4 and 5 o'clock in the morning, and moves in the course of the month from Sagittarius into Aquarius.

Mars, which distinctly outshone its neighbors Castor and Pollux, in Gemini, during the winter, is yet conspicuous and well worth studying with a telescope, although not much detail can now be seen on its disk. It will be interesting during the month to watch the motion of the planet with reference to the two stars. Mars rises about noon and sets in the small hours of the morning, so that it can be seen all night long. It is on the meridian, at the opening of the month, about a quarter before 9 o'clock.

Jupiter, the king of the planets, now in the western edge of the constellation Libra, rises at the beginning of February about 11 o'clock P. M., and, at the end of the month, about 9 o'clock. It is accordingly coming into fairly good position for observation. Prof. Hough has recently pointed out that there is a prevailing misconception as to the rotation of Jupiter. He himself thought in 1882 that the rapidity of rotation varied with the latitude, as on the sun. Now he concludes (and he has studied the planet assiduously for twenty years) that the different rates of rotation observed on Jupiter depend rather on the level of the markings than on their latitude. There are two principal rotation periods—9 hours 50 to 51 minutes and 9 hours 55 to 56 minutes—and spots are occasionally seen moving at these two different rates in nearly the same latitude. Usually, however, the shortest period is found only within a distance of about 9° north or south of the equator, although it is not confined to that region. The swifter moving spots, Prof. Hough thinks, are the more elevated. Fortunately for those who desire to satisfy their curiosity about this grand and puzzling planet, many of the markings on Jupiter can easily be seen with good three and four inch telescopes, and with a five or six inch glass observations of decided scientific value may be made.

Saturn is in the lower part of Ophiuchus, between Scorpio and Sagittarius. It is a morning star, rising, in the middle of the month, about 2 A. M.

Uranus in Ophiuchus, about 5° north of the red star Antares, rises one hour before Saturn.

Neptune in Taurus is too faint for recognition by the naked eye.

It is interesting to note that the new asteroid discovered by Dr. Witt last year, which at times approaches the earth many million miles nearer than Venus is at inferior conjunction, has at last received a name from its discoverer. He has chosen to call it Eros. Eros, though a very small planet, is likely to play a very important part in the future history of astronomy.

### THE MOON.

March opens with the moon approaching last quarter. New moon occurs on the 11th ; first quarter on the 18th ; and full moon on the 27th.

### THE SUN.

The sun enters Aries, and the astronomical spring begins, on the afternoon of March 20. We appear to be, at present, close to the minimum sunspot period, and those who accept the view that at such times extreme contrasts in weather conditions are likely to prevail will be encouraged by a review of the meteorological records of the past winter, especially when taken in connection with those of the summer of 1898.

## WORK OF THE WEATHER BUREAU.

Each year a concise report of the Chief of the Weather Bureau gives an idea of the splendid work which this bureau is doing. During the latter part of the fiscal year which ended June 30, 1898, it became apparent that the methods of gathering information of the approach of the West Indian hurricanes, which serve so admirably as warnings for the Gulf and Atlantic coasts, were wholly inadequate for a service which should cover the waters of the West Indies in which upward of two hundred naval and transport vessels of the United States were operated. The presence of this large fleet in the hurricane region made it imperative that precautionary measures should be taken. Accordingly a bill was submitted to Congress on January 16, 1898, authorizing the bureau to establish and operate observation stations throughout the West Indies and along the shores of the Caribbean Sea, and this bill became a law, and arrangements were made for making meteorological observations and displaying hurricane signals at Kingston, Santiago de Cuba, Santo Domingo, Barbados, Port of Spain, St. Thomas, Curaçoa, and Barranquilla. At the above named places observations will be made twice daily and cabled to Kingston and the central office in Washington. Even during hostilities Prof. Carbonell forwarded daily reports from Havana, which were especially gratifying to officials of the bureau as well as to scientists all over the world. Although the protection of our naval forces was a primary object in the extension of the storm warning system to the West Indies, other considerations scarcely less important made the step a wise and beneficent one. Now that the exigencies of war permit the removal of a greater part of the fleet from West Indian waters, the meteorological service will still serve a useful purpose in the protection it will afford to the commerce of that very extensive region.

Steps have been taken to equip about thirty stations in the Mexican republic by that government with the most modern type of meteorological instruments and to establish a service similar to our own. Additional observation stations have been established in arid and subarid regions of the West. It is believed that the additional stations will not only assist in the development of agricultural and industrial interests in the respective States in which they are located, but will also be of material benefit in improving warnings and forecasts, specially for the regions west of the Rocky Mountains.

The work of producing a thoroughly satisfactory kite was begun in the latter part of 1895. Various forms of kites were devised and thoroughly tested and many valuable laws relating to the strength and efficiency of the kites were developed. The kite finally adopted for practical work was an improved form of the Hargrave cellular type. A popular idea prevails that any one possessed of a few materials and a little ingenuity can construct a thorough-going kite. This is not true as regards the present Weather Bureau kite. The size and construction of every detail have to be worked out with reference to the several strains at the different points, securing thereby the maximum strength with the minimum weight. Suitable forms of automatic registration apparatus have also been devised. Sixteen stations have been equipped with kites and other necessary instruments, and the observers chosen for the work were, with three exceptions, drawn from the list of eligibles from the Civil Service Commission. These men were called to Washington and given a practical course of instruction in the art of flying and managing kites. The period of construction extended from the 17th of March to the 18th of April. If each station had made an ascension daily during June, five hundred and ten ascensions could have been made, whereas two hundred and seventy-eight actual ascensions were made, in each of which the elevation attained exceeded 1,000 feet. The Weather Bureau kite stations are now in a position, as far as means and appliances are concerned, to obtain a complete series of observations. It is expected that the kite observations will add largely to our knowledge of temperature of the gradients aloft, and thus contribute to the solution of the problem of reducing barometer readings on the plateau to sea level.

As is usual, all forecasts and warnings issued by the department are of the greatest possible value to the community at large. The true measure of efficiency of the Weather Bureau is found in the promptness and accuracy with which notice of the approach and force of severe atmospheric disturbances is given. The efficiency of the bureau during the year 1897–98 was fully up to the high standard of the previous year. Hurricanes, wind and snow storms, freezing weather, and floods were heralded by timely and accurate warnings, and undoubtedly saved many lives and a vast amount of property. The distribution of the forecasts was in accordance with methods tried and proved by the experience of previous years. The daily press, the mail, telegraph, telephone, railroad bulletins, etc., were utilized to the greatest possible extent; and forecasts, warnings, maps, and bulletins were issued and distributed to the extent of 23,531,500, which is a most remarkable showing ; 5,239,800 weather maps of all classes were issued, and 108,600 bulletins were distributed during the year. Each map or bulletin contains daily forecasts and statistics showing the weather conditions over some part of the United States. In the large cities the map contains a large number of reports. These are exposed on bulletin boards, etc., by boards of trade, business houses, and public offices. There is also a very considerable number issued to the schools and colleges for purely educational work. Climatic work was carried on in the cotton, corn, and wheat regions, consisting in reporting the daily temperature and rainfall at 129 stations in the cotton region and 131 in the corn and wheat region. The establishment of an agricultural experiment station in Alaska in April, 1898, led to the detail of an official of the Weather Bureau for duty in organizing a climate and crop service in that territory. The central station of the new service is situated at Sitka, at which point continuous observations are registered. Various publications and The Monthly Weather Review were continued.

Among the interesting features of the scientific work carried out by the bureau were observations on the rainfall and outflow of the great lakes, minute oscillations by the great lakes, and meteorological chart of the great lakes. In 1891, 633 miles of telegraph lines on the sea coast and frontier were turned over to the Weather Bureau as appropriate to a purely meteorological service. These lines traverse thinly settled regions or connect islands with the mainland by submarine cable at points where there is not enough commercial business to warrant the construction of a private line. These lines serve a double purpose. First they enable the bureau to receive early information of changes in the weather of exposed points on our coast, and they permit of display of storm warnings near several of the great highways of vessels leaving or entering our ports.

Instruction given in meteorology in the United States varies in its character as the subject is considered as a part of a course in climatology and geology, or a course in mathematics and physics. The former method of treatment is appropriate to high schools and to those who contemplate becoming observers in the Weather Bureau. The latter method of treatment is appropriate to those in universities, and should fit one for the prosecution of important work in dynamic meteorology. The importance of the subject has been kept in mind specially in the assignment of observers to duty at points where there are colleges and universities not already provided with instructors in meteorology. Prof. Cleveland Abbe, editor of The Monthly Weather Review, has been requested to prepare a report of the general conditions of the subject in the United States. A meteorological observatory has been erected at Columbia University, and a complete course of instruction in this subject will undoubtedly follow. Important improvements in experimental equipment were also introduced during the year, and classes of students visit Weather Bureau stations regularly, and advantage is taken of this opportunity to instruct large numbers of pupils in the use of meteorological instruments, as well as the methods of observations and general work of the bureau.

### AN AUTOMATIC MECHANISM FOR OPERATING MINE-DOORS.

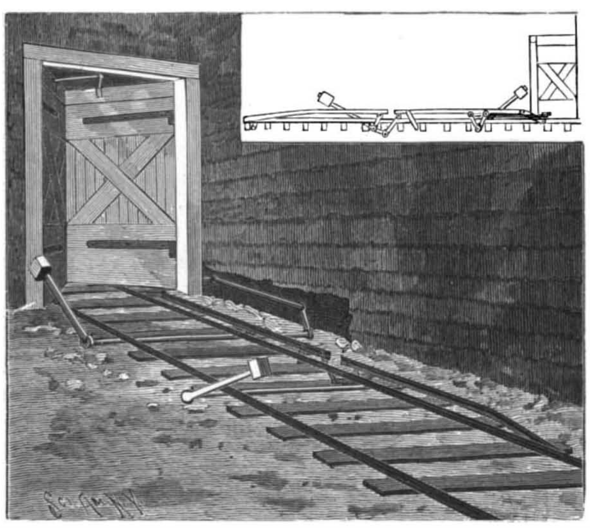
An ingenious mechanism has recently been patented by Alfred N. Humphreys and Edward McGrew, of Irwin, Penn., which is designed to operate the doors of a mine by means of devices which are laid along the track leading into the mine, and which are operated by the wheels of a train.

The mine-doors in the present invention are hinged to stanchions and close at an angle to each other. A construction consisting of an arm rigidly secured to one of the doors, and pivoted to a link connected with the other door, insures the simultaneous opening of the two doors.

The door-opening mechanism comprises essentially two terminal wheel-bars mounted adjacent to one of the rails, and an intermediate wheel-bar connecting the other two.

The two terminal wheel-bars are supported at their outer ends on links pivoted in housings. The one terminal wheel-bar has a connection with the intermediate bar; the other terminal bar is joined to the intermediate wheel-bar by means of a bell-crank lever, as shown in the small side elevator. Shafts connected with the inner ends of the terminal bars extend across the railway and, at the side opposite the bars, carry arms provided with weights serving to return the parts to their normal positions after having been acted upon by the wheels of a car.

The intermediate bar is designed to operate the mine-doors through the medium of a rock-shaft, a crank-arm, and a link connected with one of the doors. The rock-shaft extends across the track and carries a weighted arm which is designed to return the intermediate bar to its initial position and to close the doors after a car has passed.



AN AUTOMATIC MECHANISM FOR OPERATING MINE-DOORS.

As a train approaches the station from either side, the wheels will depress one of the terminal bars. This depression will cause the links and other connecting mechanism to depress the intermediate wheel-bar. As the intermediate bar is depressed, the rock-shaft will pull upon the link connected with the main door and thus open tne doors. After the train has passed between the open doors and over the last wheel-bar, the weights carried by the arms on the several shafts will return the parts to their normal position and close the doors.

In order that the doors may be air-tight when closed the various wheel-bars and parts have been placed in such positions that they shall meet this requirement.

### A FRENCH ELECTRIC LOCOMOTIVE.

The question of the electric traction of trains is a subject of ever increasing interest. Of the interesting experiments made by the Company of the West upon the Mantes line with the Heilmann locomotive, we have already given an account. Aside from these experiments, which are still proceeding methodically upon the section between Mantes and Rouen, the engineers of this company have just decided upon the electric exploitation of the new line constructed between the Champ de Mars and Versailles in view of the approaching exposition.

On another hand, the Company of Orleans has under consideration the project of having its trains hauled electrically in Paris as far as to the terminal station of Quai d'Orsay.

The Companies of the North and East are, likewise, making studies of electric traction, but the results of these are not yet kuown.

Finally, the Paris-Lyons-Mediterranean Company, which already has had occasion to apply electricity to the exploitation of the Berandière branch in the vicinity of Saint Etienne, and upon the Fayet line on the Swiss frontier, has, for a short time past, been carrying on some experiments between Paris and Melun with a high speed electric locomotive of which the nitial performances have proved very satisfactory.

Constructed after the plans of M. Auvert, engineer of the central rolling stock service, and under the direction of M. Baudry, engineer-in-chief of traction, the new electric motor did not at first reach the degree of perfection that it now appears to have attained. It was only after long tentatives and numerous experiments that it was possible to focus, so to speak, each of its parts. and to make of it that harmonious whole and marvel of power and precision that we at present admire.

The locomotive *E*1, begun toward the end of 1896, was not really finished until a few weeks ago, and it was only last month that, in the presence of a privileged few, it was submitted to its high speed experiments between Paris and Melun and return.

We have the good fortune to be able to offer our readers a reproduction of a photograph of the first electric train that ran over the principal lines of the Lyons system, hauled by the new locomotive. To the rear of the engine, of which one will remark the very peculiar form, is coupled a special car containing the accumulators, and a first-class coach in which, in the trial trip, were seated fifteen invited guests.

The locomotive is mounted upon three pairs of wheels of 3·6 feet diameter. The front axle alone is a carrier, the two others being motors.

Upon each of these latter are directly keyed the continuous current electromotors, which give them a rotary motion, and of which it is well to give a brief description, since these are the principal parts.

Their inductive system consists of two large horseshoe electromagnets placed one in front of the other behind the axle. The armature is of the Brown type, with conductors inclosed in iron. These latter, 150 in number, consist of copper bars of elliptic section. On each side of the armature there is arranged a collector, and four carbon rubbers serve to transmit the current.

The frame of the locomotive carries a box divided into five compartments. In the one in the front, the highest part of which does not exceed 4·25 feet above the axles, there is an air compressor actuated by a small electromotor of 5 horse power, and necessary for the operation of the brake, the whistle, and the starting mechanism. In the rear compartment, in which stands the engineman, are installed the levers and the maneuvering commutators. The three other compartments contain a rheostat for establishing or interrupting the current and 18 accumulator elements. These accumulators, which are of celluloid and of a special type, suffice to make the locomotive run with a reduced speed. In order to obtain higher speeds it is necessary to use the supplementary electric energy of 192 elements contained in the first car or tender, and the utilizable capacity of which is 1,000 amperes-hour. The weight of the engine and its tender in service is 198,660 pounds. The results, which, as we have said, were very satisfactory, were the following, in the course of the most recent experiments: The maximum load hauled between Paris and Melun, going and coming, was 147 tons at a mean speed of 27 miles an hour. In running, with the electromotors coupled parallel with each other, M. Auvert easily obtained a speed of 60 miles with a 100-ton train, and estimates that it will be possible greatly to exceed this without any inconvenience.

For the above particulars we are indebted to Le Gênie Civil.

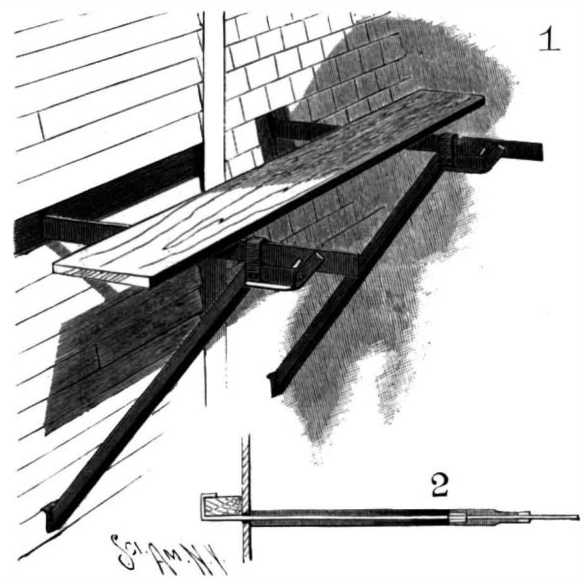
### Erratum.

In our issue of January 28, 1899, we described and illustrated a stamp-mill referred to as "Parker's Rotary Ore-Stamping Mill," the invention of which was credited to A. A. Parker. The mill in question was invented by E. F. Parker, of Denver, Colo., and W. D. McDougall, Y. M. C. A. Building, San Francisco, Cal., and is known as the "McDougall-Parker Rotary Rapid-drop Stamp Mill."

### A SIMPLE SCAFFOLD-BRACKET.

In the accompanying illustration we present a bracket for builders' scaffolds which has been patented by Louis S. Miller, 72 First Place, Brooklyn, New York city, and which is so constructed that it may be readily packed within a small space when not in use.

Of the accompanying illustrations, Fig. 1 is a perspective view of two brackets in position, and Fig. 2 is a top plan view of a bracket.



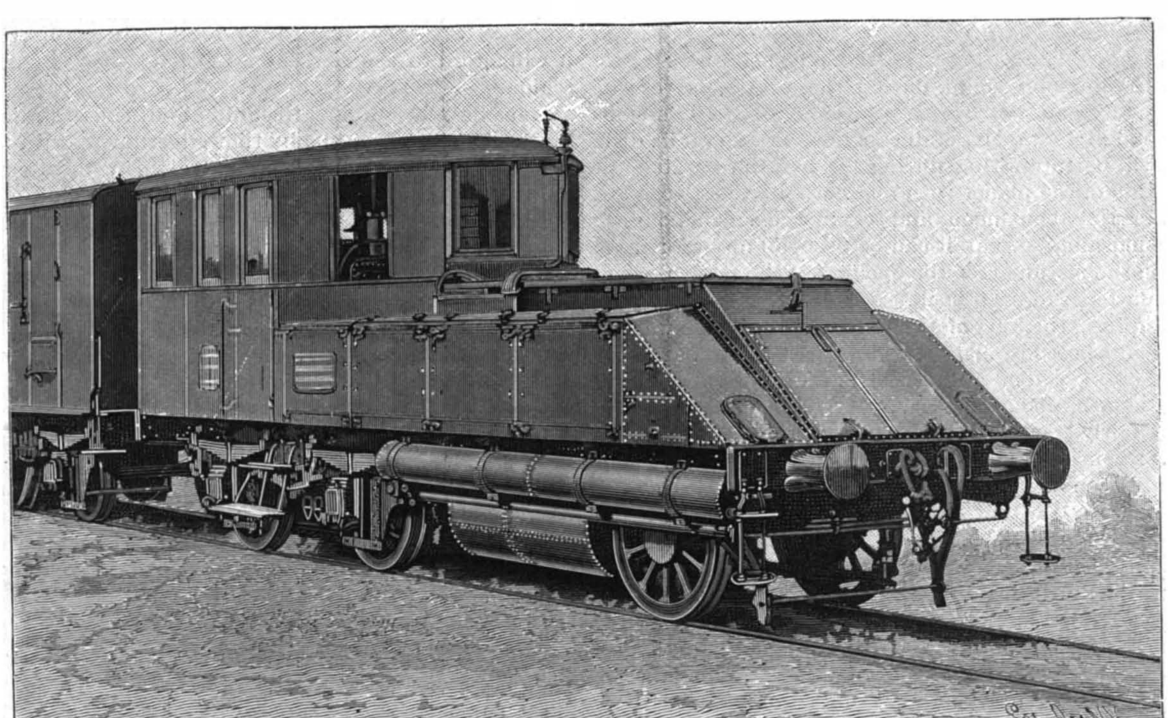

MILLER'S SCAFFOLD BRACKET.

The bracket has an arm with a hooked inner end engaging the studding, as shown in Fig. 2. The arm is supported at its outer end by a brace of angle iron formed with a tooth in its lower end adapted to be embedded in the sheathing-board to hold the bracket from lateral movement. The upper portion of the brace is turned outwardly at an acute angle to its body, and is provided with two cheek-plates which receive the arm between them. Between the cheek-plates a tooth is located which engages one of two notches in the arm. On the bracket a loop is secured through which the arm freely passes.

It should be observed that the arm is provided with more than one notch in order to adjust the bracket to various widths of studding.

### The First Horseless Carriage.

Vaucanson invented a horseless carriage some one hundred and fifty years ago. In a document which has recently been discovered it is recorded that the mechanician was honored, in 1740, by a visit from Louis XV. for the purpose of inspecting the carriage which ran without the aid of a horse or other visible means of propulsion. Two persons in the vehicle made the round of the courtyard to the satisfaction of his majesty and suit. but, though a promise was secured of royal patronage, the Academy of Sciences declared that such a conveyance could not be tolerated in the streets, so the scheme had to be abandoned. The motor power was supplied by a huge clockspring, so that only a short journey was possible, but the gear seems to closely resemble that of the horseless carriages of to-day.



THE NEW ELECTRIC LOCOMOTIVE OF THE PARIS-LYONS-MEDITERRANEAN RAILWAY.

### INTERESTING STATIC MOTORS.

BY HOWARD B. DAILEY.

The amateur worker in static electricity who possesses a good influence machine finds himself equipped with a source of much instructive entertainment for himself and scientifically inclined friends. To the experimenter any piece of accessory apparatus having novelty of design is always a welcome acquisition. The experiments possible with a six or eight plate Wimshurst machine, such as is described and illustrated in SCIENTIFIC AMERICAN SUPPLEMENT, No. 584, are of endless variety, and, when aided by suitable accessories and manipulative skill, luminous effects of great brilliancy and exceeding beauty may be produced. Such manifestations naturally appeal chiefly to the eye, but not less interesting to the student of physics is that class of experiments dealing with the conversion of mechanical energy into electrical and back again into mechanical energy in a manner readily perceived by the eye at a glance.

To demonstrate this principle, as well as to exhibit in a striking way the operation of electrical attraction and repulsion, the writer has devised two forms of static electrical motors. Fig. 1 is a small horizontal engine. At the ends of a vulcanite lever or walking beam are two wooden balls covered with gold leaf to give them a conducting surface. These play up and down between upper and lower sets of stationary brass balls.

The two upper balls, which are in metallic connection with each other, are supported above the walking beam upon four perpendicular glass pillars and are connected with one of the conductors of a static machine. The lower balls, which are not insulated, are given an earth connection through a binding post in the ebony bed frame of the engine. As the upper balls become charged through the action of the machine, their attraction causes the nearest of the two movable balls to rise within striking distance, when it receives a spark, thus becoming itself electrified, and is immediately repelled downward to one of the earth-connected balls, to which it yields up its charge. Being now in a neutral condition, it is again attracted upward. As the material separating the moving balls is an insulator, the action of each is independent of the other, one being repelled while the other is attracted. A reciprocating motion is thus given to the lever which is communicated to the flywheel shaft by means of a connecting rod and crank disk.

Since the attractive and repulsive force of static electricity is far from powerful, it is essential that machinery operated by it should be very light and freely running. To this end the moving balls, which are about 1½ inches in diameter, are made hollow and very thin, being turned in halves and glued together. The flywheel, which is of gilded wood, is very light and runs in pivoted bearings, as does the walking beam. This beautiful little machine, highly finished in all its parts, presents a very attractive appearance and runs at a rapid rate of speed; the click of the sparks as the swiftly flying balls charge and discharge themselves being strongly suggestive of the puffs of a steam engine. Watching the instrument in operation, an observer, unaware of the lightness of the moving parts, is impressed with the idea of considerable power, but is somewhat surprised to find that a sheet of note paper standing upon edge and leaning at a slight angle against the rim of the flywheel soon brings it to rest. Fig. 2 is a simple rotary motor. Into the hub of a horizontal spindle, whose indented ends receive pivot pointed screws passing through the tops of two upright brass standards, are inserted four slender vulcanite rods carrying at their outer ends gilded wooden balls. At the opposite sides of the instrument and very near to the revolving balls are placed two larger balls of polished brass, supported upon glass rods and connected respectively with the opposite poles of a static machine. The current being turned on, attraction and repulsion cause a rapid rotation of the spindle.

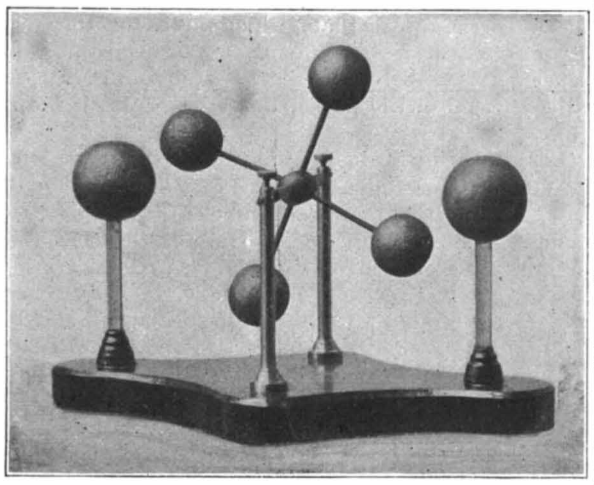


Fig. 2.—ROTARY ELECTRIC MOTOR.

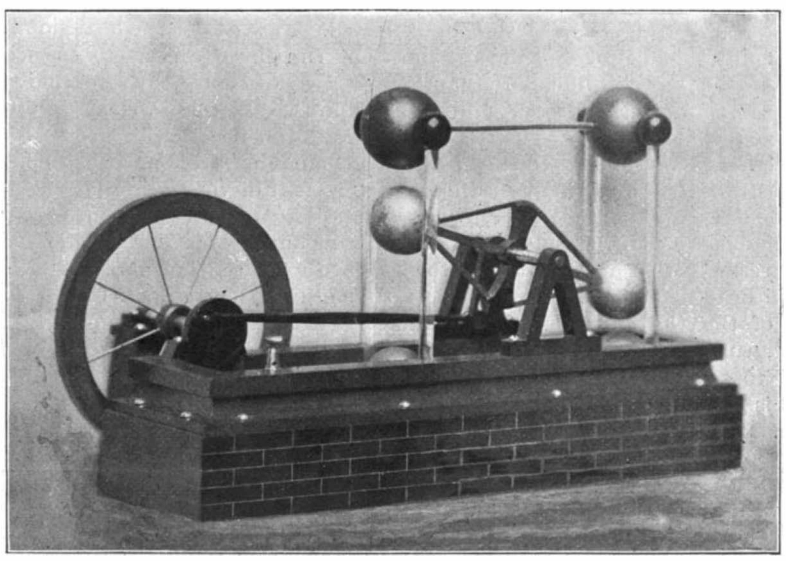


Fig. 1.—STATIC ELECTRICAL MOTOR—RECIPROCATING.

This motor, from its continuous rotary action, is much the more powerful of the two, and has about it a sensitiveness and life that is wonderfully taking, while its appearance in the dark is highly interesting. Both these instruments run very satisfactorily either from a small influence machine or an ordinary frictional machine, furnishing an excellent illustration of the reappearance as mechanical energy of part of the power applied to the static generator after having been transformed largely into electrical energy.

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IT is said, according to press reports, that in Stuttgart, Germany, all horse trucks and wagons are to be banished from the streets after a certain period of time. Stuttgart is the home of Herr Daimler.

### MEASURING AND TESTING INSTRUMENTS USED IN THE MANUFACTURE OF NAVAL ORDNANCE.

(Continued from first page.)

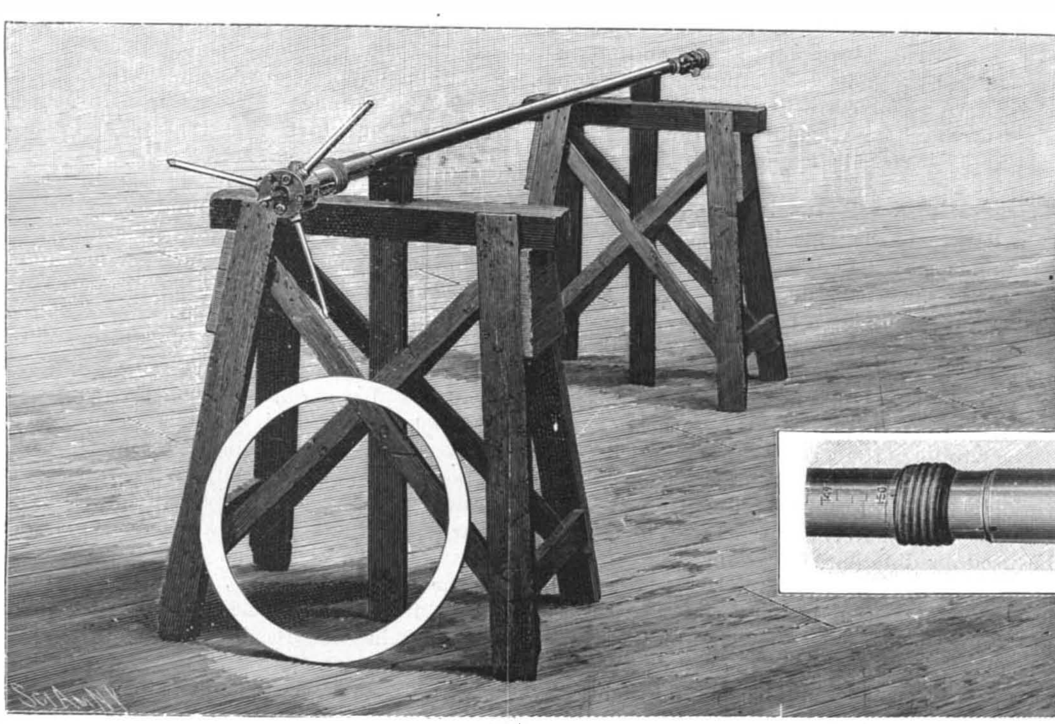
ciently different from that of other classes of machine shops to necessitate special appliances for performing and testing the various operations, and these appliances have been invented largely by the naval officers in charge of the work and have been constructed in the gun factory.

All measurements are given to the machinists in the form of steel rods, called "points," which are about ⅜ of an inch in diameter and of a length which corresponds to the desired measurement. The rod is rounded on the ends and is ground off on an oilstone to the exact length required, this length being determined in a measuring machine. The length of the rod is stamped on the rod in figures running to the third decimal place.

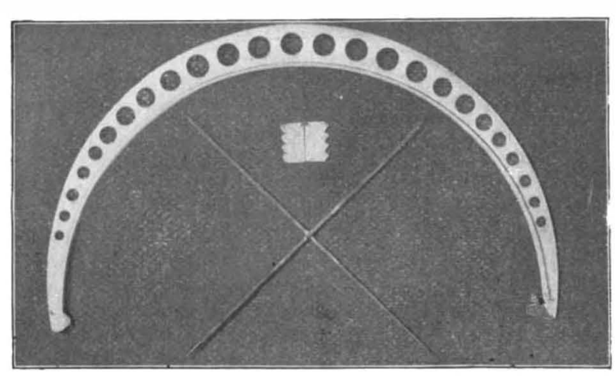
The measuring machine in which the length of the "points" is tested was invented and built in the Naval Gun Factory, except for the graduation of its scales. This machine has a bed 7 feet long, which is supported on a heavy wooden stand. The entire machine, including the bed, is machined all over. Two V-shaped guides are formed on the upper face of the bed. A fixed head is secured at one end of the bed between the guides, and an adjustable head is mounted on the guides. Each head has a hardened plate secured in the face which is opposite the other head, and it is between these plates that the measuring is done, and against them that the ends of the "points" rest. A scale plate, which is 67½ inches in length, and which was graduated by the Brown & Sharpe Company, is sunk in the beds between the two guides, and it is graduated with the utmost precision in hundredths of an inch.

The adjustable head consists of a rectangular box which is open at the top and bottom. It is held firmly down on the guides by two straps which fit over the upper edges of the sides of the head and which slide on guides formed on the sides of the bed. The under sides of these latter guides are at right angles to the side wall of the bed, while their upper faces are inclined downward toward the bed. Gibs carried by the straps, and held against the under sides of the strap-guides by setscrews on the straps, serve to prevent wobbling of the straps on their guides. Notches are formed in the strap-guides at intervals of half an inch, and bolts which are guided in vertical holes in the straps engage these notches and lock the straps. The upper ends of the bolts are pivoted to spring-pressed thumb-levers which are fulcrumed on the straps and serve to operate the bolts. Hand screws are carried by the straps, and they may be screwed against the strap-guides as an additional locking means for the former.

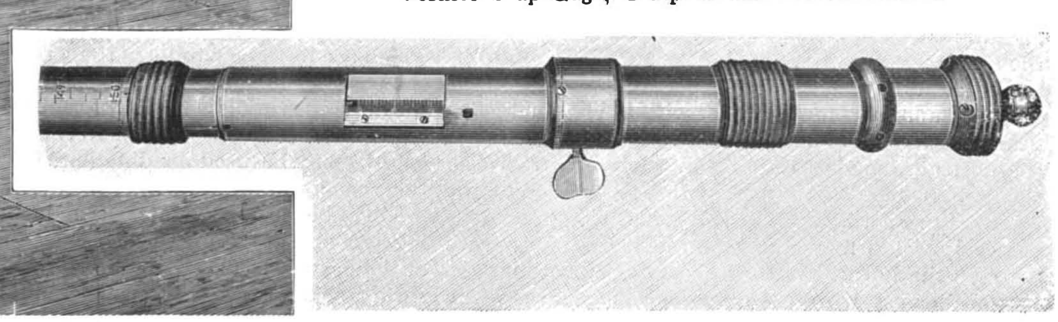
Screw shafts are journaled on the adjustable head, one on each side, so that they can have no longitudinal movement relatively to the head; and their threaded ends engage screw-boxes which are fastened to the straps. These boxes are split, and the cut is drawn together by a screw to compensate for wear. The threads on the screw shafts are very perfect and are cut forty threads to the inch. Each shaft, besides having a hand-wheel by which it may be turned, carries a bevel gear which meshes with a similar gear on a shaft that is journaled on the end of the adjustable head, so that the screw shafts are geared together.



Star Gage and Rind Gage.



Vernier Snap Gage, Templets and Crossed Points.



Handle of the Star Gage.

MEASURING INSTRUMENTS USED IN THE MANUFACTURE OF NAVAL ORDNANCE.

This gearing, when the straps are locked to the bed by means of the bolts, engaging notches on the strap-guides and by the clamping of the hand screws, enables the adjustable head to be moved back and forth by turning either of the screw shafts. Two wires are fastened in the front of the adjustable head, and, after passing over guide pulleys back of the fixed head, have a weight attached to their ends. This weight draws the locking bolts in the straps against the front walls of the notches in the strap-guides, and it also forces the screw-shafts against the front surfaces of the threads in the screw-boxes, thus eliminating any error due to looseness or wear of these parts. Two vernier plates, one on each side. are secured to the inner sides of the adjustable head in an inclined position, so that their graduation lines, coming down on a sharp edge, reach the surface of the scale plate in the bed for the purpose of accurate reading. A magnifying glass is supported above the verniers by a slotted arm having a rack formed along the upper edge of the slot. The rack is engaged by a spur-gear on a stud that is carried by a vertical post which may be turned on its axis or clamped in a vertical bearing on the adjustable head. A hand-wheel attached to the spur-gear enables the glass to be moved back and forth, and the post permits it to be swung from side to side. By the use of the vernier plates, measurements may be read to the one-thousandth part of an inch. One of the screw shafts is provided with a vernier wheel, by means of which measurements may be read to the ten-thousandth part of an inch. A small magnifying glass for the vernier wheel is clamped to a vertical rod that is fixed on the adjustable head.

In measuring a "point" on this machine, the "point" is laid on two or more loose blocks which lie on the bed and support the "point" centrally over the long scale-plate. One end of the "point" is made to rest firmly against the fixed head, and the adjustable head is moved by hand until the locking bolts of the straps can engage notches which place the head at the next half-inch mark beyond the end of the "point," and the hand-screws on the straps are set up. The screw-shafts are then turned to bring the adjustable head against the end of the "point." This end of the "point" is then repeatedly lifted off its support, while the adjustable head is given a final adjustment to secure with the end of the "point" a contact that is firm but which does not amount to compression. The inches and thousandths of an inch are then read on the vernier plates within the adjustable head, and the ten-thousandths of an inch are read on the vernier wheel on the screw shafts. In practice, however, instead of using the vernier wheel, the ten-thousandths are usually interpolated on the vernier plates.

When a "point" is to be used in applying a certain measurement, the adjustable head is first accurately placed by means of the readings on the large scale and vernier plates (and also, if desired, of the vernier wheel) and then the "point" is cut as near as possible to the given length, taking care that it be too long rather than too short. The ends of the "point" are then shaped with a file and are rubbed down on an oilstone between repeated trials until the "point" will lie between the heads of the measuring machine with the desired firmness of contact.

The measurement having been transferred to the "point," it is used directly to apply the measurement to an inside diameter ; but, for gaging an outside diameter some form of calipers must be used. For the rougher cuts, jointed calipers and beam calipers are used, the latter having verniers thereon. But the finishing cuts are tried by use of "snap gages." These consist of crescent-shape pieces of soft steel (for the larger measurements, about one-fourth of an inch in thickness), having their horns tempered and formed on the insides into flat faces, which are at right angles to a line connecting the horns. Owing chiefly to changes in the temperature, the horns of the "snap gage" do not remain at all times the same distance apart. On each occasion when the "snap gage" is to be used it is carefully adjusted to the "point" in a most ingenious manner. If, on attempting to place the "point" between the horns, the latter are found to be too close together, a blow of sufficient force to dent the metal is struck with the edge of a hammer near the inner margin of the crescent. This denting of the gage forces the metal laterally and lengthens the inner curve of the crescent, the outer curve remaining of the same length. The result is to separate the horns very slightly. If, now, they are found to be too far apart to properly contact with the ends of the "point," another blow is struck with the hammer edge near the outer curve of the crescent, with the effect that the horns are made to approach each other. When the "snap gage' is adjusted, the mechanics of the Naval Gun Factory will, in spite of the fact that the gage may weigh five pounds and be more than a yard between the horns, get the work almost without exception correct within three one-thousandths of an inch.

While the plain "snap gage" is used in most of the outside measurements, there is a vernier "snap gage" made of aluminum that is used for some of the larger outside measurements. This gage consists of a crescent-shape aluminum frame, having steel blocks dovetailed upon lugs on the inner sides of the horns. One of the steel blocks has its surface at right angles to a line joining the horns, and the other steel block has its surface inclined at an angle of about thirty degrees. Upon this inclined surface is mounted a sliding block, having a face that is opposed to the face of the block on the opposite horn. The sliding block is adjusted by a screw journaled in the block on the horn and engaging a lug on the sliding block. Each of these blocks carries a scale plate, which plates together form a vernier for measuring the increase or decrease of distance between the measuring faces on the horns, due to the travel of the sliding block up or down the incline.

For measuring the inside diameter of the jacket, when it has been expanded by heat for shrinking on the tube, to see if it has been sufficiently enlarged, two "points" of the proper length are fastened at their middles and crossed at right angles to each other. These "points," secured to a handle, are thrust back and forth through the interior of the jacket, and the degree of expansion in all parts is thus tested.

Templates are used to determine the curves at the ends of the jacket and of the hoops and to turn the threads in the breech and breech-block.

In testing the bores of the great guns two delicate and ingenious instruments are used. One of these instruments is used to test the straightness of the bore and the other to test its uniformity of diameter. Between each of the final cuts in the bore of the gun the straightness of the bore is tested. At least for the last 10 feet of its length it must not run out of a perfectly straight line more than four or five one-thousandths of an inch. It is usually true within two one-thousandths of an inch. The testing for straightness is done by an instrument which consists of a compound lever one arm of which carries a roller which rests transversely in the bore of the gun and rises and falls as the gun turns on its axis in the lathe, if the bore is out of true, and the other arm of which is formed into a pointer that moves over the face of a scale with motion to correspond to the movement of the roller. The instrument is supported by a metal base plate which is bolted to two bars that are clamped in the tool post of the lathe on which the boring is being done. At the forward end of the base plate rises a pair of short standards which have slots in which rest two knife edge lugs that are carried by the long lever. The rear end of the base plate carries a pair of tall standards which have slots that receive the upward thrust of a pair of knife edges formed on lugs at the rear end of the short lever. Similar lugs at the rear end of the long lever and a pair directly above these lugs on the short lever are connected by a link which transmits the motion of the long lever to the short lever. The two arms of each lever are proportioned to each other about as one to ten. The link is made of two end pieces bolted to an intermediate piece, so that its length may be adjusted to bring the short lever to a horizontal position. The short lever carries a weight which is shifted along the lever until it nearly but not quite counterbalances the weight of the long lever on the roller in the bore. On the end of the short lever is a finger which stands against an ordinary steel scale that is clamped to a standard. The short arm of the larger lever is of metal, but the long arm is of wood (having considerable depth) to reduce the weight. The wooden arm is removable, so that arms of different length may be used, as may be most convenient. The roller consists of a hardened steel disk that has a diameter of about four inches.

In testing a bore, the slide-rest, to which the base of the instrument is attached, is run up until the roller on the long lever has reached the point at which the bore is to be tested, and the slide-rest is then stopped. The gun is now slowly revolved, while the pointer is carefully watched to note its movement over the scale. The bore is thus tested at stated distances throughout its length.

The instrument used to test the diameter of the bore is called the "star gage." This instrument is so delicate that readings may be taken upon it in ten-thousandths of an inch. It consists, essentially, of a cylindrical casing or pipe having a head in which are three sockets carrying steel rods or "points," the sockets being acted upon by springs that force them against the tapered end of a rod that slides in the casing. By measuring the difference in the movements of the rod which are necessary to force the "points" out against the bore of the gun at different points along its length, the difference in diameter is determined. The "points" are threaded into the sockets so that those of different lengths may be used for different sized guns. Two of the sockets are mounted in sector-shape blocks that are held between the plates of the head by screws passing through arc-shape slots so that the radial position of these sockets may be changed. Back of the three spring sockets is a set of four holes in the head, in which four guide points may be screwed. These points in the spring sockets are set at equal circumferential distances apart and used without the guide points when the bore is to be tested before it is rifled. But, in testing the bore after it is rifled, the guide points are put in place and run in the grooves of the gun, and the movable points are set to run either on the lands or in the grooves as is desired. The casing is made in sections, so that it may be put together to any desired length ; and a scale is marked upon it, so that the location of the points in the bore may be measured. The rod (whose tapered end forces outward the spring sockets) has a handle that fits over the cylindrical casing, and the handle is made in two sections that are screwed together for adjustment and are locked, when adjusted, by a thumb screw. The forward section of the handle carries a vernier plate at the side of a slot through which shows a short scale plate on the casing.

In using the star gage, a ring gage whose internal diameter is the same as the correct bore of the gun is placed outside of the movable points, the latter are forced firmly against the ring by the action of the tapered end of the rod, and the vernier on the handle is set at zero by screwing one of the handle sections upon the other. The handle sections are then locked in adjusted position by the thumb screw, and the gage is ready for use. The head of the star gage is now inserted into the bore to the point to be tested, and the rod is slid forward until the movable points are in firm contact with the bore, when the reading is taken on the vernier, as plus or minus the indicated number of ten-thousandths of an inch, according as the bore is larger or smaller than the standard of the ring gage.

It is by the use of such ingenious and accurate instruments as have been here described that the great guns of our navy, with their parts varying in dimension from a fraction of an inch to forty feet, are built as accurately as the highest class of smaller machinery, and they demonstrate that the American naval officer is not only a fine sailor and a powerful fighter, but that he is a mechanical engineer of the highest order as well.

### Miscellaneous Notes and Receipts.

**Decorating Wax or Stearine Candles.**—This is done mostly with decalcomania (transfer pictures). Coat the candle first with a warm gelatine solution prepared in water, then lay on the transfer picture firmly and smoothly and allow to stand for several hours. After that dip the candle in water, so that the paper upon which the picture is printed is soaked and can be so removed that the picture remains on the candle. When this is properly done, remove the gelatine with a soft sponge and water, allow to dry, and dip the candle in melted paraffine, so as to give the picture a protective covering. Instead of the gelatine, spirit lacquer may be used, but this cannot be washed off.—Die Mappe.

**Reliable Hair Remedy.**—Dieterich gives the following prescription for a good hair water, furthering the growth of hair: Quinine hydrochlorate, 0·4; tannin, 1; spirit of wine, 80; tincture of cantharides, 1; glycerine, 6; eau de Cologne, 4; vanillin, 0·01; and powdered sandalwood, 0·005 gramme. This liquid is allowed to stand five days and then filtered. The head should be washed with it every two days. A hair pomatum, serving for the same purpose, which has been found especially valuable to prevent the falling out of hair with nervous headache, is recommended by Leistikow in the following composition: Tincture of cantharides, 3; chloral hydrate, 2; lanolin, 5; vaselin, 10; cherry laurel water, 10; and lime water, 10 grammes.—Pharmaceutische Centralhalle.

**The Japanese Watch Industry.**—According to the Deutsche Uhrmacher Zeitung, the Swiss consul at Yokohama reports:

The production of the Osaka Watch Company in 1897 amounted to about 2,500 watches, mostly silver. During the time of its existence the factory has produced about 10,000 watches. Since a year ago the factory in Osaka imports movements and cases from America, but the watches thus produced are dearer than the American, which they imitate, and are no better.

The factory which is being founded in Tokio, and is to make watches of Swiss models, under the direction of Japanese who have learned the trade in Switzerland, has not yet completed its outfit of machinery. It possesses a steam boiler of five horse power, a machine for making watch cases, as well as some machines for making arbors, wheels, screws, etc. This "factory" has, after an existence of four years, not yet produced a single watch, and can only be regarded as a watch making school, which now employs about twenty young persons. Besides, it will, like the factory at Osaka, import a number of ready-made watch parts, and, according to the new treaty, will have to enter them as articles of luxury, dutiable at the highest rate, for watch parts, as well as finished watches, are subject to the rate of 25 per cent. Both establishments are now working with Japanese forces. The Osaka Watch Company has dismissed its manager as well as the American operators.

"According to these statements, it seems that the civilization of Japan, progressing in Western fashion, which in other fields can boast of considerable achievements, did not yet afford an adequate ground for the watch industry," concludes the above-named journal.

## Correspondence.

### Facilities for Building War Ships.

To the Editor of the SCIENTIFIC AMERICAN:

As an old reader of your valuable paper, I take the liberty to consult you about a matter which is of some interest to me, and I would ask you, if this is not an abuse of your time, to kindly send me a few lines on the point at issue.

I always thought until recently that the facilities of England in building men of war, cruisers, etc., were enormous and far beyond the corresponding facilities of the United States in particular. Now, a friend of mine, apparently well posted on these matters, assures me that the United States can, if they wish, turn out as many, as big, and as good vessels fit for war, say in three years, beginning now, as England can in the same time. This I cannot believe. From what I read, I feel pretty certain that the vessels being of the same type and of the same perfection, England can surpass the United States for the number of vessels turned out in a given time. Each of us is honest in his opinion, and we would like to know who is mistaken.

A. W. FORSTALL.

College of the Sacred Heart, Denver, Col.

[In answer to an inquiry sent out by the British Admiralty a few years ago to ascertain the warship building facilities of Great Britain, it was found that the whole British navy could be duplicated in two years' time. As the total tonnage of the British and United States navies is about 1,500,000 tons and 300,000 tons respectively, arguing on this basis, the capacity of the British yards is at least five times that of our own.—ED.]

### Railroading in the Philippines.

BY SPECIAL CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

No better idea of the undeveloped condition of our new Oriental colony could be conveyed than by the statement that this great island group, with an area of over 114,000 square miles and a population exceeding 20,000,000, has but a single railroad line. The only railroad line of the Philippines—the Manila and Dagupan Railway—extends for a distance of 130 miles from Manila to Dagupan, a minor port near the center of the west coast of Luzon. It thus serves as an outlet to the largest continuous area of valley lands on Luzon or elsewhere on these numerous islands.

The lack of interest in transportation facilities and in commercial and agricultural pursuits under Spanish rule is ever apparent, and this neglect is quite comprehensible to the average student of Philippine affairs. The governor-generals, always expecting a recall, had little interest in the development of the country, and all save military improvements, which were imperative, were neglected. Estimates for road making and for other internal improvements were ignored, or, if any start was actually made, the work was never completed; for the funds raised for this purpose through oppressive taxation were all misappropriated or used for improvements here in Manila.

But in spite of all this and the restrictive methods of the Spanish government regarding commerce and industry, the company which constructed the Manila and Dagupan Railway were granted quite liberal concessions. This was due probably to the hope of an increase in revenue from taxation on the road and to the advantages it would offer for transporting troops, rather than to a desire to benefit the island commercially.

The question of railroads occupied the attention of the colonial government as early as the year 1875. At that time an elaborate scheme was formulated. It provided for the construction of roads of general public utility, either by the government or by subsidized companies, under concessions granted by the home government; and for roads of private interest under concessions granted by the governor-general of the colony. But no definite move toward securing a railroad line for these islands was made until ten years later. In 1885 the Spanish government offered a subsidy of $7,650 per mile on a specified line of 130 miles, but it was not accepted by any Spanish capitalists. The following year another and more liberal offer was made. It included a guarantee of 8 per cent annual interest on a maximum cost of $49,643 per mile. In the fall of 1886 the offer was accepted by a number of London capitalists, and, in accordance with the terms of the concession, the line was to be completed within four years from July 22, 1887. At the end of 99 years the road, with the rolling stock, was to revert to the government without compensation.

Most of the work of construction of the road was done by native laborers, but quite a number of Chinese coolies were employed. The track is of 3 feet 6 inches gage, and steel rails weighing 45 pounds to the yard are used. The entire roadbed is very level and is quite free from cuts and curves, but has plenty of bridges, and this last was the only difficulty met with in the construction of the road. On the whole line there are at least sixty iron bridges, with cylindrical steel piers. The bridges are uniformly of 20 meter spans, and the largest is that over the Rio Grande de la Pampanga, which consists of six spans. The roadbed has an average elevation of about four feet above the general level and is all ballasted with fine gravel. The ties are of hard wood, which is generally cut on the islands.

The rolling stock is very light as compared with that of our railroads. The locomotives appear to be little superior in speed or capacity to the "jerk water" or "dinkey" locomotives in use about mines and manufactories in the United States. They are of less than ten tons weight and the passenger cars are correspondingly small. These carriages are of an English type and are of three classes, all being divided into three compartments, with a gangway running along on the outside. Each apartment will seat eight passengers. The few first-class passengers are comfortably seated in cane chairs, and the second and third class carriages have wooden bench-like seats. The second-class cars are the more comfortable of the two, as they are seldom crowded, while those of the third class are usually filled with natives carrying great baskets or bundles.

At present there are three passenger and three freight trains each way daily, but only one of the trains carries mail. The passenger trains cover the 130 miles between Manila and Dagupan in eight hours. A passenger train is usually composed of eight or ten carriages, of which more than half are usually of the third class. The passenger rates range from two cents per mile for third-class to five cents per mile for first-class passage. The station houses and other buildings along the line are very complete, owing to a requirement of the Spanish authorities. The Manila depot is a well arranged two-story building 70 by 45 feet, with car sheds 325 feet long. It covers four tracks, but the entire structure is built of wood. The general offices of the road are located on the second floor, while the first floor is quite similar to American station houses. There are twenty-eight other station houses on the road, and, while they differ somewhat as to size, they are of a uniform type. There are good freight sheds at all stations.

The machine shops and engine houses of the road are located at Caloocan, four miles from Manila, and here General Manager Higgins has his residence. With the exception of the general manager and a few English overseers and one or two Spanish station masters, the road is operated by natives. There are native station masters, telegraph operators, clerks, engineers, trainmen, mechanics, and laborers, and all of these work for very low wages. Twenty dollars in gold is a large salary for a station master or clerk, and the trainmen receive but little more than half this amount. But the natives give good satisfaction in every capacity in which they are employed, in spite of their inclination to make extra money when the chance is presented.

As to the original cost of the road there are few reliable statistics, and its present financial standing is unknown to others than the officials. But it is evident that the cost of construction per mile must have been much lighter than the cost of similar roads would be in America, and the running expenses are much lower. From all appearances the road is at present in a very flourishing condition, and since the capture of Manila the traffic has been heavier than ever before.

This single railroad line of our new Oriental colony traverses some of the finest country to be found in all these islands. For probably 90 miles it runs diagonally across a continuous level or slightly rolling area, separated from the sea and hemmed in by mountain ranges which in places rise to the height of 5,000 feet. The northwestern corner of the valley opens on the shallow gulf of Lingayen, whereon is situated Dagupan, the terminus of the road. On the southern end this ideal valley region is bounded by Manila Bay, the Pasig River, and Lake Bai, the most important lake in these islands. In this valley region and the bordering mountain region is included all of the six provinces wherein was begun the Spanish subjugation of these islands, and to-day they are the most important part of Luzon. These are Manila, Bulacan, Pampanga, Tarlac, Nueva Ecya, and Pangasinan, all of which are traversed by the Manila and Dagupan road.

The scenery along the line of this railroad is most picturesque. For fifteen miles out of Manila the land rises in irregular, long, sloping hills, scarcely half a hundred feet in height. On one hand is a succession of rice fields, and on the other the hillsides are terraced with queer native bamboo huts. At Caloocan are seen the first real signs of civilization. Twenty-five miles from Manila is Malolos, the capital of the so-called Filipino Republic. Like many other native towns, it is stretched out for a considerable distance among the bamboos and ponds. Between Malolos and Calumpit, a distance of nine miles, there are twelve bridges across streams of sufficient volume to be called rivers. Ten miles from Calumpit is San Fernando, and ere we reach this place we have left behind the bordering hills of Manila Bay. Twenty miles beyond San Fernando we pass through a cut about 300 yards long and 30 feet deep, the only one of any consequence on the road, and here at Bamban we have reached the mountains. Beyond Bamban the landscape changes, and cocoanut groves begin to supplant the bamboo flats. Tarlac is one of the most important towns on the road. It is located in the province of Tarlac.

The remaining forty-five miles of the road to Dagupan runs through flat land, well drained, and there is a succession of rice fields, cane fields and cocoanut groves. The only important town on this part of the road is Bayambang on the river Agno. The English firm of Smith, Bell & Co. have a large rice mill there, and at Calasias, the next station to Dagupan, are made the finest of the Manila hats. Such are the scenes along the only railroad line in the Philippines, and in spite of its insignificance this road has done much toward improving the country through which it passes. Ere long American energy and capital will begin the grand work of development so long delayed through Spanish misrule, and the toot of the American locomotive, echoing through the bamboo jungles and cocoanut groves, will soon awaken these oppressed islands from their long sleep.

### Science Notes.

A telegram has been received from Sydney by the Royal Society. It states that the boring in the coral atoll of Funafuti had been discontinued after reaching a depth of 1,114 feet. The cores were obtained and the material traversed was described as a "coral reef rock."

A bill authorizing the use of voting machines has been introduced in the Legislature of Illinois, and it is claimed that the Chicago Board of Election Commissioners has promised to give machines a trial if the Legislature gives it authority to do so. It is probable that the bill will pass.

The Automobile Club de France announces a competition of motor carriages actuated by storage batteries. Exhaustive tests will be made on the life of the cells and on their efficiency. Account will also be taken of their weight and the facility of operating and the cost of maintenance.

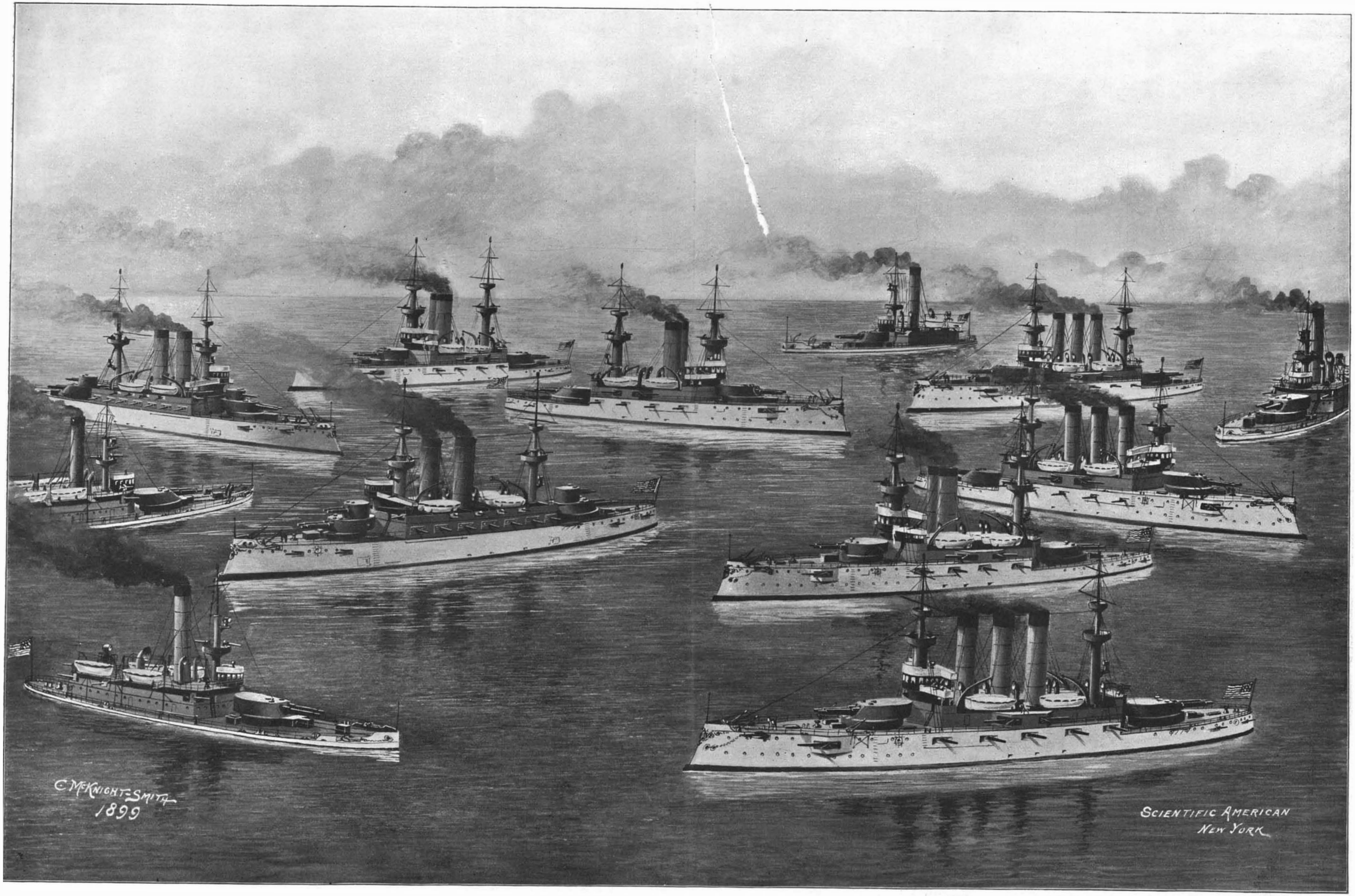
A repetition of the serious accident which occurred over a year ago at Garrison's, on the Hudson River Railroad, has occurred in England, on the London and Northwestern Railway. Between Chester and Holyhead the track runs close to the seashore. During a gale which occurred at night the track gave way while a goods train was passing, precipitating the engine and several cars into the sea, and the engine was found on end. It is thought that the tide carried away the sea wall and ballast before the train reached the scene of the accident.

The Crehore-Squire Company, of Cleveland, O., has been capitalized for a capital of $1,000,000. The promoters of the new company state that they will adopt the system invented by Messrs. Crehore and Squire, which will tend to revolutionize telegraphy. Col. Squire stated that they expected to put up wires throughout the country and that they had sent as high as four thousand words a minute by the system. It was tried by the government about six months ago and over three thousand words a minute were sent at that time.

The present director of the New York State Museum, Albany, and his associates, are, without exception, warmly interested in securing a more active co-operation of the museum and its staff with the teachers of science in the colleges and schools of the State, which the peculiar circumstances of the museum have heretofore made impracticable, and will be very glad of suggestions from teachers in any institution in the University. Science teachers ought to feel some measure of responsibility for notifying the museum of matters of interest in their locality and acting as associate or honorary members of the museum staff, the scientific officers of which will in turn be glad, as far as practicable, to visit schools where their services are requested, and give advice and suggestions regarding collections, field work, and other matters of interest.

We have before referred to the Marine Salts Company, which was going to extract gold from sea water (see the SCIENTIFIC AMERICAN for August 13, 1898). Mr. Pack, the Assayer of the United States Mint, in San Francisco, has made some interesting experiments in this line, which are reported in The Mining Press of that city. He finds gold in the water of the ocean only in solution amounting to about 0·5 of a grain to the ton; in value about 2 cents. The gold in the water of San Francisco Bay contained probably about twice that amount, though largely in a finely divided state, only a portion being in solution. The quantity of gold and silver actually contained in the ocean water and the possibility of profitably extracting them has been for a long time under discussion. In 1872 Sonstadt discovered gold in sea water and reported it to be less than a grain to the ton. Prof. Liversidge, in a paper read before the New South Wales Royal Society, estimates the sea water of the coast in that region to contain a very small amount of gold to the ton, namely, 0·5 of a grain. Mr. Pack's figures agree admirably with those of Prof. Liversidge. In view of the small value of the yield of gold per ton, it is extraordinary that people could be so deceived as to invest money in so crazy a scheme.

ARKANSAS. KENTUCKY. WISCONSIN. ILLINOIS. CONNECTICUT. OHIO. MISSOURI. FLORIDA.




WYOMING. KEARSARGE. ALABAMA. MAINE.

**FLEET OF BATTLESHIPS AND MONITORS NOW BUILDING FOR THE UNITED STATES NAVY.**

### BATTLESHIPS AND MONITORS NOW BUILDING FOR THE NAVY.

There are now completed and in commission in the United States navy five battleships, four of which are of the first and one of the second class. These are the "Oregon," "Indiana," and "Massachusetts," of 10,288 tons, and the "Iowa," of 11,410 tons, first-class battleships, and the second-class "Texas," of 6,315 tons.

There are now building in our yards eight first-class battleships of over 11,000 tons, whose aggregate displacement is 94,125 tons. As the aggregate displacement of the battleships now in commission is about 60,000 tons, it will be seen that we have over 50 per cent more tonnage of battleships in course of construction than took part in the operations of the late war.

These eight vessels represent three successive naval appropriations. The "Kentucky" and "Kearsarge" were authorized in 1895 and are about ready to undergo their steam trials; the "Alabama," "Wisconsin," and "Illinois" were authorized in 1896 and are about 60 per cent completed; while the "Maine," "Ohio," and "Missouri" were authorized last year and are in the early stages of their construction.

Judging from the rate of progress achieved in the past, we may expect to see the first-named ships in commission by the close of the present year; the three "Alabamas" by the close of 1900, and the "Maine" with her mates in the winter of 1902–03.

In addition to these fine vessels, we unfortunately have under way four ships of an obsolete and discredited type, which will be known as the "Arkansas," "Connecticut," "Florida," and "Wyoming." They are monitors, pure and simple, and represent a class of ship which was built in the early, experimental stages of warship construction, when designers were feeling their way toward the ideal fighting ship as represented by the eight battleships above mentioned. These four monitors were ordered by Congress in the face of the opinion and advice of the men who design and the men who fight the vessels of our navy. The fact that we are committed to the construction of four of these archaic curiosities serves to show to what absurdities Congress can be committed when it sets up its own judgment against that professional opinion which should guide it in such purely technical questions as those of warship design.

Including the monitors, we now have under construction the twelve armored vessels which our artist has shown grouped together in the accompanying illustration. As each of the ships is drawn with careful attention to detail, particularly in the matter of armament, the group conveys an impressive idea of the exceptional offensive qualities of the forthcoming addition to our navy.

The particulars of the ships are given in the accompanying tables, from which it will be seen that, while there has been a reduction in the weight of the main battery, there has been a remarkable increase in the weight of the intermediate battery, the latter being so great as to render the total energy of gun-fire enormously greater in the latest ships of the "Maine" class.

Taking the vessels in the order of their advancement toward completion, we have first the "Kentucky" and the "Kearsarge," whose dock steam trials have already taken place. Comparing them with the "Oregon" type before them and the "Alabama" type following them, they represent a transition stage. In the "Oregon" we have an unprecedented development of the armor-piercing gun and a weak intermediate battery. In the "Alabama" we see a reduction in the number of armor-piercing and a proportionate increase in the intermediate rapid-fire battery. In the "Oregon" were four 13-inch and eight 8-inch armor-piercers, while the intermediate battery consisted of only four 6-inch, and these were originally slow-firers. In the "Alabama" the 8-inch guns have been thrown out entirely, and the weight has been put into an extremely powerful battery of fourteen 6-inch rapid-firers. Now this change, which is in agreement with the course followed by other navies, was gradual, and in the "Kentucky" and "Kearsarge" we see the intermediate step, for in these ships four of the 8-inch guns are retained, and the demand they make upon the displacement of the ship is shown by the fact that the intermediate battery consists of 5-inch instead of 6-inch guns. As the total weight of guns, mounts, ammunition, etc., for a 6-inch is about double that required for a 5-inch gun, it is evident that the retention of the four 8-inch guns necessitates the use of the lighter guns in the broadside rapid-fire battery.

The most novel feature in these ships is the double-deck turrets for the main battery. They were adopted after much discussion, in which it was argued that the 8-inch guns would not be capable of training independently of the 13-inch guns below them, and that one lucky shot might put half the main battery out of action by disabling both guns. To which it was replied that the great economy in weight and the unequaled protection afforded the 8-inch ammunition hoists, more than compensate for the risks incurred. The performance of these turrets will be watched with great interest, and we shall not be surprised if they are repeated in some modified form in future ships.

The weakest feature of the "Kearsarge" is that it sits very little higher in the water than the "Oregon"—a feature which would greatly hinder it in chasing an enemy to windward. In the "Alabama" class, ships of the same tonnage, this is rectified by the addition of a spar deck, which extends aft for three-quarters of the ship's length. This raises the freeboard to about 20 feet forward as against 13 feet aft, and enables the forward 13-inch guns to be carried at an elevation of 26 feet above the water line. A further improvement over the "Kearsarge" is shown in the wider separation of the intermediate battery, which is rather crowded in the earlier ship and might be entirely wrecked by a single 12-inch shell. Eight of the 6-inch guns are carried on the main deck within the 5½-inch armored citadel, four are placed behind 5½-inch armor on the spar deck above the citadel, and two are carried in 5½-inch sponsons forward on the main deck. This is a far better arrangement. The guns would take longer to silence and the danger of panic is reduced. While the total muzzle energy of the metal thrown from one broadside in five minutes works out as practically the same as that of the "Kentucky," the greater carrying power of the 6-inch over the 5-inch gun would render the fire of the "Alabama" more destructive at ordinary fighting ranges of 2,000 to 3,000 yards.

In the "Maine" class we see a greater advance than in any other ships of the new navy. These remarkably fine vessels embody the experience gained during our late war, and in them, moreover, we have not hesitated to adopt some of the best features of foreign practice. The most important advance has been in speed and armament. The grave defect of the five ships already described is their low speed of 16 knots, which is from 3 to 4 knots less than that of some foreign battleships now building or in commission. It is due largely to the efforts of Commodore Melville that the "Maine" and her sisters are to steam at 18 knots instead of the 16 knots originally proposed. The result is to be obtained by giving them an increased length of 20 feet to accommodate the more powerful machinery. Another important modification that practically doubles the fighting power, as compared with the "Alabama," is the introduction of smokeless powder and improved rapid-firing ordnance. The 12-inch guns will be of great length and will show the high velocity at the muzzle of 3,000 feet per second, the same velocity being called for in the 6-inch rapid-firers. The muzzle energy of the 12-inch gun will be 48,000 foot-tons, as against 25,985 foot-tons for the 12-inch guns of the "Iowa," and 33,627 foot-tons for the 13-inch guns of the "Alabama." The 6-inch guns will have about 6,000 foot-tons energy, as against 3,204 foot-tons for the old slow-fire 6-inch weapon. The new energies therefore represent an increase of nearly 100 per cent over the old weapons firing brown powder.

The new guns will be provided with improved breech mechanism of the Weling pattern, the rights of which were recently purchased from Maxim-Vickers for $200,000. The rates of fire will be greatly increased thereby, so that here again will be a large addition to the fighting capacity.

In the accompanying estimate of the total energy of broadside fire in one minute the rates of fire are calculated from actual results obtained. They are, in the case of each ship, the best that could be obtained by trained crews. As a matter of fact, such a fire will never be sustained for five minutes, but the table serves the end of showing the vast increase of power and rate of fire in the case of the "Maine" due to smokeless powder and improved breech mechanism. Unless the 13, 8, 6 and 5-inch guns originally designed for the "Kearsarge" and "Alabama" classes are modified to suit the new smokeless powder, the "Maine" will be theoretically nearly three hundred per cent more powerful than the earlier ships.

| | Displacement. | Main and Intermediate Batteries, Broadside. | Weight of Shell in Pounds. | Foot-Tons, Energy per Shot. | Speed of Fire. | Total Energy of Broadside for Five Minutes in Foot-Tons. | |
|---|---|---|---|---|---|---|---|
| **Kearsarge** | 11,525 tons. | 4 13-inch. | 1,100 | 33,627 | 1 per two minutes. | Brown powder | 336,270 |
| | | 4 8-inch. | 250 | 8,011 | 1 " minute. | | 160.220 |
| | | 7 5-inch rapid fire. | 50 | 1,834 | 8 " " | | 513,520 |
| | | | | | | Total brown powder | 1,010,010 |
| | | | | | | " smokeless powder. | 1,450,000 |
| **Alabama** | 11,525 tons. | 4 13-inch. | 1,100 | 33,627 | 1 per two minutes. | Brown powder | 336,270 |
| | | 7 6-inch. | 100 | 3,200 | 6 " minute. | | 672,000 |
| | | | | | | Total brown powder | 1.008,270 |
| | | | | | | " smokeless powder. | 1,569,000 |
| **Maine** | 12,500 tons. | 4 12-inch. | 850 | 48,000 | 1 per minute. | Smokeless powder | 960.000 |
| | | 8 6-inch. | 100 | 6,000 | 8 " " | " " | 1,920.000 |
| | | | | | | Total smokeless powder. | 2,880,000 |

Experimental work, however, is being done with the 13-inch gun, and in recent tests with smokeless powder an energy of about 44,000 foot-tons has been secured. The powder chamber has to be of less diameter and longer for the new powder, but there is no structural difficulty to prevent the change from being made.

The four monitors will have all the vices of their type. Their worst feature is that they roll so quickly as to make accurate shooting an impossibility. Admiral Sampson condemned them in his report of the San Juan engagement, and there is not a naval officer of the new school in our navy that favors the type. The "Arkansas" and sister ships have only 18 or 20 inches freeboard, and in any kind of a sea their 12-inch guns, of which they carry two in a forward turret, would be half the time out of sight in the trough of the waves. The present designs are a modification of those first made, the ships having been lengthened 27 feet amidships to accommodate an increased supply of coal. The particulars of these ships will be found in the accompanying table.

| Name. | Type. | Displacement in Tons. | Speed in Knots. | Armor. Belt. | Armor. Turrets. | Armament. Main. | Armament. Intermediate. |
|---|---|---|---|---|---|---|---|
| Kentucky | First-class battleship. | 11,525 | 16 | 13¾ in. | 17 in. | Four 13-in. | Fourteen 5-in. rapid-fire. |
| Kearsarge | " " | " | " | " " | " | " " | " " " |
| Alabama | " " | " | " | " " | " | " " | " 6-in. " |
| Wisconsin | " " | " | " | " " | " | " " | " " " |
| Illinois | " " | " | " | " " | " | " " | " " " |
| Maine | " " | 12,500 | 18 | 12 " | 14 in. | " 12-in. | Sixteen " " |
| Ohio | " " | " | " | " " | " | " " | " " " |
| Missouri | " " | " | " | " " | " | " " | " " " |
| Arkansas | Monitor. | 3,100 | 12 | 11 " | 11 in. | Two 12-in. | Four 4-in. " |
| Connecticut | " | " | " | " " | " | " " | " " " |
| Florida | " | " | " | " " | " | " " | " " " |
| Wyoming | " | " | " | " " | " | " " | " " " |

### A New Copyright Law.

A new copyright amendment of far-reaching importance is now before Congress and is to be found in a section of the Legislative, Executive and Judicial Appropriation Bill relating to the Library of Congress. The exact text is as follows: "Provided that on and after the first day of July, 1899, no person shall be entitled to a copyright unless the copies deposited with the Librarian of Congress of such copyright, book or other article, or the photograph deposited of a work of the fine arts, shall be of such substantial and permanent paper or substance, and ink and impression, as shall be according to such standard as shall be from time to time established and approved by said Librarian." It will be seen that no provision is made in the law for the publication of standards, and as the law requires that two copies must be deposited with the Librarian on or before the date of publication, it will be seen that an error in not complying with the standards would necessarily result in a loss of the copyright. It is very probable that this point has not been considered by a committee of the House, and when it is, this seeming oversight will be corrected. The American Copyright League has directed its counsel to file a protest against alterations of the copyright statutes which seemed to clothe the Librarian with arbitrary power, not only of establishing a standard, but of altering it at will. The recent investigations which have been carried on in England regarding paper and the life of books would certainly show the necessity for some law of this kind, but the bill should be worded so as not to cause hardship to anyone.

ACCORDING to Science, Prof. Cleveland Abbe, editor of The Monthly Weather Review and Professor of Meteorology at the Weather Bureau, has given his valuable collection of books, papers, and pamphlets relating to meteorology to the Johns Hopkins University.

## THE TELLTALE PLUMMET IN THE WASHINGTON MONUMENT.

BY C. FRANCIS JENKINS, C.E.

Doubtless the longest plumb line in existence is that suspended in the Washington Monument, which has a free swing of more than 510 feet. It is of hard drawn copper wire, $\frac{3}{64}$ inch in diameter, and is suspended, for protection, in a galvanized iron pipe. The wire is located in a plane cutting the center of gravity of the monument, which is 174 feet 10½ inches above the door sill. The plummet was set June 12, 1887, with the top end of the wire fastened to an adjustable brass screw in an I beam about 10 feet from the west wall.

In the plummet house (which is riveted to the vertical protecting pipe), at the base, is a hollow iron pedestal, one side of which is fitted with a door for access to the interior, where stands a bucket of water in which the "bob," a 25 pound brass spheroid, swings. On top of the pedestal are two telescopes, one on the north side facing south and one on the east side facing west. Both are moved by micrometer screws with a travel along scales graduated to inches and twentieths, which, with the screws, give readings to thousandths of an inch.

These readings are taken daily, the maximum deflection ever observed being 0·14 inch, which by calculation shows that the top of the monument moves about three times as far as the center of gravity.

As carefully taken data would prove of great value to engineers who undertake the erection or custody of very tall shafts, it is proposed to make the readings automatic and continuous by means of a kind of improved pantograph enlarging one thousand times. These, with the heat records taken at the top and at the bottom, both inside and out, would constitute a record of great value, showing what scientists call the "breathing" of this 81,120 ton mass of stone.

No less interesting was the location of the shaft, or what is recorded thereof. The bench mark, known as the Jefferson pier, was built on the first meridian line of the United States, in 1793. It is at the intersection of a line drawn N.-S. through the center of the Executive Mansion and another E.-W. through the Capitol. No considerable record exists of the establishment of these lines, although it is tradition that President and Mrs. Jefferson were present at the time, and that Mrs. Jefferson gave her thimble to be set in the top of the wooden monument to receive the cratched cross. From this monument, and another located 90° therefrom, levels were taken, with which subsequent levels were compared to determine whether the monument settled evenly. All the levels taken show that the foundation has remained horizontal, although subject to a gradual diminishing settling, which, in the centennial year (1876), was 8·82 inches.

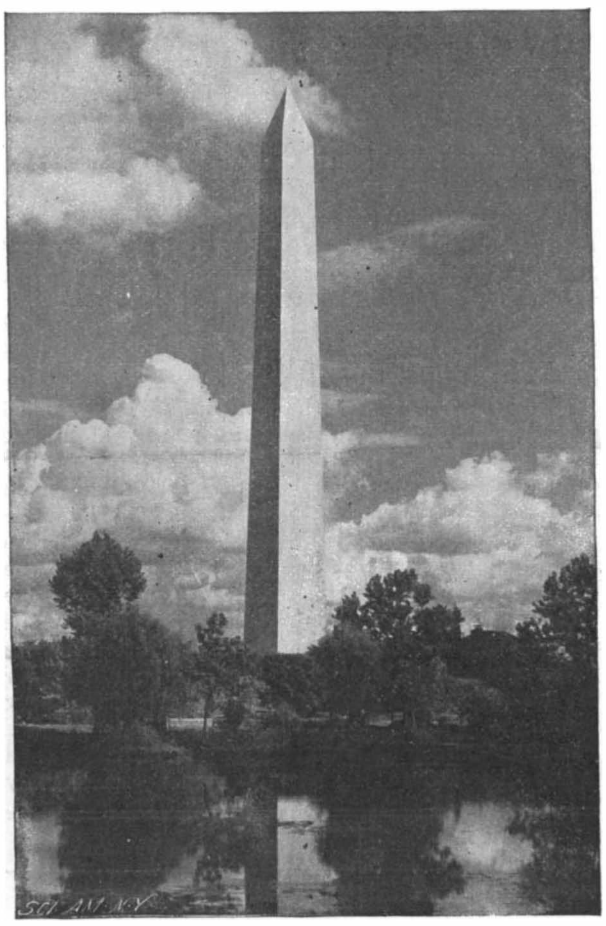
### Starting a New Steam Plant.

BY EGBERT P. WATSON.

It not unfrequently happens that new steam plants are put in use with the greatest possible dispatch. Owing to a rush of business or delay in getting the new engines and boilers, so soon as they can be set up in place the boilers are fired and steam turned on the piping at full pressure at once. Then there is hurrying to and fro with wrenches and calking tools and all the appliances of the trade to stop leaks that would not have appeared had a proper course been pursued. A steam plant is a complex structure, and until the strains caused by changes of form from expansion and contraction have been adjusted or taken up gradually, there will always be trouble, and lasting derangement if too great haste is made to start. The course that long experience has shown to be the safest in the end is indicated in the advice here given.

Take the case of the tubes and tube sheets of a firebox boiler. So soon as a fire is started, the tubes, tube sheets, and side plates are exposed to great heat, if the fire is urged, in a short time, and while the rest of the boiler is cold, or at the temperature of the air and contained water, whatever that may be. In boilers of defective circulation or none at all, this variable temperature may be maintained for hours, and it requires no imagination to see that the effect upon the boiler is injurious, to say the least. The tubes are stretched tightly between two rigidly fastened sheets of greater or less thickness, with the result that something must give or buckle, when they are heated, to the extent of the expansion at least. This applies to the side sheets and stay bolts as well, and from this brief citation it follows that, when a new boiler is started for the first time, discretion is certainly the better part of valor. Not unfrequently boilers which have been well constructed in the first instance, a good job in all parts, have been practically ruined, or, if that is a little too strong an expression, very much injured by haste in putting them into action. More harm has been done by the "hurry-up" plan of starting a new steam plant than persons without experience can conceive. Not only the boiler suffers, but the brickwork and front also, if the boiler is an externally fired one.

When a new boiler is fired for the first time, a boy's bonfire on the grates for ten or twelve hours is ample heat. The water should not be allowed to get over blood heat, or about 100 degrees, and this temperature should be steadily maintained all day. Upon no account should any steam be formed, the boiler being allowed to cool slowly at night. For the second day the heat should be increased to 200 degrees and maintained at that stage for ten hours, the heat and vapor being permitted to circulate through the whole of the pipe system. On the third day steam should be raised to ten pounds and kept at that all day. If this plan is followed, the changes of form which take place will occur slowly instead of violently when a contrary course is exhibited, and all the expansion strains absorbed or redistributed without bad results. On the contrary, if fires are forced from the start, there may or may not be visible local leaks, but the probabilities are that in the near future various disturbances will appear which might have been avoided by less violent measures upon the start. On the third day also the boiler should be thoroughly cleaned by feeding and blowing at frequent intervals. During the process of construction much dirt of all kinds accumulates; since black oil is used in quantity for drilling and tapping holes, a greasy sludge will be formed and settle on the cooler parts of the boiler, unless it is removed before it has time to settle. Not only upon the cooler parts, but upon other parts as well. If the circulation is active, this sludge is carried around until it happens to hit some place that it sticks to. When that occurs, no water can get beneath it, but heat from the other side of the plate can; when that occurs, the plate is



THE TELLTALE PLUMMET IN THE WASHINGTON MONUMENT.

overheated and the steam pressure forces the sheet down, making a bag, or pocket, that has to be cut out promptly and the sheet patched. This danger is supposed to be imminent in old boilers only, but it is by no means unknown in new boilers but a few weeks old.

It not unfrequently happens that new boilers are started with no water supply aside from the contents of the boiler, but it seems needless to say that this is a dangerous proceeding. If from any cause leaks of importance should start, or many small leaks, the only course possible would be to haul the fire or fires at once. This might or might not be feasible, according to circumstances, but an ample water service should be assured before the fires are started, and at least two sources of feeding the boiler when at work—an injector and a steam or power pump. Injectors are fickle things, especially new ones. If a slight air leak is present in the suction, they promptly quit work, although the leak is not apparent to the eye. All new boilers are liable to foam from the grease in them, and an injector will not work then, because it needs dry steam, not hot water, to act properly. The writer was much bothered by a high pressure injector refusing duty recently (225 pounds steam pressure), and only got it to act at last by binding all suction joints externally with red lead putty. After this was done there was no further trouble. The joints were not practically air tight, although they seemed to be.

The time to pack all valves, joints, and stuffing boxes is before the start; not after it. Much confusion has been caused by neglecting this apparently minor detail, if there is any such thing as a minor detail about a steam plant. Above all things, keep the man with the handy screw wrench from tightening up leaky joints under pressure. Upon no account should this be allowed, even with so low pressure as ten pounds. A bolt that leaks may be a bolt that is broken, and the least twist upon it sets it free. After that anything may happen. The writer once saw a bolt blow out under 200 pounds pressure, and as it left a considerable area undefended, one bolt after another ripped off until the pressure was reduced by the area opened. If a man had been trying to tighten that leaky bolt, he would have been killed. Again, a blow cock of only half inch diameter leaked so badly that a man undertook (contrary to advice) to tighten it. As soon as he touched it with the wrench it promptly blew out and he had a badly scalded hand as the result. Fittings are sometimes caught by two or three threads only, the man at work on them having heard the whistle blow before he got through, and forgotten to screw them up afterward. The best time to make all changes and adjustments is when the boiler is cold. It cannot do any harm then.

Look out, too, for the man who supposes things about a steam plant. Suppositions in lieu of personal knowledge are dangerous and cannot be tolerated. With all the precaution which can be exercised, accidents may occur; they are quite likely to happen when only lukewarm vigilance is observed, instead of absolute personal inspection of every detail under pressure.

### Clocks in the White House.

"The clocks in the White House," remarked an official clock winder to a Washington Star reporter, "are by no means the least interesting things about the house, though but little has ever appeared about them in the newspapers. Strange as it may appear, but one of the old clocks there is of American manufacture, though all that have been purchased of late years are. The one clock referred to was made in New York and was purchased when James Monroe was President. It is one of the permanent fixtures in the green room, and has been there ever since it was purchased. As a timepiece it compares favorably with any of the foreign-made clocks, though it was made at a time when America was not as famous for its timepieces as it is now. The most interesting clock there, of course, from its history, is the clock in the blue parlor, which was once the property of Napoleon Bonaparte, who presented it to General Lafayette, and the latter presented it to General Washington. The frame of it is made of alabaster and French gilt bronze. It has to be wound but once in a month. It keeps time to-day as accurately as when first made. What is known as the Lincoln clock, purchased when President Lincoln was in the White House, is an object of interest in the red room, and is of ebony and gold. It strikes the quarters, halves and hours. In Mrs. McKinley's room is a clock which has been running without the slightest intermission for nearly thirty years. The clock at the foot of the stairs leading up to the President's office is the one that the public generally sees. It is rather modern in construction, of the 'regulator' pattern, and is very reliable. The clock in Private Secretary Porter's room is admired for its cathedral gong rather than anything else, but it is a good clock, and has proved itself such for the ten or fifteen years it has been there."

### The Corner Stone of Health.

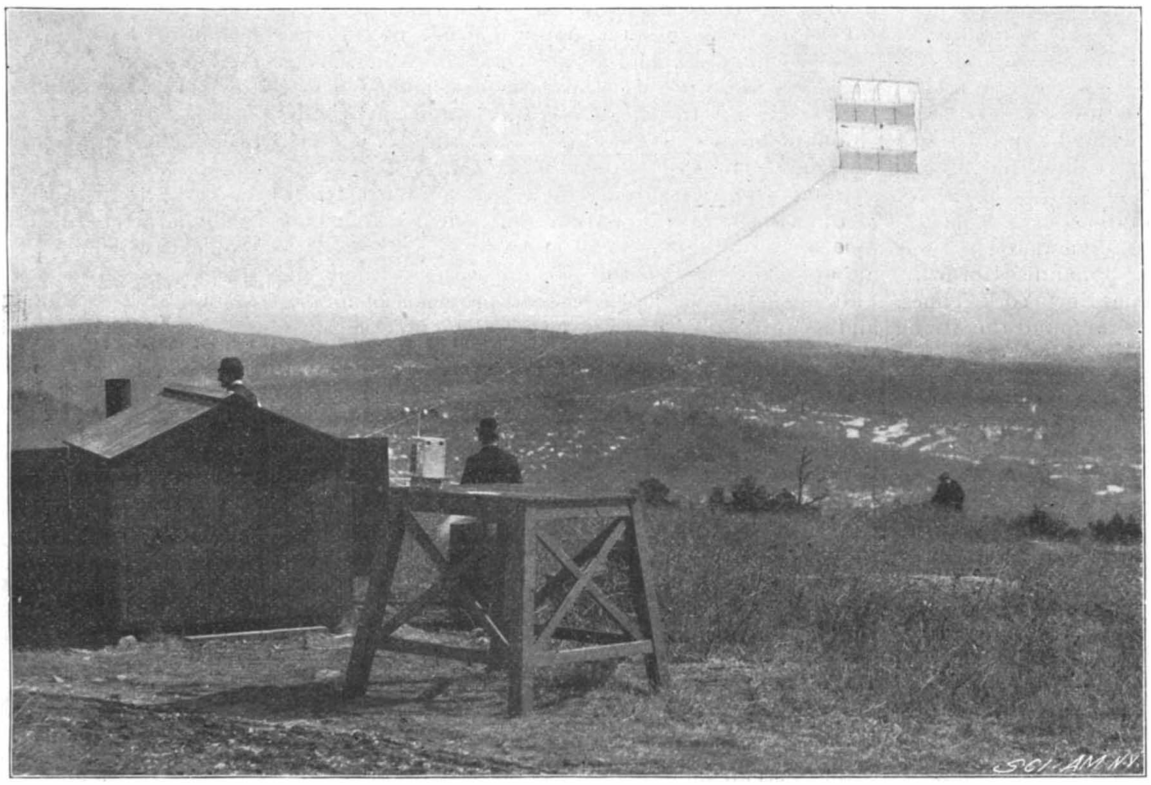
"Exercise," said a physician the other day to the editor of a contemporary, "is the corner stone of health. It differs essentially from work, in which the fundamental idea is that of labor. On the contrary, the idea of exercise is based upon activities undertaken for the benefit of the body or mind, some form of exertion intended to promote health or furnish amusement. Work is essentially toil, even though it be congenial. Exercise, on the other hand, is purely recreation. If exercise be taken only from a sense of duty, it loses the distinguishing feature of exercise and becomes work. A course of exercise, say cycling, should be carried on by easy stages. Exercise is a tonic and therefore benefit is not to be derived from a single dose. If active exercise is necessary as a hygienic measure, what form is best? You cannot persuade your patients to run, it is so undignified; or to saw wood, it is too laborious. But if you can persuade them to ride a wheel, you have cured them, if it is exercise they need." The wheel was then discussed from the therapeutic point of view in this way: "Active exercise may be divided into three classes, those requiring strength, speed, and stamina, and they all increase in common the circulation of the blood. Exercises requiring the exertion of strength are more fatiguing than those of speed. Cycling can be adapted to the requirements of the enfeebled invalid."

THE last determination of the speed of sound has been made by Mr. A. Leduc, who finds that the rapidity of propagation of sound waves through dry air at 0° C. (=32° F.) is 1098·58 feet per second.—Comptes Rendus, December 26, 1898.

## RECENT KITE EXPERIMENTS AT THE BLUE HILL OBSERVATORY.

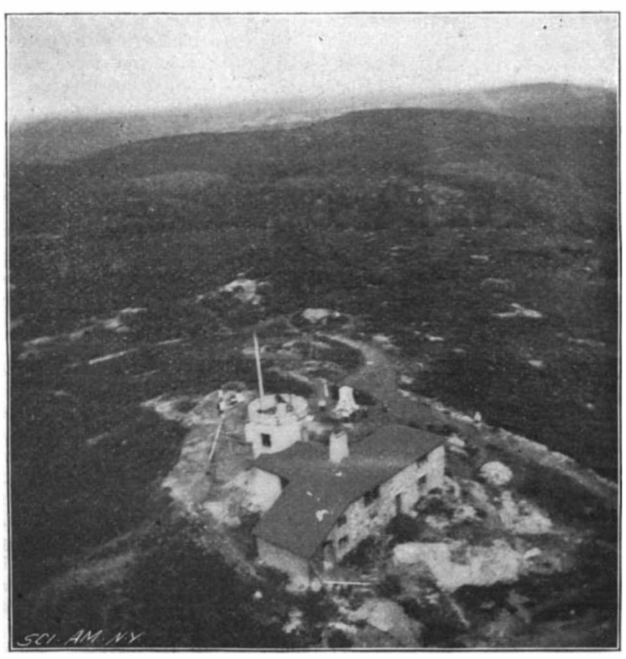
Kite flying has ceased to be monopolized by the small boy and is now used very largely for meteorological work. The government has established many stations equipped with apparatus for aerial work, and we have an important observatory entirely devoted to it. We have, from time to time, given some account of the remarkable experiments which have been made at the Blue Hill Observatory, near Boston, and we are now pleased to give our readers a more detailed description of the work.

The kites are flown singly or in tandem. The main line for flying the kites is made of steel music wire, No. 14 gage, which is 0·0325 inch in diameter. It weighs 15 pounds for each mile of length and breaks at 300 pounds strain. It is usually worked at less than half its breaking strength. Continuous lengths of 8,000 feet are obtainable, and as few splices as possible are used. For attaching tandem kites at any point along the main line a special aluminum cast clamp is used.



THE BLUE HILL OBSERVATORY—BEGINNING OF AN ASCENT.

The windlass employed since February, 1897, is a modification of Sir William Thomson's apparatus for deep sea sounding, and is shown in our engraving. The wire is reeled upon a drum which is an ordinary flanged pulley 20 inches in diameter and 4 inches wide. The flanges are grooved for the reception of the driving rope and the brake rope. The drum will hold about 40,000 feet of wire, but the greatest amount used heretofore has been 32,000 feet. The wire passes from the drum under a pulley which is moved horizontally slowly backward and forward by means of a cam geared to the axle of the drum, and which distributes the wire uniformly over the face of the drum. A second pulley delivers the wire to the strain pulley, around which it passes four times, then it goes over small pulleys which form a part of the dynamograph. One of these pulleys is carried at the end of a rod and moves with it, freely, in a horizontal guide. The opposite end of the rod is held by a heavy spring. Any strain on the wire tends to stretch the spring. All motion is transmitted through suitable levers and cams to the pen lever, which marks the variations in intensity of strain on the chronograph drum, which is covered with suitably ruled paper. By this means a continuous record of the pull is obtained at all times. After leaving the dynamograph the wire passes over the swiveling pulley, which is shown in our photograph. This is supported on a ball-bearing sleeve and takes any horizontal direction assumed by the wire. This pulley registers upon a dial the length of wire passing over it. With the apparatus the speed of winding can be varied from seven miles an hour to three miles an hour, and by regulating the engine the speed can be further reduced to less than one mile an hour. By means of the distributing and regulating devices which we have described, the windlass is practically automatic in action, and, when set in motion for winding, it requires no attention except at times when tandem kites are to be removed from the line. When the strain is very light, a crank may be attached to the axis of the storage drum and the line wound up by hand if desired. Ordinarily, of course, the steam engine is used. The small house behind the engine is arranged to move forward on rollers and cover the entire apparatus when it is not in use.



BIRD'S EYE VIEW OF BLUE HILL OBSERVATORY TAKEN FROM A KITE BY W. A. EDDY.

The meteorograph is one of the group of recording instruments carried by the kites. The height attained in meters, the temperature, the relative humidity, and the velocity of the wind are all recorded on the same chronograph drum by mechanisms of the well known Richard type, the four registering pin levers being parallel.

At the back of the instrument is secured a double rudder which keeps the end carrying the anemometer always facing the wind and in a horizontal position, so that the anemometer spindle is always vertical, irrespective of the blowing backward of the instrument by the wind.

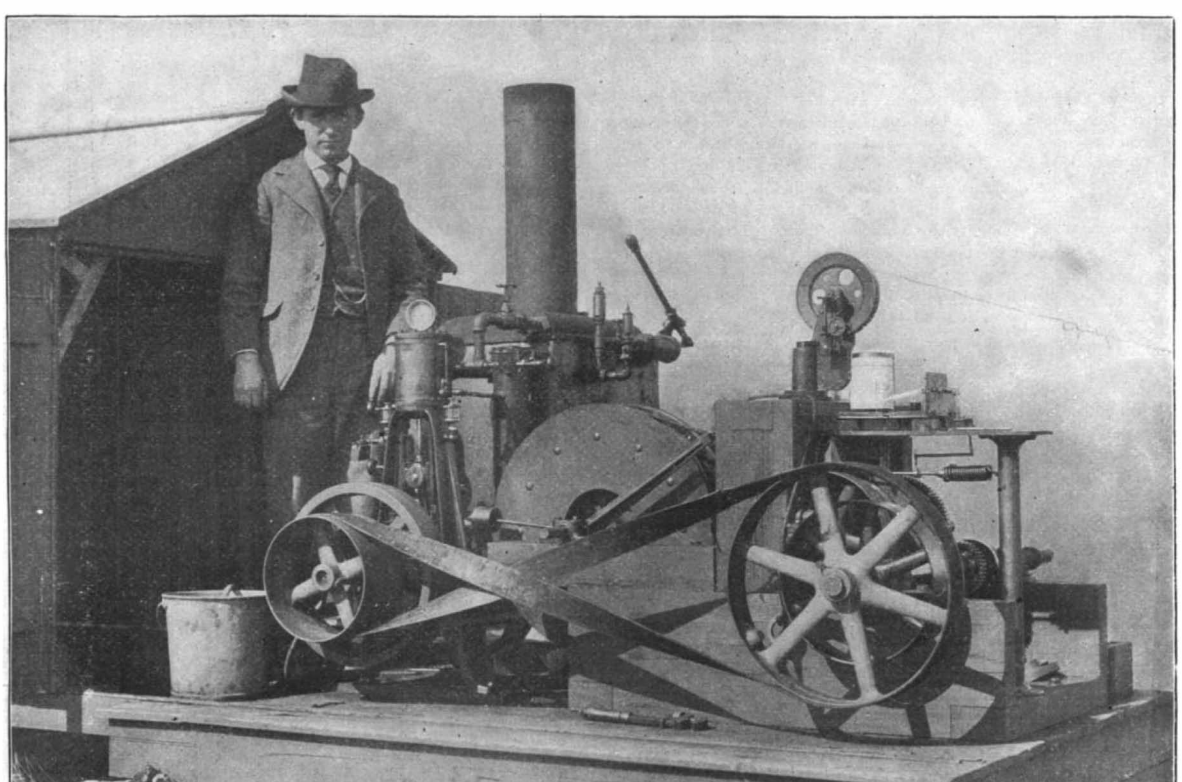
The complete instrument, including the rudder, weighs a little less than three pounds. It is suspended from the kite by means of a ring and toggle at the end of a long cord. The meteorograph is carefully compared with standard instruments before and after its ascent. The first kite is not always flown directly from the windlass, owing to the irregular surface of the hill, the wire being sometimes passed over a pulley secured at any suitable distance from the windlass. Usually about 1,000 feet of wire is allowed to run directly from the windlass before the pulley is removed. The first kite is a large one, having at least 70 square feet of lifting surface, and when it has taken up 984 feet (300 meters) of wire, another of the same size is attached by means of a clamp. The bridles of the kites are adjustable, so that the pull just below the second kite will not exceed 160 pounds. Stops of three to ten minutes are made when 300, 600, 1,000, 1,500, and 2,000 meters of wire are out, another smaller kite being attached at the last point. After this, stops are made after each additional 2,000 meters of wire are out. Stops with the same length of wire out are made when the kites are being reeled back, in order to obtain a second set of records at each point. The interval between the ascent and descent serves to show any change in the meteorological phenomena. After it is brought back to the ground the meteorograph is again compared for at least ten minutes with the observatory instruments before the records are removed. The vertical height of the instrument above the hill is computed by a mathematical formula, the angular altitude above the horizon being obtained by observing the kite with a surveyor's transit. If the kite is not visible by reason of clouds or darkness, the heights are taken from the barograph record.

Since 1894 the work with kites at the Blue Hill Observatory has advanced until, within the past two years, the meteorograph has repeatedly been carried to heights exceeding 10,000 feet. The greatest height—11,224 feet above sea level—was reached on August 26, 1898, and the average height obtained during 1898 was about 8,000 feet.

Compared with balloons, kites are much less expensive, more easily handled, and the exposure of the instrument is probably equal to that of the instruments at the ground—something impossible to obtain with instruments carried by balloons. Another great advantage is that the kites are controllable and the records may be obtained at any desired point up to over 12,000 feet. While the heights reached heretofore do not equal the highest balloon ascension, the progress made so far warrants the belief that a height of three miles is possible.

In addition to our views, which show the steam power windlass for kites and the beginning of an ascension, we are enabled to present, through the courtesy of Mr. William A. Eddy, of Bayonne, N. J., a bird's eye view of the Blue Hill Observatory, which he took in August, 1895, with a camera sustained by a kite.

The work carried on by the Blue Hill Observatory is watched with interest by meteorologists all over the world, and up to the present time there has not been published any adequate description of the apparatus which is



BLUE HILL OBSERVATORY—STEAM POWER WINDLASS FOR KITES.

employed in achieving the remarkable results, so that we are pleased to announce that in our SUPPLEMENT for next week, No. 1209, we shall publish an elaborate paper upon the kites, windlass, meteorograph, etc. This article has been prepared by Mr. S. P. Ferguson, of the Blue Hill Observatory, who has devised and constructed the apparatus which we have shown.

### Szczepanik Again.

Szczepanik occasionally gives interviews to the press at his laboratory, and when Dr. Johannis Horowitz, the Vienna correspondent of The New York Times, went to see him, a short time ago, he found the young man bubbling over with new ideas in which the ultra-violet rays played a major part. The inventor took Dr. Horowitz into a room in which two miniature railway trains were approaching each other on the same track. At some distance from each other they suddenly stopped. This was another one of the great inventions added to his repertoire, and the inventor explains the effect as follows: When the trains are approaching each other on the same line of rails, the ultra-violet rays of light from the lamps act upon the respective electric apparatus, set automatic brakes in motion and thus stop the trains, whether in daytime or at night.

The inventor also thinks that, with the aid of the apparatus he is constructing, he will be able to aim guns with absolute certainty. On the enemy's approach the other army would withdraw, leaving behind baggage wagons and other impedimenta loaded with bombs. The explosives are furnished with a small apparatus, the nature of which he does not divulge. When the enemy reaches the camp, a powerful electric or magnesium lamp will shed a light on the explosive material, and, at the same moment, when a single ray falls upon the apparatus, the bombs will all be exploded. In the same way submarine mines would be fired, and, of course, it would be useless to aim guns. Guns could be directed against the enemy without even measuring the distance. With a rectangular stop, rays would be sent out which would form a wall of light which could not be penetrated by a bomb, provided with the apparatus without its bursting. Instead of the present problems of aiming and measuring with guns, it should be practically, in the future, aiming at a light. These are only a few of the stories which emanate with delightful frequency from the laboratory of this gentleman who is blest with such a fertile imagination.

### Seventy-fifth Anniversary of Franklin Institute.

Franklin Institute of Philadelphia was organized on February 5, 1824, and a committee was appointed to assist in a formal celebration of the event. The splendid work the Franklin Institute has accomplished cannot be overestimated. The additions to the roll of membership, and the subscriptions which have been received to the endowment fund, are practical evidences of the interest exhibited. The library is rearranged, and the model collections have been rehabilitated. The excellent work done by the sections and committees all points to increased activity. Many important discoveries and important inventions were first brought to the attention of the world in the venerable building of the Franklin Institute.

### The Current Supplement.

The current SUPPLEMENT, No. 1208, has a number of interesting articles. "Restoration of the Temple of Karnak" is a paper accompanied by an elaborate series of illustrations showing the splendid work which has been accomplished in repairing this wonderful milestone in the world's history. "Tuberculosis in Animals," by W. Hunting, is continued. This is a most valuable article, dealing with one of the most serious problems which now confront us. "Instruments for Measuring Small Torsional Strains" is an article describing a very ingenious measuring instrument. "The Use of Musical Vibrations and Chromatoscopic Figures" describes Dr. Corning's method of treating nervous diseases. It is an entirely unique and successful scientific treatment, requiring the use of the phonograph and stereopticon. "Geographic Distribution of the Vertebrata" is a lecture by Prof. Witmer Stone specially reported for the SCIENTIFIC AMERICAN SUPPLEMENT.

### Contents.

(Illustrated articles are marked with an asterisk.)



## RECENTLY PATENTED INVENTIONS.

### Agricultural Implements.

COTTON-GIN.—EUGENE R. BARBER, Valdosta, Ga. The cotton-gin provided by the present invention has a belt with gripping-plates which grasp the cotton in order to retain it on the belt. The belt passes beneath a stationary blade; and the cotton at that point is acted upon by a set of stripping-fingers, which stroke past the edge of the stationary blade to remove the cotton-seed.

LAWN-MOWER.—EDMUND A. LANDON, Penn Yan, N. Y. The primary object of this inventor is to construct a machine which will cut grass and weeds of any height, and which will cut close to a tree, shrub, or sidewalk. With this end in view, the machine is provided with a finger-bar having a rearward extension formed with a transverse groove in its upper face. A sickle-bar has guided, lateral movement on the finger-bar, and has a rearwardly-extending arm provided with a tongue loosely engaging the transverse groove in the rearward extension of the finger-bar. The arm carries a roller engaging the cam-ribs of the driving wheel. By reason of this construction the knife or sickle-bar will be moved quickly and uninterruptedly while the machine is moving forward.

### Bicycle-Appliances.

SUPPORTER.—HENRY VANDER WEYDE, London, England. The bicycle-supporter comprises a pair of legs pivoted to work upon universal joints at opposite sides of the rear wheel. Springs are so applied as to tend to swing the legs downwardly about their universal axes. Controlling-links, universally joined to the main frame and to the legs, constrain the legs to diverge outwardly when lowered and bring them close alongside the rear wheel when raised. The legs are operated by a cord passing over pulleys, to the handle-bar. Novel mechanism is provided whereby the cord is wound up to bring the legs into operative position. The supporter is well adapted to hold the bicycle on any surface, even when the roadway is laterally inclined.

### Electrical Devices.

AUTOMATIC CIRCUIT-CLOSER. — HENRY F. BLACKWELL, Jr., Brooklyn, New York city. This invention provides means for switching Gamewell, standard cut-out, fire-alarm signal-boxes into circuit. The means in question comprise two swinging switch-arms having connection with the main circuit. A cam operates to move the switch-arms into position to close the alarm-circuit. The cam is provided with a pinion and is rotated by the rack as it engages the pinion in its downward movement. This downward movement and consequent rotation of the cam causes the switch-arms to close the alarm-circuit in order to sound the bell.

### Engineering Improvements.

STEAM-ENGINE REVERSING VALVE.—HARRY E. BROWN, New Matamoras, Ohio. The valve-gear comprises a main and an exhaust-controlling valve. The main valve has a passage extending through it, adapted to receive the controlling-valve, and an exhaust-port within its body connecting with the passage. A hollow controlling-valve mounted to have a limited reciprocation operates to close the passages, and has ports connecting its interior with the exhaust passage at all times, and other ports adapted to connect its interior with either side of the main valve. A reversing-valve is provided, which admits steam to either side of the main valve. It is possible to reverse the engine by the operation of the throttle-valve, thus enabling a number of parts to be done away with and simplifying the valve-gear.

ROTARY ENGINE.—GEORGE H. CARR, Rockport, Tex. This improved rotary engine comprises two rotating piston-disks having peripheral contact and connected to insure uniform rotation by means of gear-toothed sections located at the middle of the length of the disks, a portion only of the teeth and coacting gorges extending throughout the length of the disks and forming piston-heads or abutments. To insure evenness of rotation, a toothed section is employed; but in order to maintain a durable tight joint and to reduce the friction to a minimum, this toothed section is made as short as possible. By this construction a tight joint and a reduction of friction are both secured.

ROTARY-ENGINE.—JAMES J. CALLIHAN, New Orleans, La. This engine has a ring-cylinder with circular abutment-cavities opening from the periphery of the cylinder-cavity. Exhaust and supply ports open into the abutment-cavities upon opposite sides of a radial line. A piston-disk is provided having piston-heads fitting the cylinder-cavity. Abutments are mounted to turn in the cavities already mentioned, and have curved recesses adapted to receive and pass the piston-heads. The abutment-edges are cut away on the center line of the recesses, so as to uncover the ports when the abutment is in a radial position.

FUEL-FEED DEVICE FOR FURNACES.—CHARLES GROLL, Roubaix, France. This self-acting apparatus for stoking smoke-consuming furnaces comprises a hopper with regulating-vanes, an endless distributing apron, and a distributing-box, the partitions of which are arranged to allow coal of varying sizes to pass, although each compartment cannot receive a greater quantity of coal than that intended for it. In connection with these parts a stoking-device is used, formed by a fixed channel serving as a support and guide for a series of chains, each acting as an isolated carrier to convey the coal to the several points of the grate. Metal brushes are provided which operate to clean the chains.

CUT-OFF VALVE.—CHARLES A. PETERSON, Hot Springs, S. D. A steam-engine valve has been patented by this inventor, which comprises a valve-body having openings leading into the steam-chest and having ports connected with the cylinder-ports. A hollow main valve is mounted to turn in the valve-body and has ports for registering with the openings and the ports in the valve-body. A cut-off valve is mounted to oscillate in the hollow main valve to cut off the ports therein from the steam supply. On the stem of the cut-off valve, a segmental gear-wheel is mounted, which meshes with a similar gear-wheel on the engine-frame. The latter gear-wheel is rocked by the governor to operate the cut-off valve.

### Mechanical Devices.

TIDE-POWER.—WILLIAM REED, Manhattan, New York city. To provide a tide-power for forming a head of water for driving turbines or other motors is the purpose of the present invention. A float is arranged to rise and fall with the tide and carries a number of superimposed water-receptacles. Stationary reservoirs at different levels are each adapted to be filled from a corresponding float-receptacle at high tide, and are furthermore adapted to fill the next highest float-receptacle at low tide. Any number of water-receptacles may be used on the float, a corresponding number of stationary reservoirs being then employed in order successively to lift the water to different levels to obtain a head of water having suitable pressure.

HEMP-CLEANING MACHINE.—JOSÉ TORROELLA, Merida, Mex. This machine is so constructed that there will be a total absence of chains, pressure-bars, and springs employed in other existing machines to hold the hemp or other leaves while they are being led to the revolving knives in order to be cleaned. For the purpose of holding the leaves during the process of cleaning, revolving disks placed at angles to each other are used. The knives are so shaped upon the scutching-wheel that the quantity of cut fiber found in the bagasse will be reduced to a minimum.

CLUTCH.—THEODORE J. KOVEN, Jersey City, N. J. The present invention provides an improvement upon a clutch which has been patented by the same inventor, and which when used on a drive-shaft with a driving pulley will turn the shaft with a gradually increasing rapidity of revolution until the regular speed is reached. A disk having a recessed hub is mounted to slide on and turn with the drive-shaft, and an extension of the loosely mounted driving pulley extends over the hub. Pivoted on the disk is an angle lever, of which one member is adapted to enter the recess in the hub of the disk, and is located in the path of the extension from the driving pulley, the other member being curved and adapted to engage a pin which has a fixed relation to the lever. There is also a shifting mechanism whereby the clutch may be carried out of the path of the driving pulley extension. The present invention seeks to store power when the machine is stopping, so as to make that power available when the machine is to be started again.

PAPER CUT-OFF FOR BOX-COVERING MACHINES.—ISIDOR DREYFUSS, Manhattan, New York city. The object of this invention is to provide an improved cut-off for paper-box-covering machines which will be automatic in its action and yet capable of being operated by hand. The attachment may be adjusted to boxes of various sizes. The knife-operating mechanism is constructed so that the knives will act with a shear cut. One of the knives has a rocking movement and the other a reciprocating movement. The rocking knife operates to meet the cutting edge of the reciprocating knife as the latter descends and leaves the reciprocating knife just before its ascent, so that on the ascent of the reciprocating knife the lower knife will offer no resistance.

BASKET-MAKING MACHINE.—WILLIAM JACKSON, Traverse, Mich. The base of the machine carries stapling-mechanism and has a reservoir adapted to contain compressed air. On the base a carriage slides on which a form is mounted. A cylinder is held by the base and communicates with the reservoir. A piston-rod is driven by the cylinder and moves the carriage. A second cylinder is mounted on the carriage and has communication with the reservoir. A rod is driven by the second cylinder; and a mold carried by the rod is movable toward and from the form and rotatable therewith. By reason of this construction the parts for pressing and clinching the elements of the basket may be guided with more effectiveness and certainty than heretofore.

COAL-LOADING APPARATUS.—JAMES L. LAMB, Trinidad, Col. This invention provides an apparatus for loading coal into cars, and embodies a trestle-way or support, on which a carriage is mounted to slide toward and from the car, the carriage supporting a conveyer mounted to turn and to be moved vertically, so that it may be adjusted in order properly to direct the coal.

APPARATUS FOR LOADING VESSELS.—SAMUEL H. BRADFORD, Sandusky, O. The main portion of the apparatus comprises a horizontal frame hinged on a base frame, and an endless traveling carrier arranged in the horizontal frame. The carrier transfers coal, ore, or grain into a hopper which delivers at any point on an arc or circle. The carrier-frame is hinged to vertical standards in turn adjustably hinged to the base frame. The delivery apparatus is mounted upon a rotatable base-frame, so that it may be swung horizontally at any angle to permit a convenient delivery of material. The rotatable base-frame is itself mounted upon a truck or wheeled frame adapted to run on rails along the edge of a wharf, so that the apparatus may be easily shifted from one point to another.

TYPE-WRITING MACHINE.—WILLIAM P. QUIMBY, Gettysburg, Pa. The improvements in the present machine relate particularly to the spacing mechanism; and by means of these improvements a single or double spacing may be effected by one movement, in order that an operator, in printing the last letter of a word, may simultaneously effect a double spacing to provide for the usual spacing between words. The invention provides a rocking escapement-lever, type-levers, a spacing-lever, and intermediate means including a variably movable connecting device whereby the rocking-lever may be positively moved by the independent movement either of the key or spacing-levers a given distance, and may be positively moved by the joint operation of such levers a distance in excess of the first distance. The extent of the movement of the key and spacing levers is the same in both instances.

FIRE-ESCAPE.—ROBERT WATSON and CHARLES E. STEVENSON, Nanaimo, Canada. The fire-escape is of that class in which a trolley rail is fixed and supported near the top of a building in a horizontal position, and is arranged to co-operate with a trolley hung thereupon and carrying a basket, which may be shifted sidewise on the trolley-rails and raised and lowered. This invention provides, chiefly, a detachable section for the trolley-rail, which section may be raised and lowered and adjusted to alinement with one or more fixed trolley-rails arranged at different levels. The adjustable section is provided with a special brake-mechanism and may be raised and lowered, its ascent or descent being regulated either from below or by a person carried on the section.

### Railway-Appliances.

SMOKE-CONVEYER AND SPARK-ARRESTER.—WILLIAM H. DANA, Dallas, Texas. It is the purpose of this invention to provide a device which shall convey the smoke and cinders of a locomotive to the rear end of a train, so that the passengers in the cars are not subjected to the annoyances of inhaling smoke and obnoxious gases. With this end in view the locomotive smokestack is curved rearwardly and merges into a horizontal conveying-tube. This tube extends over the locomotive, tender, and cars of the train, and is made in sections coupled together. In the sections of the tube screens are fitted, which arrest the sparks and cinders. Boxes in front of the screens collect the arrested cinders.

RAILROAD-CROSSING.—JOHN C. EASLEY, Van Buren, Ohio. In this railway-device a bed-plate is arranged in the crossing. In keepers on the bed-plate, track-sections are mounted to slide. Between the adjacent ends of the track-sections, track-blocks are movable, which slide in guides on elevated portions of the bed-plate. Link connections between the blocks and sections are provided. On the bed-plate, a shifting-plate is mounted, which is connected with the blocks by links, and which imparts a sliding motion to the blocks and to the rail-sections.

SWITCH-OPERATING MECHANISM.—WILBUR J. HARRIS, Mount Pleasant, Ohio. To provide a simple mechanism which may be operated by the flange of the car-wheel to throw the switch in the direction desired, and to provide a controlling apparatus therefor, are the purposes of this invention. The mechanism has a pivoted bar adapted to be moved by contact with the car-wheel flanges. The bar, by means of intermediate levers, links, and connecting rods, throws the switch-rail. The direction of the throw will depend upon the position of a connecting-rod, which position may be changed at will by the motorman.

SELF-CLOSING RAILROAD-SWITCH.—RUFUS F. CARNES, Eldridge, Ala. Not infrequently it happens that a train-crew or trackman forgets to close a switch after a train has passed. As a result accidents occur which cause not only considerable damage to property, but sometimes loss of life. To prevent such accidents, the inventor of the present device makes the closing of the switch automatic by providing it with a motor set into action by the opening of the switch. At the end of a certain time, the motor is caused to act upon the switch. A device is arranged beside the roadbed of the siding, to be normally pressed upon by cars on the switch, and is provided with a locking device to hold the escapement while the cars are on the switch.

AIR-BRAKE HOSE-COUPLING. — THADDEUS M. HALL, Bonham, Tex. This invention belongs to that class of couplings for air-brake pipes in which the valves between the joints are opened when the pipes are connected, and held open so long as the connection remains unbroken. The valves automatically seat themselves when the connection between the pipes is broken, thereby preventing the escape of air. When the hose is pulled apart, the valve is still left open to work automatically. In the present invention the two interlocking shells are formed with valve-seats for ball-valves mounted within the shells. Rotatable supports are connected with the balls whereby they are caused variably to rotate to and from the valve-seats when the couplings are joined to or disconnected from each other.

### Miscellaneous Inventions.

CRUTCH.—RICHARD SCHWARTING, Brooklyn, New York city. The foot of the crutch is provided with a serrated tip and with an ordinary spring-pressed tip. When the ground is covered with ice and snow, the serrated or spur tip is lowered into position, so that the crutch in resting upon the ground cannot slip. When the weather is fine and traveling good, the serrated tip is raised and the ordinary tip used.

MUSIC-HOLDER AND TURNER.—CHARLES YAGER, New York city. This music-leaf turner has a series of leaf-carrying frames mounted to swing from one side to another. Each frame is adapted to hold a leaf of music so that the several frames may be manually thrown to turn the different leaves. The music-leaf turner may be manipulated with great ease, and may be folded very compactly.

SEWING-MACHINE ATTACHMENT. — CARL F. CAIN and HERMANN SANGTINETTE, Brattleboro, Vt. This attachment consists of a gage especially adapted to insure the stitching of a seam of predetermined width, or to locate a line of stitching a predetermined distance from the edge or seam of a garment or from a line of stitching. The gage bears a scale in inches and fractions of an inch, and is so constructed that it may be accurately set before it is applied to the bed-plate of the machine. The attachment may be placed in position on the plate or removed therefrom without dislodging the scale-bar.

PNEUMATIC SHOE-STUFFER.—FRED G. WHITE, Aurora, Mo. The shoe-stuffer provided by the present invention is especially designed to give a shoe the desired shape to display it in a shop-window. The stuffer consists of an inflatable bag in the form of a shoe, which bag is provided at the toe with a hood which receives a rod whereby the toe can be pushed into the shoe.

ROTARY BRUSH. — NEIL CAMPBELL, Jersey City, N. J. In this invention a broom-head for rotary street-sweepers is provided, which comprises peripheral and radial webs having axially-extending and alining perforations receiving connecting ribs. The ribs space the broom-material between them. Backing-boards secured to the radial webs within the ribs support the inner ends of the broom-material and hold it in place. With this construction the broom may be made of sufficient strength to withstand hard usage. The broom-head is easily repaired and thus no inconsiderable expense is saved.

TRAP-NET.—ABNER S. CHASE, Marshalltown, Iowa. The trap-net is composed of two sections, the upper of which has a line connected with its upper portion. This upper section has additional lines connected with its lower portion and reeved through the lower section. By drawing on the first-named line the upper section may be lifted from the lower section, and by drawing on the second-named lines the two sections may be drawn together.

ATTACHMENT FOR SPECTACLE-TEMPLES.—LEO F. C. GIEBERICH, Manhattan, New York city. It sometimes happens that the fine wire forming the hook of the spectacle temple embeds itself in the soft tissues of the skin and thus produces painful irritation. The inventor of this attachment overcomes the difficulty by providing the hook with a protector formed of cork rolled into tubular form with a plurality of layers, the outer one of which is secured to the preceding layer to give the protector a permanent form.

HINGE FOR COUCHES, BEDS, OR ADJUSTABLE CHAIRS. — AMBROSE HUTTINGER, Cleveland, Ohio. The present invention is an improvement upon a similar hinge patented by the same inventor and seeks to simplify the previous construction. The hinge-sections are connected with two frames. One of the sections is toothed. A locking-lever is pivoted to the frame of the other section and is arranged to engage the toothed section. A releasing-lever is pivoted to the locking-lever and is arranged to hold it out of engagement with the toothed, hinged section. The invention dispenses with the necessity of a foot-lever, and enables the head portion of a couch, bed, or chair to be adjusted to any inclination.

LABEL-CABINET.—CLARENCE A. KNAPPENBERGER and HENRY H. BARNES, Jr., La Harpe, Ill. To construct a druggist's label-case for use in finding and applying the right labels to bottles and packages is the purpose of this invention. Druggists usually employ thread-cases or improvised sets of drawers for this purpose, with the result that it is not possible readily to determine which drawer contains the label sought. In this label-cabinet, an outer case, having trunnions on the inside and back of the front edge, and holders consisting of a front part having a glass panel, are provided. Grooves in two end pieces receive the trunnions within the case. Means are provided for separating and retaining the labels. When a label-holder is turned down or opened, the labels are made easily accessible; when the holder is turned up, it acts as a door to close up the opening in the front of the case.

ANIMAL-TRAP. — FRANK J. HEDA, Vesta, Neb. The trap is constructed of a length of wire coiled to form a casing, the wire having its resilient end extending longitudinally along the outer side of the casing. A trigger is attached to the casing and serves to hold the spring end of the wire in proximity to the casing. A loop is carried by the spring end of the wire and projects normally into the casing to impale the animal when the trigger is released.

## Designs.

ADVERTISING-TABLE. — ELLA F. DOUGHERTY, Staunton, Va. The table consists of a frame and legs supporting the top. On the top are supported two pockets, between which a hollowed block containing an ink-well is placed. In front of each pocket a smaller pocket is secured.

SPOON.—AUGUST MILLER, Taunton, Mass. The chief feature of this design is to be found in the peculiar ornaments of the spoon, ornaments which consist principally of scrolls and fleurs-de-lis.

HEATER.—JAMES S. MACKENZIE, North Bend, O. The design provides a heater which is adapted to fit between the stove and stove-pipe. Through the heater, pipes run, which conduct air from the atmosphere through the heater and to the room in which the stove is placed. Heated air is thus constantly supplied with no additional expense in fuel.

SAFETY-PIN. — SILAS P. TOMKINS, Tilly Foster, N. Y. The safety-pin is provided with a hook adjacent to a longitudinal member of the pin. The safety-pin is primarily designed for use on horse-blankets, the hook being slipped over a part of the harness to prevent the blanket's blowing about.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for 10 cents each. Please send the name of the patentee, title of the invention, and date of this paper.

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## Notes & Queries

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**Names and Address** must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
**References** to former articles or answers should give date of paper and page or number of question.
**Inquiries** not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
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(7598) C. M. D. answers T. E.'s query No. 7551, as to whether a dynamo works well in a low temperature, as follows: A dynamo will work better at a low temperature than at a high one. The lower temperature keeps the iron cores and especially the copper conducting wires cool, securing greater conductivity. The same applies to the outside wiring. A Thomson-Houston arc generator shows the difference very markedly by the position of its regulator armature on hot or cold nights. On warm nights full load would bring armature nearly flat on stop, while at zero the same machine would have a surplus good for one or sometimes two 45 volt lamps—arcs. [The above statement is of course true, though, in answering the original query, it was not necessary to go into this matter at all, since the only point raised was whether cold weather would prevent a dynamo and storage battery from working. The temperature coefficient of copper is about 0·002 per degree Fah., that is, copper improves two-tenths per cent for each degree it is cooled. The night temperature in this city between the hottest and coldest nights is about 90 degrees. For 100 degrees the conductivity of the copper is about twenty per cent higher in the coldest night of winter than in the hottest night of summer. This is the whole difference in capacity of a series wound machine, such as is the Thomson-Houston; but in a shunt wound machine the difference is still greater.]

(7599) H. W. C. asks: 1. What substance, if any, is opaque to the lines of force coming from a permanent magnet? A. An iron screen surrounding a magnet furnishes so easy a path for the lines of force that few or none leave it to pass through the air. 2. How is the compass on a modern steamship protected from the magnetic influence of the steel and the dynamos? A. For the protection of ships' compasses against the iron about them, see SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 527, 534, 709, 760, price 10 cents each. 3. What is the best shaped burner for a Trouve acetylene lamp and where can I get a burner of that kind? A. A two-pronged burner with the jets directed against each other, and the acetylene burning in the air between the jets, is found to work satisfactorily. 4. How can I take off and use the electricity that is found on the belts in a machine shop when the machinery is running? A. A comb such as is used in all static machines will draw the electricity from a belt.

(7600) H. P. G. writes: Please inform me how to make a simple electric friction machine? A. You will find full instructions for making a Holtz machine, which gives the same kind of electricity in far greater power than the friction machine, in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 278, 279, 282, price 10 cents each, with many experiments which may be performed with it.

(7601) J. S. C. asks: How is it we can speak any word at any rate of vibration in the musical scale? For instance, I can say boy or any other word in *f*, a very slow rate of vibration, or in *e*, a much more rapid rate; in fact, from the very lowest to the highest rate of vibration per second, showing that it is not the number of vibrations per second. A. You do not speak a word at any rate of vibration in the musical scale. The tone is formed by the vocal cords in the larynx at any rate of vibration which their tension allows. This tone is formed into words by the mouth, nose, tongue, teeth, lips, and palate, and in this form it issues from the mouth. If the mouth is held motionless, any tone can be sung, but no words can be formed so long as the vocal organs are not allowed to move.

(7602) R. G. asks: What sizes wire by B. & S. gage correspond to No. 20 and No. 18 American gage? A. No. 20 American wire gage corresponds to No. 21 B. & S. gage. No. 18 A. W. G. corresponds to No. 19 B. & S.

### NEW BOOKS, ETC.

We have just received from the United Correspondence Schools of 154-158 Fifth Avenue, New York city, some of their instruction papers. We have examined them carefully and we certainly approve of both systems which are used and the matter which is taught. They are eminently practical, and are particularly valuable to the student from the fact that all the material which is not germane to the subject is entirely eliminated. Of course, a correspondence school can never take the place of a scientific school or university, but at the same time there is a very large class of people who have not the time nor money, nor possibly the inclination, to spend three or four years in a school where they are often obliged to study things which will be of no immediate value to them. This Correspondence School begins in the proper way in making students obtain a practical knowledge of arithmetic, algebra, logarithms, geometry, mensuration, etc., before proceeding to the study of principles and applications of the subject being taught. The Schools give instruction in electrical engineering, mechanical engineering, civil engineering, sanitary engineering, architecture, art, sheet metal working, pattern making, etc. The method of teaching is entirely without text books, all of the instruction papers being furnished by the School, and they are accompanied by the question papers which contain inquiries on the subject contained in the instruction papers. As soon as the answers are received by the School they are examined with the utmost care. All answers are corrected in red ink, and the work is returned to the student with such suggestions and criticisms as will enable him to better understand the subject. In this way mistakes are pointed out and the material furnished is explained to the satisfaction of every individual student. Experience has shown that written comments on a man's work are more valuable and lasting than verbal ones, and the students will have the satisfaction of knowing that the criticisms are made by competent men.

### TO INVENTORS.



# INDEX OF INVENTIONS

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[See note at end of list about copies of these patents.]



(*Continued on page 126*)

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THE ELECTRIC HEATER.—A VALUABLE paper, with working drawings of various forms of the electrical heaters, including electric soldering iron, electric pad for the sick, etc. 6 illustrations. SCIENTIFIC AMERICAN SUPPLEMENT 1112. Price 10 cents. For sale by Munn & Co. and all newsdealers.

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