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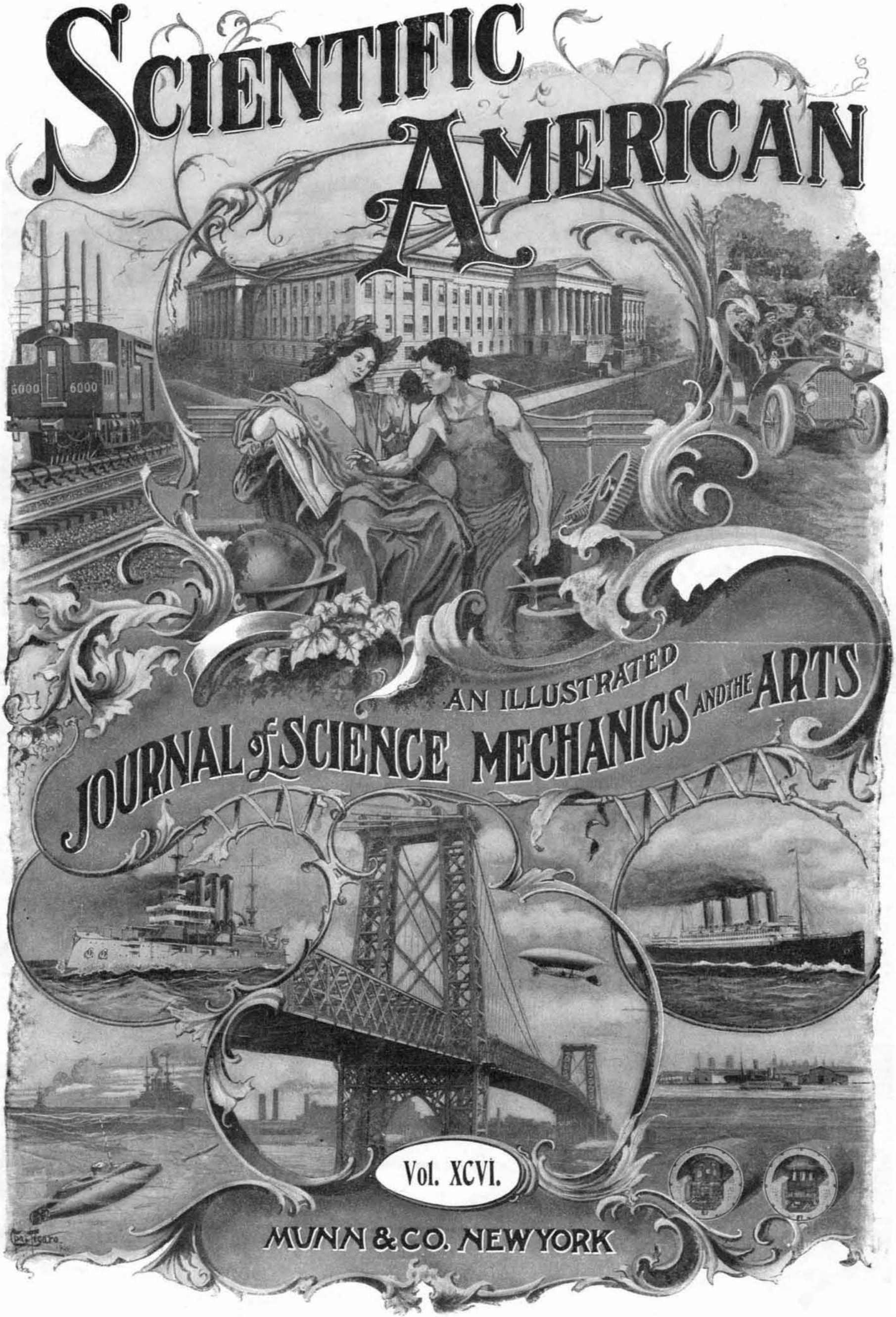

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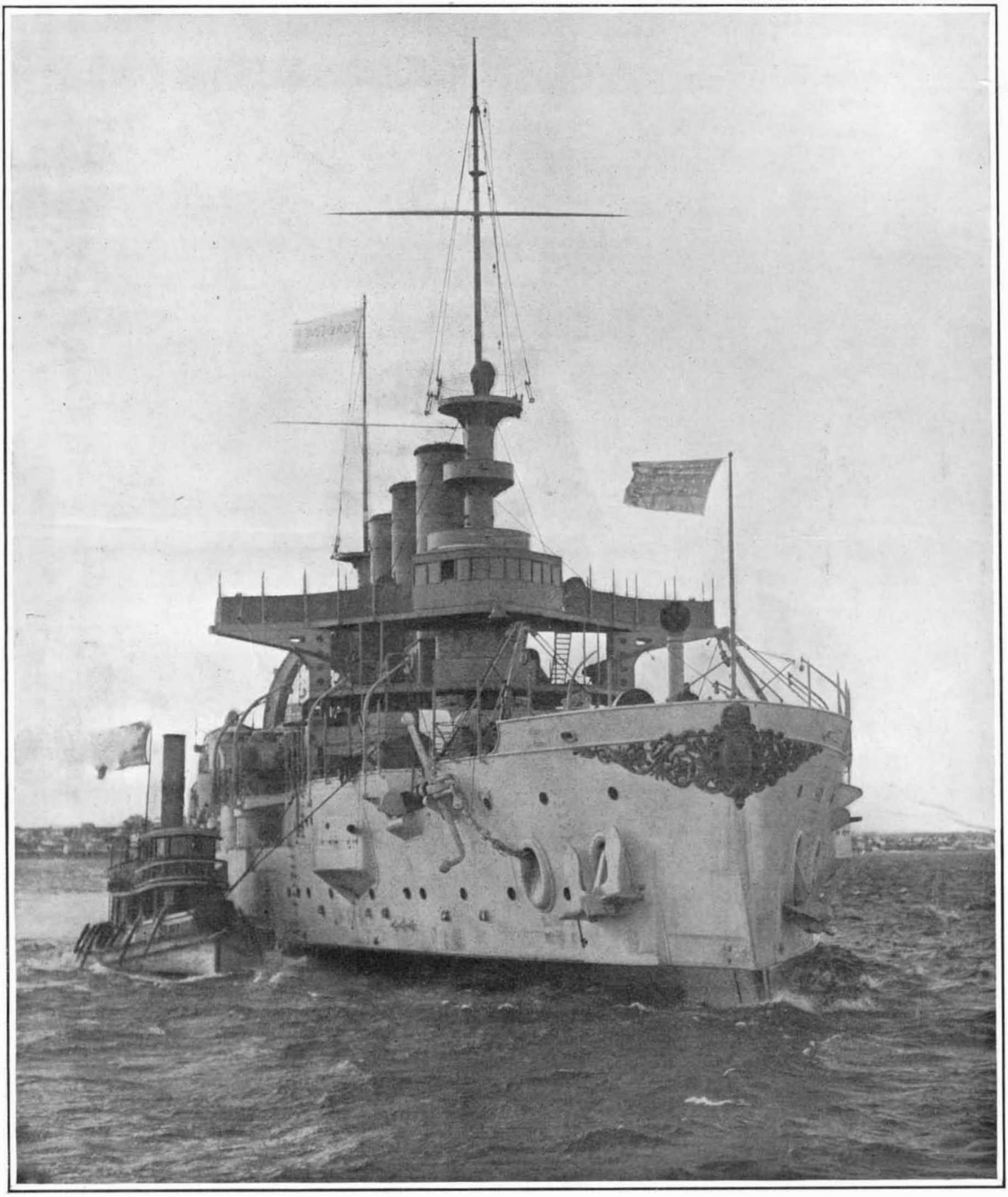

Displacement, 16,000 tons. **Speed,** 18.33 knots. **Coal supply,** 2,200 tons. **Armor:** Belt, 9 inches; turrets and barbettes, 10 to 12 inches; deck, 1½ to 3 inches. **Armament:** Four 12-inch; eight 8-inch; twelve 7-inch; twenty 3-inch; twelve 3-pounders; 8 small guns. **Torpedo tubes,** four 21-inch. **Complement,** 916.

BATTLESHIP "VERMONT" LEAVING HARBOR FOR HER STEAM TRIALS.—[See page 7.]

SCIENTIFIC AMERICAN

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Editor is always glad to receive for examination illustrated ... on subjects of timely interest. If the photographs are ... the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

REVIEW OF THE YEAR 1906.

Any review of the technical and scientific progress of the past year must necessarily take note of the truly phenomenal tide of prosperity, which has continued to rise steadily throughout the year, and shows at its close no signs of abatement. An analysis of the causes of this prosperity shows it to be founded upon the rapid and very thorough development of the abundant natural resources of the country, and among these, undoubtedly, the most important factor has been that of agriculture. Never before, in the history of the United States, have the farming interests been so favorably situated; and the excellent conditions are attributable to a series of abundant harvests, which have enabled the farmers not only to get rid of heart-breaking mortgages, but to restock their farms, purchase new and better machinery, surround themselves with more of the comforts and even luxuries of life, and in many of the States roll up very considerable bank deposits. The development of the mineral resources of the country, also, has been unparalleled; while in many of the leading branches of manufacture, factories and plants have been run to their full capacity, and many of them are several months behind their orders. Without going into details, it is sufficient to instance the steel industry, where conditions are such, that in the closing months of 1906, some of the mills, and particularly those devoted to the manufacture of steel rails, were so overloaded with orders that their total output up to the end of 1907 will barely serve to meet the demand.

CIVIL ENGINEERING.

Water Supply and Irrigation.—In the broad field of civil engineering, the prevailing activity is nowhere more evident than in the construction of costly works connected with water supply, irrigation, and the opening up of artificial waterways. New York city has witnessed the completion of the great Croton dam, with its capacity of 32 billion gallons of water, and the commencement of work on two additional reservoirs in the Croton Valley, above the dam, which will provide an additional storage of 25 billion gallons and serve to protect New York against a threatened water famine, tiding the city over until an ample supply shall have been guaranteed by the construction of the new Catskill reservoirs and the 90 miles of aqueduct by which the impounded waters will be brought within the city limits. During the year, the engineers of the Board of Water Supply so far completed their plans and estimates, that they are now ready for tenders, and it is probable that the actual work of construction will be in full swing before the year is far advanced. The plans contemplate the building of reservoirs, aqueducts, and filters sufficient to store, purify, and convey to New York city, 500 million gallons of water daily from the Catskill Mountains, at a total cost for the completed work of about $162,000,000. During the year the westerly basin of the Jerome Park reservoir was completed and put in service, and New York city was thus provided with an additional local storage and distributing reservoir, with a maximum capacity of 773,400,000 gallons.

The past year will ever be a notable one in the annals of irrigation, because of the vast system of works instituted by the government for the reclamation of the arid lands of the West. These works contemplate the construction of storage reservoirs which, in the size of their dams and the amount of water to be impounded, will form the most notable structures of the kind in the world. The Shoshone dam will be 240 feet in height above the bottom of the reservoir; the Pathfinder, 190 feet; and the Roosevelt, 230 feet; while the respective storage capacity of the three dams will be 19,863 million, 43,560 million, and 61,000 million cubic feet of water. Across the border, in the Province of Alberta, Canada, the Canadian Pacific Railway has completed another huge irrigation project, in which a valley 150 miles in length by 40 miles in width is being brought under cultivation. This block of irrigated lands alone is estimated to have room for half a million people, and it is a significant fact that 95 per cent of the present settlers in the district are Americans. In this connection mention should be made of the disaster in the Imperial Valley, where the great Colorado River broke through its banks into one of the irrigation canals, and the whole of its waters were diverted from the Gulf of California into the Salton Sink of the Imperial Valley. Thrust back into its channel by the construction of a 3,000-foot dam, the river has again broken through, and a further effort, estimated to cost $3,000,000, is at once to be made to close the breach and turn the river back into its natural channel.

Tunnels.—The past year has been remarkable for the activity which has been shown in the construction of tunnels and subways. It would seem, indeed, as though we were witnessing the close of the era of bridges and the opening of an era of tunnels; for the tunnel is taking the place of the bridge and viaduct, both for the crossing of waterways and in the provision of means of rapid transit in cities and thickly-populated districts. Limitations of space prevent any detailed mention of the work being done abroad in such cities as London, Paris, and Berlin, and we must confine ourselves to a recapitulation of the work planned and already executed in the city of New York. In the first place, mention must be made of the brilliant success attending the operation of the twenty miles of rapid transit subway in New York city. On a single day in the second year of its operation, this system recently carried over 600,000 passengers, and on that same day it should be mentioned that over 2,000,000 passengers were carried on the combined subway, street railway, and elevated systems of the city. The Rapid Transit Commission has authorized, and will shortly call for bids upon, new subways aggregating a total of 80 miles, whose total cost will reach $160,000,000. At the present time twelve separate tunnel tubes are being driven beneath the Hudson and the East Rivers. Five of these tubes have been put through and are being finished; two others will be connected in the opening months of 1907; and all of them will have been opened through by the close of the present year. A record in speed of construction was recently made on one of the tubes of the Hudson Company's tunnels, where the shield was advanced 72 feet in a single day. The large amount of valuable experience gained by our engineers has resulted in the use of improved methods and better machines. As evidence of this, it may be mentioned that the Hudson River tubes are now being driven through the mud by the displacement method, the material being thrust aside by the advancing shield, instead of being taken in through the doors in the shield. The Rapid Transit engineers are to be congratulated upon having solved, during the year, the important question of Subway ventilation. This was done by providing large ventilating openings between the stations, and air-cooling plants of generous capacity at the stations themselves. The temperature has been lowered on the hottest days from six to eight degrees, and this, coupled with the continual renewal of the air, has rid the Subway of the former stuffiness and unpleasant odor. Two vast tunnel projects have come again into public notice, one of which, the Behring Sea tunnel, can never, because of physical obstacles, get beyond the paper stage; while the other, the English Channel tunnel, will probably be made the subject of favorable legislation by the British government during the present year. The great Simplon tunnel was opened for traffic early in the year, and is now under successful electrical operation.

Bridges.—During the year excellent progress has been made in the erection of the great railroad and highway cantilever bridge across the St. Lawrence River, near Quebec. Although this structure is by no means the largest bridge in respect of its over-all length, it will contain the largest single span ever erected, the main span over the river measuring 1,800 feet between the towers. The total length from center to center of anchorage piers is 2,800 feet, made up of two 500-foot anchor spans, and two 562½-foot cantilever arms, extending over the river and carrying between them a central suspended span of 675 feet. The depth of the trusses over the main piers is 350 feet. The floor system will accommodate two steam railroad tracks, two electric car tracks, two highways for vehicles, and two sidewalks. The bridge is now more than one-half erected, and will be completed probably during the present year. In New York the Blackwell's Island cantilever bridge is being slowly erected; the Manhattan suspension bridge, thanks to political jugglery, seems to be practically at a standstill; while it is interesting to note that there is a revival of interest in the project for erection of a bridge across the Hudson River.

Armored Concrete.—The professions of architect and engineer overlap so broadly in these days, that we may be excused for speaking of the progress of armored concrete under the head of civil engineering. Indeed, the development of this new material of construction, or combination of materials, is proving to be fully as useful to the civil engineer as it is to the architect. In the first place it has served greatly to broaden the scope of masonry arch construction, the embedded steel rods serving to give that tensional strength which uneven loading renders necessary in all arches, and particularly those of long span. For subway work it has taken the place of the steel column and concrete arch for walls and roofs, and when the steel is judiciously distributed it is doing good service where formerly the massive steel column and the plate girder had come to be the standard construction in pier and viaduct work. The too frequent failures of armored concrete are always traceable either to poor design or careless workmanship—never to any inherent fallacies in the principles of construction.

Panama Canal.—The past year must always be notable in the history of the Panama Canal as having witnessed the completion of the era of preparation and the commencement of that of active construction. The year opened under a cloud of many discouragements and uncertainties; but as the months have gone by, order has gradually come out of confusion; a definite plan has been outlined; an organization perfected; experience as to the best methods and probable costs acquired; and the great work has at length been thrown open to competitive bidding. The two most important events of the year were the very exhaustive and able Senate investigation covering every possible feature of the enterprise, and the technical investigation by the International Advisory Board. The Isthmian Canal Commission has committed the country to the construction of an 85-foot, high-level, lock-and-lake canal, and it is upon this plan that bids are requested. The work will be executed along those well tried lines which have proved so successful in the building of our great railroads and other large engineering works. It will be built by contract on the percentage basis and under the supervision of the Canal Commission's Chief Engineer—a plan of which the SCIENTIFIC AMERICAN has always been an earnest advocate.

NAVAL AND MILITARY.

The most important naval event of the year, as affecting naval construction, was the successful trials of the battleship "Dreadnought." The world's attention was riveted upon this vessel, mainly because she was the first battleship to be built embodying the lessons of the Russo-Japanese war, and also because the British government had avowed its intention of establishing a record in rapid construction. The "Dreadnought" is notable for the facts that she was built in less than eighteen months; that she is armed as to her main battery exclusively with 12-inch guns; and that she is driven by turbine engines. The ship developed a speed of 21½ knots, and in her gun trials stood the simultaneous discharge of her 12-inch guns without structural injury. That the turbine engines have given great satisfaction is proved by the official announcement that henceforth all the larger British warships will be driven by this type. Other nations must now follow suit; for even Germany, which has always discredited the turbine, is reported, on good authority, to have decided upon its adoption. The Japanese have launched their own "Dreadnought" in the "Satsuma," a 19,200-ton ship carrying four 12-inch and twelve 10-inch guns in the main battery, and twelve 4.7-inch guns in broadside for repelling torpedo-boat attack. Germany has planned a 19,000-ton vessel which is to carry fourteen 11-inch, 50-caliber guns of high velocity, and a penetrating power approximately equal to that of the 12-inch piece carried by other powers. Our own government contemplates an even larger ship of 20,000 tons displacement, carrying ten 12-inch guns, which, being all arranged on the center line of the ship, will be all available on either broadside. In the weight and distribution of her armor and in the provision of internal bulkhead defenses, this vessel will be superior to anything built or planned by other navies. The armored cruiser seems at last to have merged in the battleship, as witness the three new British 25-knot cruisers of the "Inflexible" type, carrying eight 12-inch guns in four turrets; the new Japanese cruisers of the "Tsukuba" type, of 16,000 tons displacement, which will carry four 12-inch and eight 8-inch guns in the main battery; and the new Russian "Rurik," mounting four 10-inch and eight 8-inch guns. If things continue to go the way they are moving now, the future warship will be a cruiser-battleship of 20,000 tons or more displacement and 22 or 23 knots speed, carrying from eight to twelve 12-inch guns, and a numerous battery of 4.7 or 5-inch for repelling torpedo attack.

Progress in the United States navy has been exceedingly satisfactory during the past year. There have been completed or put in commission all the powerful battleships of the "Connecticut" and "Georgia" classes, and the equally effective cruisers of the "California" class, and in these vessels we possess homogeneous fighting ships which are equal, if not

superior, to the best squadrons that could be brought up against them by foreign navies. If we except the "Dreadnought" and possibly the ships of the "Lord Nelson" class, the latter armed with four 12-inch and ten 9.2-inch guns, there is, indeed, no squadron of foreign ships to match the five vessels of the "Georgia" class, and certainly there are no individual ships of the all-round excellency of the "Connecticut" and "Louisiana." Two ships of the new "Dreadnought" type have been commenced, namely, the "South Carolina" and "Michigan," which on 16,000 tons displacement will carry eight 8-inch guns, all available on either broadside. As things are now trending among the navies, the future types will resolve themselves into battleships of 20,000 tons displacement or over; fast scouts of 3,000 to 5,000 tons and 25 knots speed, and torpedo-boat destroyers of 25 to 35 knots—the British have a 36-knot turbine-driven destroyer now under construction. A notable event of the year was the towing of the large floating drydock "Dewey" from Hampton Roads to Cavite in the Philippine Islands. Mention should be made of the excellent records of our various ships at target practice, which place us abreast, if not ahead of, the world in accuracy of fire. The growth of our navy was strikingly exemplified in the assemblage at Oyster Bay last summer, for review by the President, of the vessels of our North Atlantic fleet—a combination which, as was remarked at the time, was approximately equal in powers of attack and defense to the combined Russian and Japanese fleets that were engaged in the battle of the Sea of Japan.

There have been no developments in guns or armor during the past year that call for special mention. The armor-piercing projectile seems to have a slight advantage over face-hardened armor, but both are of very high quality. The development in guns has been in opposite directions; for while there has been a tendency abroad to increase velocities, the guns on the "Dreadnought" having a service velocity of 2,900 feet per second, the velocities of our naval guns have been reduced to 2,700 feet per second, while the future guns for our army coast defense are to return to the 2,000 or 2,100 foot-second velocity of ten or twelve years ago; the weight of the guns and projectiles being increased, in the case of the army gun, to compensate for the lower velocities. Mention should be made of the government tests of the 6-inch Brown wire gun which, with a pressure of 32 tons in the powder chamber, delivered its shell with a muzzle velocity of 2,740 feet per second and a muzzle energy of 10,295 foot-tons; which, by the way, is more than double the energy of the naval 6-inch gun above referred to. Our army and navy ordnance officers consider that these reductions in velocity are necessary in order to prolong the life of the gun. The army 12-inch guns become so reduced after firing 60 rounds as to lose their accuracy entirely.

WIRELESS TELEGRAPHY.

In the past twelve months wireless telegraphy has maintained its hold on the interest of the public, because of a number of interesting conditions, scientific and otherwise. Early in the year both Fessenden and De Forest made extensive essays to give us cableless telegraphy; but the result of their experiments, like those previously made by Marconi, were futile in so far as transoceanic work is concerned, and the submarine cable still holds its own. The constant litigation that has been waged between the opposing interests over patent rights had awaked the hope that an end might finally be reached in which the limitations of the various claimants would be clearly defined, and the question decided whether or not the Marconi company was to have an absolute monopoly on wireless transmission. One of the untoward features, at least on this side of the Atlantic, is the sale of their securities by several of the largest companies. The majority of the companies that are engaged in this practice are over-capitalized, and have not earned, and are not now earning, dividends. The promoters of these companies have in many instances led the public to believe that the system they advocated was perfect, and that a means of selectivity had been evolved. For this and other reasons the transmission of messages overland has not been as much of a success as some of the more optimistic of the quarter of a million shareholders had hoped for. The interior stations scattered throughout the country have been utilized to educate the masses in the possibilities of wireless telegraphy rather than for the interchange of telegraphic business. Among those who are engaged in the practice of the art—and this includes not only numerous operating companies, but the armies and navies of the world as well—the lack of selectivity has brought about a state of affairs that borders on chaos, for only one or two stations in the active zone of radiation—and this often means a radius of a thousand miles—can send at the same time.

To circumvent this extinction of messages by interference and other difficulties that arise from it, was the purpose of the International Wireless Telegraph Conference, which convened within the last two months in Berlin. But even if all its recommendations were adopted, the fundamental problem would in no wise be solved. It is interesting to note in this connection that at this conference Poulsen exhibited his newly-developed selective wireless telegraph system, which he believes, and which we all hope, will be commercially selective instead of theoretically selective, as has been the case of its predecessors. Should the new system ring true, then the past year will go down in the history of wireless as the most progressive period since the beginning of the art.

STEAM AND ELECTRICAL RAILROADS.

Judging from the events of the year, the time is still far removed when the steam locomotive will have been crowded off the great system of railroads which it has brought into existence, and on which it has been so long supreme. For long-distance service it still remains the most economical and convenient means of traction, and particularly for the working of heavy freight traffic. The most successful competition in passenger service is that offered by the high-speed interurban lines, on which large and powerful cars, equaling in size and comfort the steam railroad cars, are being run at high speeds in successful competition with through steam trains. Gradually, the track and general equipment of these roads are being brought up to the standard of the steam roads. It is probable that their growth and successful operation will prove the most powerful factor in abolishing the steam locomotive, and breaking up into smaller units the long ten- and twelve-car trains of our present railroad service. Meanwhile, the work of equipping the terminal stations and suburban lines of the steam railroads proceeds apace. The New York Central Company has already made a partial opening of its temporary terminal at Forty-second Street and its electrical suburban lines. The power station at Port Morris is completed, and that at Yonkers practically so. The New Haven Railroad has nearly completed its Cos Cob power station, and has erected the costly lattice structure of its overhead trolley line, which consists of a pair of posts and a connecting overhead girder, spanning the four-track road at every 300 feet of its length. The company is now engaged in stringing the four trolley lines over this electrical zone, which extends from Woodlawn to Stamford. It is expected that the electrical zones of both the New York Central and the New Haven systems will be in full operation by the spring of the present year. The Pennsylvania Railroad Company is making fair progress with the excavation of the site for its terminal station on Manhattan Island. Merely to prepare the site involves the excavation of between 2,000,000 and 3,000,000 cubic yards of material, most of it rock. The present indications are that the tunnels will have to wait upon the completion of the station. The electrification of the Long Island Railroad has proved to be a thorough success, and the turbo-generators in the large power station at Thirty-fourth Street are giving complete satisfaction. In this connection, it should be noted that there is a steady displacement of the reciprocating engine by the steam turbine, particularly in the plants of large power stations, the Parsons and the Curtis turbines appearing to have practically exclusive control of the field in this country. It is to the electric roads that we are indebted for the introduction and rapid growth in favor of the all-steel passenger car. One of the leading railroads has adopted this type, not only for suburban, but for the long-distance and even the Pullman service. There is noticeable a decided growth of sentiment in favor of the use of the alternating current in preference to the direct in electrical traction, and particularly for long-distance service. A notable instance of this is in the equipment of the New Haven lines, which will use the alternating current from Stamford to Woodlawn, and the direct current of the New York Central from Woodlawn to Forty-second Street. The most important of the later developments of the year was the recent announcement that a single-phase electric road is about to be built, connecting Baltimore and Washington. This will be a two-track system, on which the express service will be run at a speed of sixty miles an hour. Just now the most notable steam railroad lines under construction are those of the Tehuantepec Railroad, which must necessarily prove a formidable competitor to the Panama Canal, and the so-called Cape to Cairo Railroad. The former line is about completed, and the latter has made such good progress, that it has now been carried over 2,000 miles north of Cape Town, and some 1,500 miles south from Cairo. Early in the year the road should reach Lake Tanganyika, after which it will be necessary to construct only about 400 miles of road in order to afford a complete rail, river, and lake route from Cape Town to the Mediterranean Sea. In this connection mention should be made of the recent attempt to interest the investing public in the proposed 700-mile Zambesi-Johannesburg electrical power transmission line—a scheme which, in spite of the prominent names which have recently been associated with it in press dispatches, seems to border on the "wildcat." If it does not pay to transmit from Niagara Falls to New York, the question may pertinently be asked: How can the thing profitably be done over twice the distance through a barren and savage country?

ELECTRIC ILLUMINATION.

Never has greater interest been displayed in new methods of electric illumination than during the past year. If the promises which are held out by the inventors of metallic filament lamps are fulfilled we may soon witness the passing of the carbon filament bulb. Although the Nernst lamp, on which great hopes were based because it requires only half as much current as the carbon filament, has proved too costly, and the osmium lamp has been found wanting for the same reason and for the additional reason that its voltage of 47 is too low for ordinary circuits, the tantalum and tungsten lamps seem likely successors of the standard incandescent lamp. The tantalum consumes about as much energy as the osmium lamp, but its long filament renders its use possible on a 110-volt circuit and on circuits of even higher voltage. Its useful life of 400 to 600 hours and its maximum life of 1,000 hours and more compare favorably with those of the best electric incandescent lamps in use. The filament is very delicate but able to stand greater variations in voltage than the carbon filament. When broken the ends readily fuse, so that the tantalum lamp's usefulness, although impaired, is not utterly destroyed. The present low cost of construction (about 50 cents), coupled with its high voltage, give it a decided advantage over the osmium filament. Guelcher's iridium lamp is made only for low tensions (24 volts); it consumes, it is claimed, only 1 to 1.5 watts per candle power, and costs about 87 cents. What its life may be it is impossible to state, inasmuch as no figures have been published. It is open to many of the objections leveled at the osmium lamp. More promising is the tungsten lamp, which is now made by four European firms using as many different processes. The normal tungsten lamp of Just and Hanamann seems to give about 30 to 40 candles at 110 volts and consumes 1.1 watts per candle. Kuzel's tungsten lamp is said to show an efficiency of 1 to 1.25 watts per candle for 19 to 32-candle lamps, with a useful life of 1,000 hours, at the end of which the loss in candle power is said to be but 10 or 15 per cent. When broken the filament automatically welds together as in the tantalum lamp. The Osmium tungsten lamps have shown from 54.7 to 55.6 candles and from 1.026 to 1.047 watts per candle at 110 volts. Whether these new lamps will fulfill the hopes placed in them can of course be determined only by thorough tests under conditions approximating those of actual service. At present the metallic filament lamp is in its experimental stage. The necessity of using the tungsten lamp in the inverted vertical position may perhaps be regarded as a defect; yet quite recently the vertical incandescent gas mantle has invaded an extensive field hitherto monopolized by the electric light.

AERONAUTICS.

In the field of aeronautics the most important event of the year was the publication of the first authoritative statement by the Wright brothers, regarding their successful power-driven aeroplane flights, made in the fall of 1905, and its acceptance by the Aero Club of America. It will be remembered that the SCIENTIFIC AMERICAN wrote to each one of the purported witnesses of these flights, and received the most convincing evidence that they actually took place. The most brilliant flight of the series was achieved on October 5, when the Wrights covered a distance of 25 1/5 miles at a speed of over 38 miles an hour, the flight terminating only with the exhaustion of the fuel supply. When the history of mechanical flight comes to be written, this achievement will give these two young machinists the same position that Stephenson holds in regard to the locomotive, Fulton to the steamboat, and Edison to the electric light. At the recent Aero Club show, the Wright brothers exhibited a 30-horse-power aeroplane motor designed and built for their new and larger machine which, with one man aboard, they are confident of driving for a distance of 500 miles at an average speed of not less than 50 miles an hour. With mechanical aeroplane flight an accomplished fact, we may now look for a diversion of interest and effort from the dirigible balloon to the aeroplane proper. Its field of usefulness will be found chiefly in military service, where it will be invaluable for reconnoitering purposes and for the conveyance of swift dispatches. In all probability its chief development ultimately will be in the field of sport, where it should enjoy a popularity equal to that of the automobile. The investigators who have confined their attention to the balloon and the dirigible balloon or airship, have also met with very encouraging success. The machines have grown in size, power, speed, and controllability. The largest of these is the monster airship of Count von Zeppelin, 38 feet in diameter and 410 feet in length, which is credited with being able to lift three tons additional to its own weight. It is said to have held itself stationary against a 33 1-3-mile-an-hour wind. The motive

(*Continued on page 8.*)

AN INTERESTING PROCESS FOR AVOIDING SPONGINESS IN HEAVY STEEL CASTINGS.

BY L. RAMAKERS.

During the past fifty years, a period in which we have learned how to cast blocks or ingots of steel of great size and weight, it has been constantly sought to avoid the formation of air spaces in the interior of the ingots, caused when the molten metal is cooling in the molds. Up to the present time a number of ways of doing this has been discovered. One of the methods consists in strong pressure being brought to bear upon the inner or outer surface of the block while it is still in a liquid state in the mold, the top of which has first been closed. In another process the upper portion of the block is kept in a heated and liquid condition for so long a time that the hollow spaces formed in the lower portion can become filled with metal. These processes are used more especially in the case of blocks weighing over five tons, and the gain secured amounts to 25 to 35 per cent, if it be taken into consideration that the porous portion of the block must be cut off from the readily forged part, and is useful for scrap purposes only. In spite of this precaution, it often happens that the readily forged part also shows signs of blistering, so that the whole block is useless for this purpose.

The process described herewith is based upon the use of a deadhead or sullage piece, and it is employed successfully at the Gutehoffnungshütte works for castings weighing up to 60 tons. The assumption has been taken as a basis that, by using a deadhead, good results can be obtained only when the upper portion of the block is reheated, and to such an extent that the steel in the sullage piece is kept in a state of fusion till the block has set and the formation of the ingot is terminated. The heat required for this purpose is obtained by forcing cold atmospheric air through an incandescent bed of coke, as by regulating the force of the blast and the pressure of the gas, carbonic oxide is generated in the receptacle containing the layer of coke, and this is completely consumed and transformed to carbonic acid above the block. The process is carried out in the following manner: The heating apparatus is filled with pieces of hard, medium-sized coke. About one hour prior to the commencement of casting the coke is ignited, and brought to a cherry-red heat by means of a suitable air blast. The apparatus has meantime been moved along till it is over the plaster mold, and the flame is used to heat the mold, and more especially the fireproof crown or the fireproof lining thereof. Shortly before the beginning of the casting the apparatus is removed from the mold, and the blast is then allowed to act with full force. While the block is being cast—an operation which requires from 15 to 25 minutes, according to the size of the block—the whole of the coke filling acquires the cherry-red heat requisite for carrying through the process. Immediately the casting is terminated, the apparatus is moved back over the mold and the heating commences.

Fig. 1 shows two apparatus in use. As may be seen from the illustration, these are suspended from small trestle cranes in such a manner that the former, upon the termination of the casting, can be easily moved over the middle of the mold. As no preheating of the air is required, the Root's blower supplying the compressed air can be mounted in the immediate vicinity of the casting pit without necessitating the use of long piping. The whole plant thus presents little difficulty in supervision. The cost of installing an apparatus, including the trestle crane and the high-pressure blower, amounts to $1,200 to $1,500 abroad. The operating expenses, varying with the size of the block, amount to from 15 cents to 25 cents per ton without royalty. The total cost is constituted as follows:

Consumption of coal per ton	6 to 10 cents
Wages	6 to 10 cents
Upkeep (plant, etc.)	3 to 5 cents
	15 to 25 cents

Figs. 2 and 3 represent blocks which have been treated according to the process described above.

Fig. 2 is a block of 25,630 pounds net weight; the weight of the sound part amounts to 23,760 pounds, so that there is therefore a loss of 1,870 pounds, or 7.3 per cent. In another block weighing 37,510 pounds the loss in weight was 4.08 per cent. Fig. 3 is a longitudinal section of a block weighing 37,840 pounds. The weight of the sound portion amounts to 35,750 pounds, so that there is thus a wastage of 5.52 per cent. In the case of a block weighing 36,080 pounds, the waste weighed 26,950 pounds, of which 1,375 pounds are assumed to be sound, so that there is thus a loss of 1,320 pounds, or 3.6 per cent. Samples for analysis were taken from certain of the blocks, say at *a*, *b*, and *c*. The results of the analyses were as follows:

BLOCK 1.

	C	Mn	Si	P	S
Charge tests	0.13	0.80	0.14	0.042	0.034
Sample at *a*	0.15	0.82	0.15	0.052	0.052
Sample at *b*	0.17	0.84	0.12	0.066	0.060
Sample at *c*	0.16	0.84	0.20	0.050	0.036

BLOCK 2.

	C	Mn	Si	P	S
Charge tests	0.18	1.00	0.12	0.039	0.034
Sample at *a*	0.14	1.01	0.13	0.057	0.051
Sample at *b*	0.22	0.90	0.10	0.060	0.055
Sample at *c*	0.20	1.01	0.15	0.045	0.029

The economic advantage can easily be deduced from the following calculation: For a piece of wrought work or a heavy piece of warship armor there is required for example, a block of 33,000 pounds net weight, i. e., the block must have 33,000 pounds of sound material. With 25 per cent waste, *a*, the block used for the purpose must weigh 44,000 pounds; with 10 per cent waste, *b*, a weight of 36,665 pounds only is necessary. Taking the price of the block at $21.25 per ton, and the price of clippings at $15 per ton, we thus get, after crediting the clip waste at *a* of 11,000 pounds and of 36,665 pounds, the following price per ton of sound material:

According to *e*	$23.33
According to *b*	16.94
Or a saving of	$1.39 per ton.

An approximately similar economy supervenes with the working processes (pressing mills, hammer works, or rolling mills) as regards coal, motive power, and wages. If, therefore, the great advantages afforded by the heating of large blocks, with respect to safety in manufacture and saving in material and wages, be compared with the small cost of heating, the conviction will soon be acquired that a heating plant should be an accessory of every modern Martin works where heavy blocks of raw metal are cast.

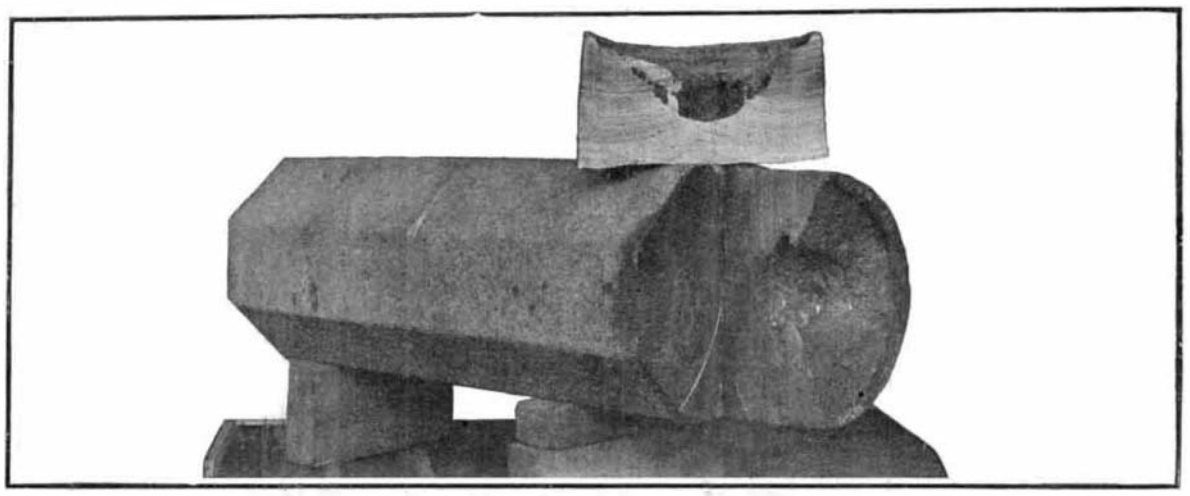


Fig. 2.—Block Weighing 25,630 Pounds, of Which 1,870 Pounds Are Lost.

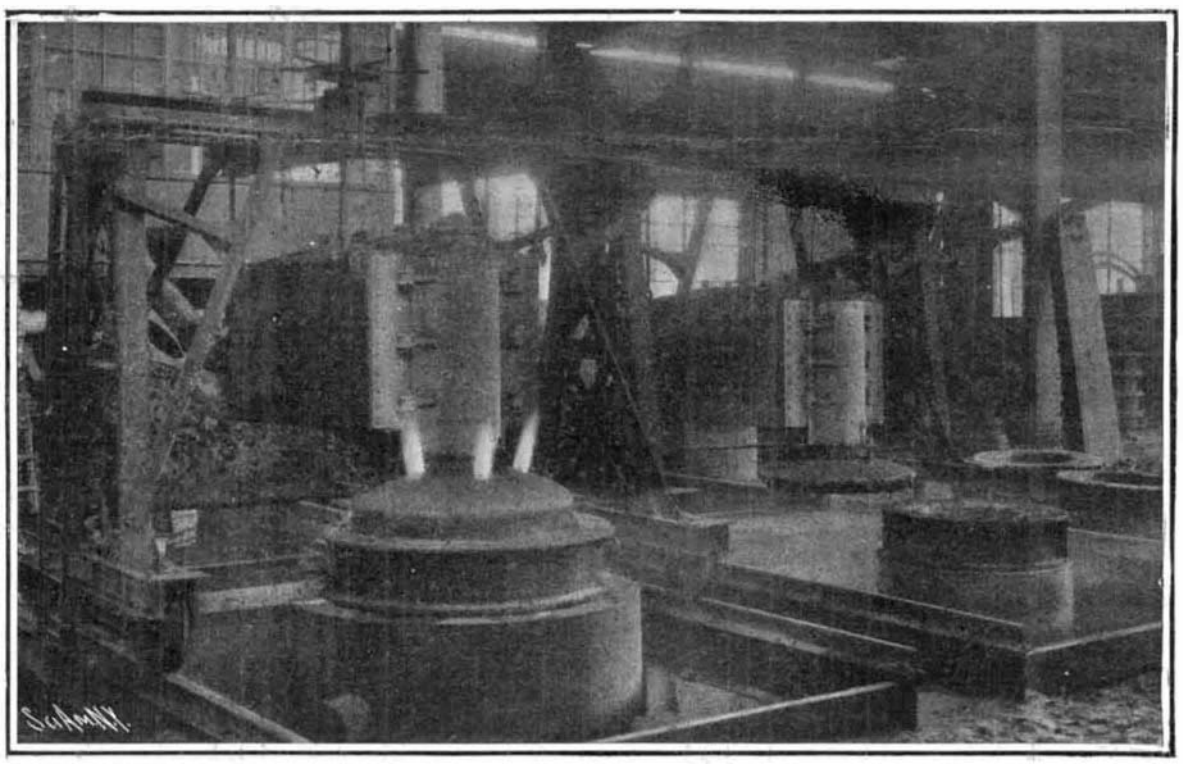


Fig. 1.—Two Apparatus in Operation.

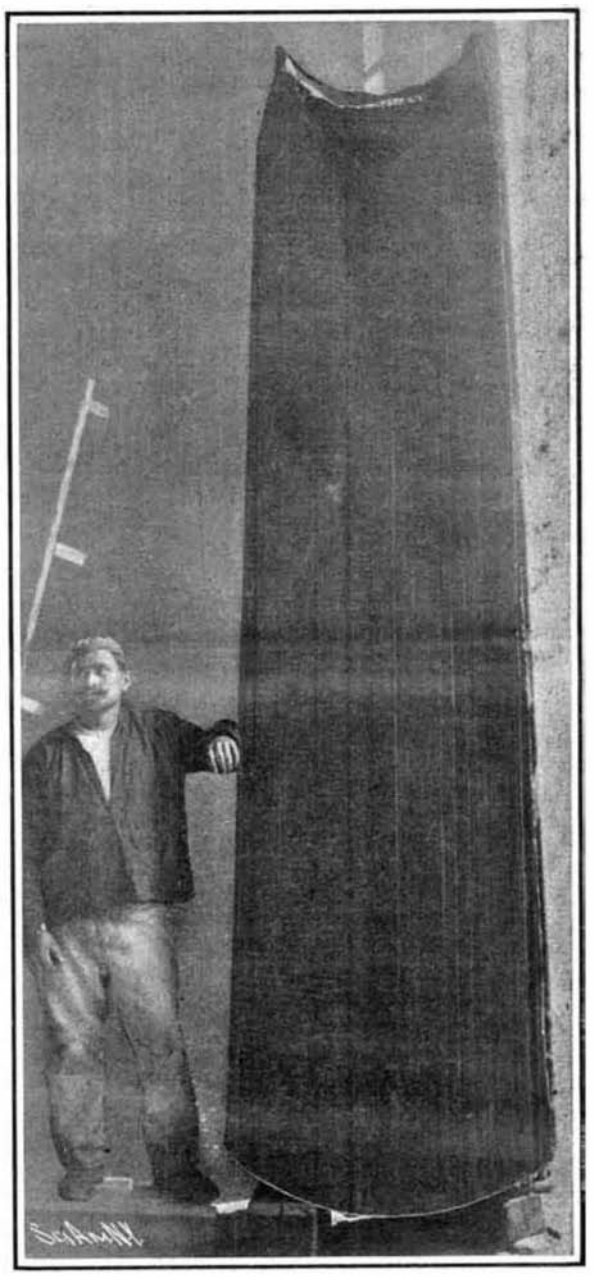


Fig. 3.—Longitudinal Section of a Block Weighing 37,840 Pounds.

The first-class cruiser "Pallada" was launched at the new Russian Admiralty shipbuilding yards on Saturday last. She is of 7,887 tons, and will have a speed of 21 knots. Her armament will consist of thirty-eight guns, the heaviest of which will be of 8-inch caliber, and two torpedo tubes.

SPEED TRIALS OF THE BATTLESHIP "VERMONT."

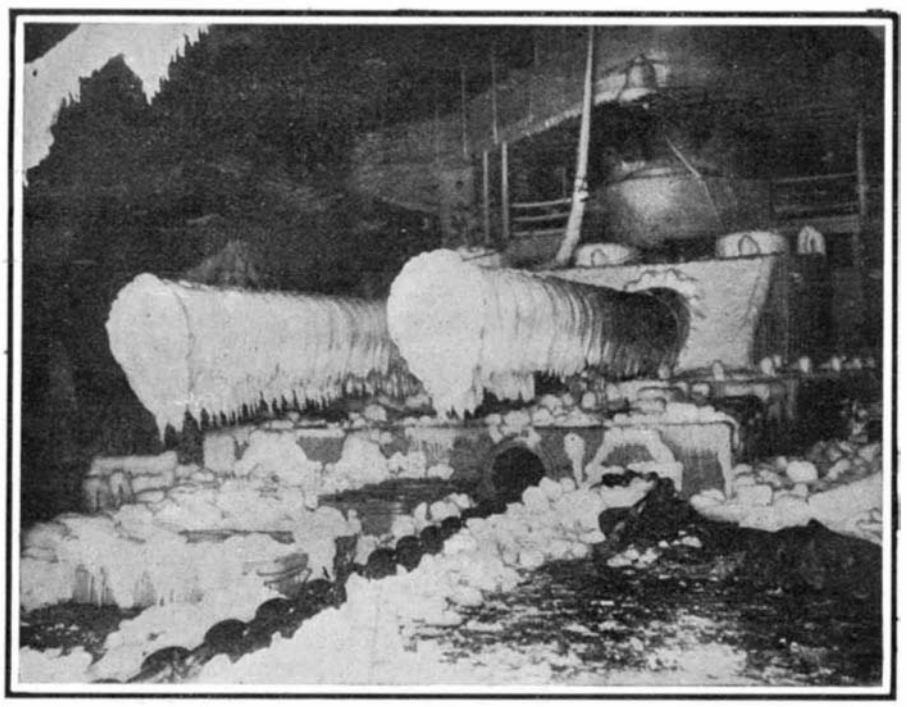
There was a time, and not many years ago, when the speed trials of a first-class United States battleship figured in large type in the headlines of the daily press, and awakened an interest which was felt to the remotest corners of the United States. That, however, was in the early days of the reconstruction of our navy, when the putting of a new warship to the test was an event of rare occurrence. Now these speed trials come at such frequently recurring intervals, that they have lost their novelty, and to some extent, their interest.

This acceptance of the success of our warship trials as a foregone conclusion, and the lack of the one-time interest in the trials, afford the best evidence both of the rapidity with which our navy has been built up, and of the excellent work which is being done in our shipbuilding yards. During the past year cruisers and battleships which are the peers of any afloat have passed successfully through their trials in rapid succession, and with a wonderful uniformity of success. The latest of these is the battleship "Vermont," one of the ships of the improved "Connecticut" class, which embodies some improvements in armor distribution and in less important details over the type vessel. Including the "Louisiana" and "Connecticut," the United States navy has, at present, six powerful battleships of the "Connecticut" type under construction or completed, namely, the "Connecticut," "Louisiana," "Kansas," "Minnesota," "New Hampshire," and "Vermont," all of 16,000 tons displacement and 18 knots speed. These vessels will form a homogeneous squadron, identical in speed, power, radius of action, and maneuvering qualities, which it would be difficult to match in any of the world's navies—always excepting the battleships of the new type carrying only the 12-inch gun as their main armament.

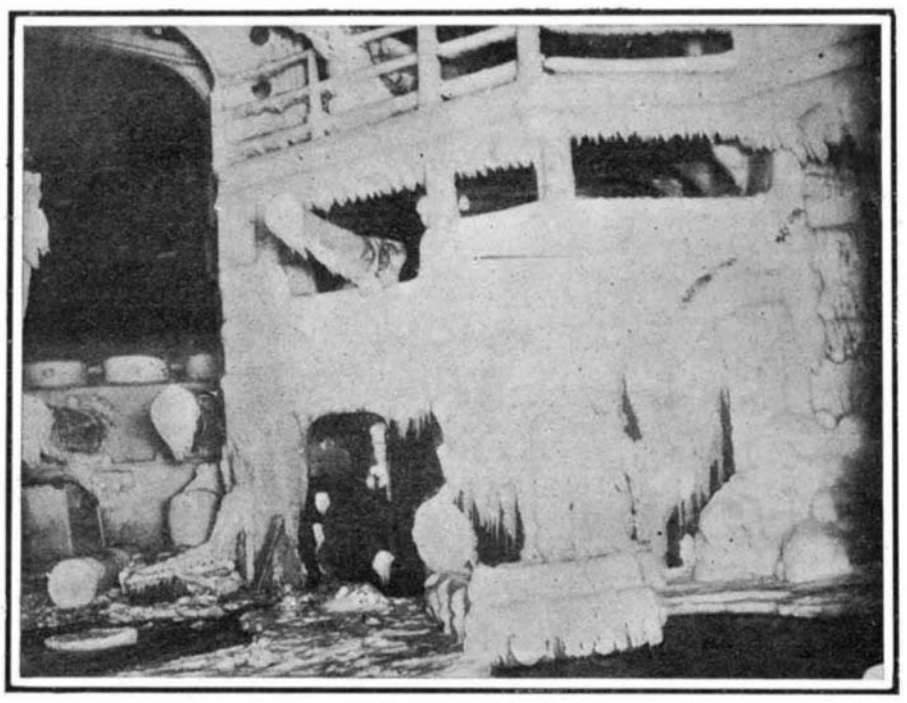
The "Vermont," which is being constructed by the Fore River Shipbuilding Company, of Quincy, Mass., is 450 feet long between perpendiculars, 76 feet 10 inches broad, and draws at mean draft 24 feet 6 inches. Her designed speed, which was exceeded on the trials, is 18 knots an hour with 16,500 horse-power; her coal supply is large, the total bunker capacity being 2,200 tons. The armor protection consists of a continuous water-line belt of an even thickness through its vertical section, which has a maximum thickness of 9 inches amidships and tapers gradually toward the bow and the stern. Associated with this belt, and sloping at the sides to meet its lower edge, is a protective deck which is 1½ inches thick on the flat amidships, 3 inches on the slopes, and 3 inches in thickness forward and aft of the main barbettes. Above the main belt is a wall of side armor, 7 inches in thickness, which extends between the main 12-inch barbettes, and reaches vertically from the top of the main belt to the level of the upper deck. The main belt and the 7-inch side armor are associated with transverse bulkheads extending from the side of the ship to a connection with the barbettes. There is a conning tower with 9 inches of armor forward, and a secondary conning tower aft protected with 5 inches of armor.

The armament is numerous and very powerful. It consists of four 45-caliber, 12-inch guns carried in two turrets, forward and aft, the barbettes being protected with 10 inches, and the turrets with 12 inches of armor. On each beam there are mounted two turrets, each containing two 8-inch 45-caliber guns, the barbettes being protected with armor from 4 to 6 inches in thickness, and the turrets with armor 6½ inches in thickness. The central casemate battery, with its protection of 7 inches of armor, is pierced by twelve casemates, in each of which is mounted a 7-inch, 50-caliber rifle. On the main, upper, and superstructure decks are mounted twenty 14-pounder, 3-inch guns, for repelling torpedo attacks. The armament also includes twelve 3-pounders, four 1-pounders, four machine guns, and two 3-inch field guns. There are also four submerged torpedo tubes for firing the new and very powerful and fast 21-inch torpedo. The "Vermont" has been fitted as a flagship, and she has accommodations for 916 officers and men.

The standardization trials of the "Vermont" took place on December 5; her four-hour full-speed trial on December 7; and this was followed by her twenty-four-hour trial, which ended December 8. On the four-hour run the highest speed recorded was 18.58 knots for 119.013 revolutions per minute, and the average for the four hours was 18.33 knots for 117.12 revolutions per minute. This performance is particularly creditable because of the fact that it was made under adverse conditions of strong wind and bitterly cold weather. Particularly fine was the twenty-four-hour endurance run. The contract called for 13,200 horse-power to be developed by the engines on this run, without any limitations as to speed. The conditions met with were those of "extreme cold, thick snowstorm, and a heavy gale of wind." Nevertheless, the horse-power developed by the main engines during

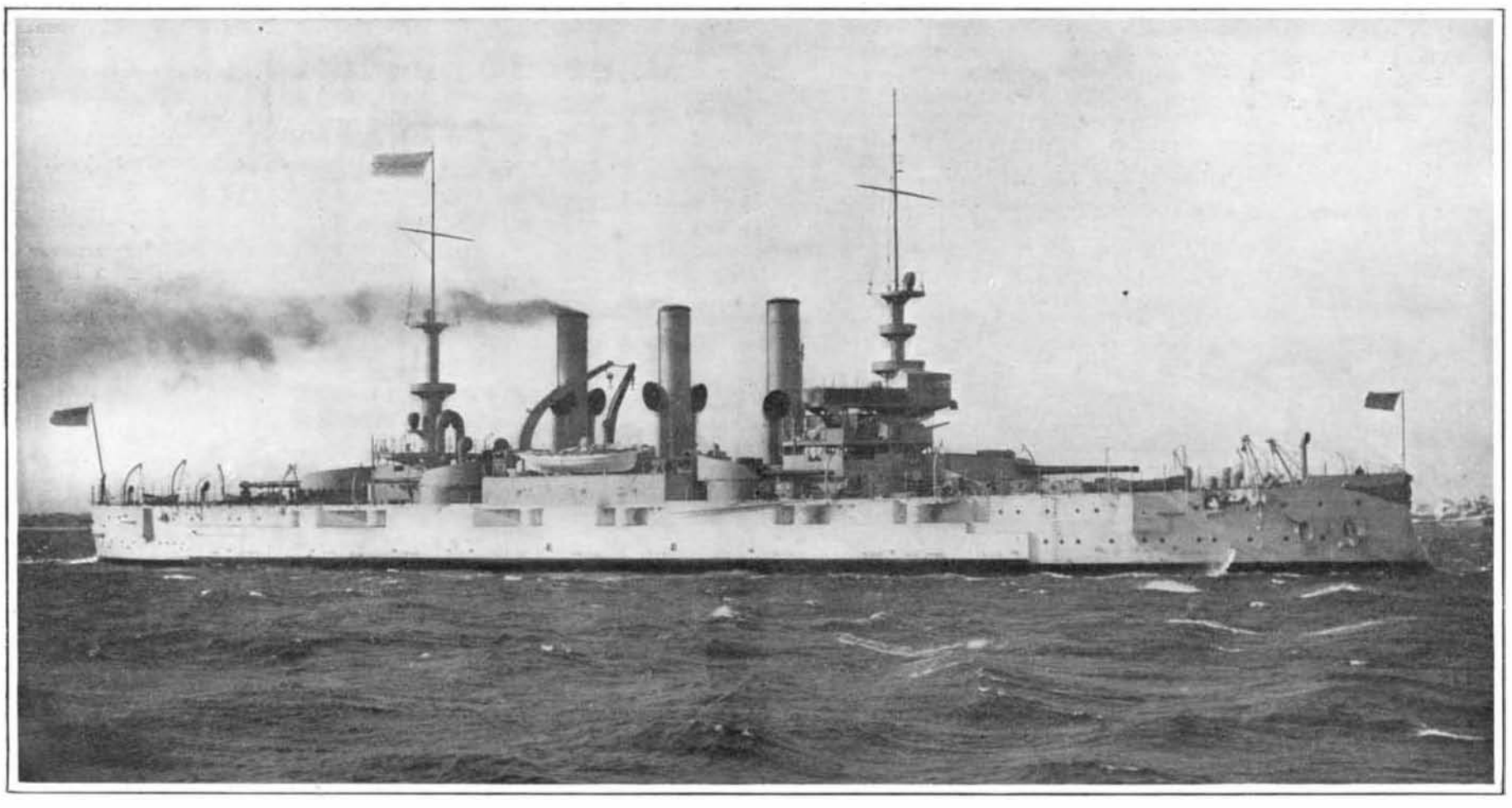


Forward 12-Inch Guns and Turret of Battleship "Vermont" at Close of Trial in Snowstorm.



Ice on Forward Bridges and Superstructure.

By courtesy of the Boston Herald.



THE 16,000-TON BATTLESHIP "VERMONT," WHICH RECENTLY AVERAGED 17.43 KNOTS ON A 24-HOUR RUN IN A BLINDING SNOWSTORM AND STRONG GALE.

the run was approximately 14,500, or 1,300 in excess of the contract, and the average speed was 17.43 knots. The heavy spray thrown up over the bows during this run froze upon the forecastle deck and the bridge, with the result that, when the ship returned to the harbor, she presented the extraordinary appearance shown in the accompanying engravings, for which we are indebted to the courtesy of the Boston Sunday Herald.

REVIEW OF THE YEAR 1906.

(*Continued from page 5.*)

power consists of two 85-horse-power motors driving four propellers, two on each side of the ship. Another new dirigible is the latest French airship "La Patrie," 33¼ feet in diameter by 196 feet long, and driven by a 70-horse-power motor, which is credited with a speed of 30 miles an hour. This airship was built by the Lebaudy brothers for the use of the French government on the same general lines as the "Lebaudy" airship. The most successful trip occurred on November 26, when the airship sailed for two hours and twelve minutes, and covered a distance of 57¾ miles. A trifle larger than the "Lebaudy" airship is the new machine of M. Henry Deutsch, known as the "Ville de Paris." It is 196.85 feet long, 35.43 feet in diameter, and is driven by a 70-horse-power Panhard motor. Although the dirigible airship has received the most attention, the European inventors have done some meritorious work with aeroplanes, and mention should be made of those of Bleriot and of Santos Dumont. The latter, which is built on the lines of the Wright brothers' machine, recently managed to rise above the ground for a brief flight of a few hundred feet. The balloonists have been exceedingly active during the year, and world-wide interest was aroused by the great international race for the Bennett cup, when sixteen balloons, representing seven different nations, started from Paris and met with varying fortune. Seven of the machines crossed the English Channel and landed in England, the greatest distance, 402 miles, being covered by the American contestant Lieut. Lahm, who landed near Whitby, in Yorkshire. This distance was exceeded later in the year by an independent trip, not in a contest, made by Mr. Leslie Bucknall, an English aeronaut, who, starting from London, landed at Vevay, on Lake Leman, after covering 472 miles, the trip being remarkable alike for the distance covered and the high speed. With a view to stimulating the development of the aeroplane, the London Daily Mail recently offered a prize of $50,000 to any one who will travel by aeroplane from London to Manchester in one day. This was followed by an offer of the London Daily Graphic of $5,000 to the inventor who should fly with one or more passengers between two given points not less than one mile apart. Other prizes offered in England bring the total up to about $70,000. In the United States the Aero Club of America has offered a $1,500 prize for a balloon race at the Jamestown Exposition.

AUTOMOBILES AND MOTOR BOATS.

That the automobile industry has settled down to certain fixed types, and that improvement is to be looked for, from now on, more particularly in details, is proved by the fact that in any review of the year's work it becomes increasingly difficult to find any novelties of a radical and far-reaching character. This was evident at the seventh annual show of the Automobile Club of America, in which it was evident that the makers had approximated so closely one type and standard of excellence that a visitor failed to observe those broad points of difference between the machines which formerly lent a stirring interest to the technical review of these annual shows. The gasoline motor still reigns supreme. While the makers of steam and electrical machines are turning out a product of the highest excellence, these types give no signs of ever again becoming serious competitors of the automobiles driven by internal-combustion engines. The electric motor promises to find its most successful field of work in the propulsion of heavy motor trucks and delivery wagons, of which some splendid specimens were shown at the late exhibition.

The public interest in competitions both of speed and endurance remains unabated. At the Ormonde-Daytona meet, held early in the year, new world's records were made in almost every event. The most sensational feat was that of the Stanley steam racer, which covered the mile on the smooth sands of the beach in 28 1-5 seconds at a speed of 127.65 miles an hour. The 200-horse-power Darracq racer won the 2-mile race, covering the distance in 58 4-5 seconds at a speed of 122.46 miles an hour, which is the fastest speed ever made by a gasoline automobile. The 100-horse-power Napier racer secured the 100-mile record of 1 hour, 15 minutes, 40 2-5 seconds, at a rate of speed of 79.28 miles an hour. Later in the year occurred the Automobile Club of America's 2-gallon fuel efficiency contest, which was won by a four-cylinder, air-cooled Franklin runabout, which covered a distance of 87 miles at a fuel expense of 0.613 cent per ton-mile. The 24-horse-power air-cooled Frayer-Miller car covered 47.9 miles at the phenomenally low cost for fuel of 0.517 cent per ton mile. Toward the close of the year the annual Vanderbilt cup contest was run off with its usual brilliant success, although, as usual, the honors went to the foreign machines. The race was won by a 100-horse-power Darracq, driven by Wagner, who covered the 297.1 miles of the course at an average speed of 61.43 miles an hour, the second place being taken by a 120-horse-power Fiat driven by Lancia, whose average speed was 60.84 miles an hour. The failure of the American cars was attributed almost entirely to the failure of the non-skid tires with which all the contestants had to be equipped, because of the rather greasy condition of the track. The best of the American machines, notably the Locomobile and the Thomas, seemed to have plenty of speed; but they were so severely handicapped with tire troubles as to have no chance at taking a leading place. That they possessed the speed is evidenced by the fact that the fastest round of the course made by any contestant was credited to the 110-horse-power Locomobile, which covered the distance in 26 minutes and 21 seconds. That these races exert a beneficial effect upon the interests of automobiling in more ways than one is shown by the fact that as the result of the last Vanderbilt cup contest a 60-mile special automobile highway, on which the future contests will be held, is being built on Long Island for the exclusive use of automobiles. Other highways of the same kind are proposed, and it may prove that this venture marks the first of a system of such roads, which may ultimately cover the country.

It begins to look as though the application of the internal combustion motor to boat and ship propulsion will, in the future, find its most successful field not in flimsy high-speed racing craft, but in staunch, serviceable, sea-going launches and cruisers, and ultimately in the propulsion of various types of merchant craft. The record for racing craft still remains at the speed of 30¾ miles an hour at which it was placed by the French motor boat "Antoinette" in the year 1905. An interesting development of the racing craft is that of the hydroplane type, several of which have been illustrated from time to time in the columns of the Scientific American. In this type an effort is made to lift the boat clear, or partially clear, of the water and drive it along on a series of slightly inclined planes. A vessel of this type was recently tried on western waters, and two others in France, the latest type being that of Levavasseur, which consists of a front boat holding the motor, to which is attached a light wooden frame for carrying a long tail at the rear end of which is the propeller. The gasoline motor has been applied successfully to a torpedo boat by the Messrs. Yarrow in London, who produced a little vessel weighing only 8 tons which has shown a maximum speed of 26 knots an hour and has a radius of action, when carrying one ton of oil, of about 300 miles. This vessel has been purchased by the British Admiralty, and is likely to become the pioneer of a new and very useful type of torpedo craft. The producer-gas engine, also, is making progress in its application to the propulsion of vessels. The Thornycroft Company have recently constructed a vessel which is driven by a producer-gas engine of 500 horse-power, while the Otto Gas Engine Company have already fitted their producer-gas engines to a dozen or more vessels, the power ranging from 35 to 90 horse-power. The latest success of this company was realized with a flat-bottomed barge of 240 tons, which is driven by a four-cylinder, 100-horse-power engine. The vessel has proved to be highly economical in operation, as will be seen by the fact that during a single year 5,200 tons of freight were carried, representing nearly 2,000,000 ton-miles at a cost of about one-fourth of a cent per ton.

MERCHANT MARINE.

The most significant event of the year in the merchant marine has been the steady advance in the performance and popularity of the steam turbine, as a drive for ships of all types, sizes and speeds. It is true that in proportion to the number of ships afloat or even of those building, the number of turbine-driven vessels is, as yet, very small; but the uniformly excellent results obtained with the latest and most improved forms of marine turbines point with increasing emphasis to this as the ultimate type of engine for all vessels, unless we except the tramp steamers of large capacity and low speed. The year has witnessed the launch of the two Cunarders, the weight of each vessel as she went down the ways being over 16,000 tons. These ships, 786 feet long, 88 feet broad, 60 feet deep, and of 45,000 tons displacement, are considerably the largest afloat. Their contract speed is 25¼ knots on trial; their contract horse-power 68,000. The "Lusitania" will make her maiden voyage to this port in the summer and the "Mauretania" in the late autumn of 1907. Outside of these vessels and a sister ship to the "Kaiser Wilhelm II." being built for the North German Lloyd Company, all of the new transatlantic liners, now under construction, belong to the large, moderate-speed, freight-and-passenger type, represented by the "Kaiserin Auguste Victoria," of the Hamburg-American Line, which made her maiden voyage to this port during the year, and the new "Adriatic," of the White Star Line. A vessel which excited considerable comment on her appearance at this port, was the great auxiliary clipper "R. C. Rickmers," which has the distinction of being the largest sailing ship afloat, her length being 441 feet, and her displacement 11,360 tons. She is equipped with an auxiliary steam engine of 750 in icated horse-power. Under steam she can make from 6 to 8 knots an hour, and under sail she has made 16 knots. Shipping interests in the United States are in a bad way, at least as far as the deep-sea carrying trade is concerned. Shipbuilding on the Great Lakes is, as usual, in a wonderfully prosperous condition; and for the coastwise trade, several excellent vessels, some of them turbine-driven, have been built or are under contract. The only salvation of our deep-sea shipping will be the passage of the Shipping Bill, of which, thanks to the assistance of the President, there seems to be at last some real grounds for hope.

Meeting of the American Association for the Advancement of Science.

The Fifty-seventh Meeting of the American Association for the Advancement of Science was opened at Columbia University with a very large attendance at 10 A. M. on Thursday, December 27, by the retiring president, Dr. C. M. Woodward, who introduced to the Association the new president, Dr. W. H. Welch. An address of welcome was made by Dr. Nicholas Murray Butler, president of Columbia University, which Dr. Welch followed with a reply. At the adjournment of the general session, the various sections met at their respective meeting places. Interesting papers were read in the departments of Mathematics and Astronomy, Physics, Chemistry, Mechanical Science and Engineering, Geology and Geography, Zoology, Botany, Anthropology, Social and Economic Science, and Physiology and Experimental Medicine.

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The Current Supplement.

The current Supplement, No. 1618, opens with a handsomely illustrated article on "The Treasures of Cumæ." Dr. Wilhelm Haacke writes a popularly worded article on Mendel's law of heredity, which law taken in conjunction with the work of De Vries may be said to have partially upset the Darwinian view of heredity. Another biological article of rare interest is that by Prof. E. Korschelt, on Regeneration and Transplantation in Animals. Mr. John D. Shoemaker contributes an entertaining account of electricity in the treatment of disease. President Roosevelt's message on the Panama Canal is concluded. Among the minor articles may be mentioned those entitled Heating of Feed Water to Approximately Steam Temperature, Colors for Book Edges, the De la Vaulx Airship, and a Wick Carbureter. Those interested in home experimental science will find Mr. A. Frederick Collins's article on an easily made high-frequency apparatus well worth reading. Mr. Collins removes the general impression that currents of high frequency and high potential can be obtained only with apparatus of special construction and shows how either D'Arsonval or Oudin currents can be produced by a high-frequency apparatus which can be easily made at home and which consists of a plunge battery of six cells, an induction coil giving a two-inch spark, a pair of one-pint Leyden jars and an inductance coil. By far the most important paper which was read at the recent meeting of the American Society of Mechanical Engineers was that of Mr. Fred W. Taylor on the Art of Cutting Metals. An abstract of this paper is published. Mr. Taylor's work is probably the only treatise to be found in print on modern work with tool steel.

Since 1891, the electrolytic copper refining industry has undergone enormous expansion, chiefly in America, and the number of electrolytic refineries in existence in 1905 was stated to be thirty-two, distributed as follows: United States, nine; Germany, nine; United Kingdom, six; France, four; Russia, two; Austria-Hungary, two. To this total of thirty-two must be added four refineries, which are reported to be working in Japan.

THE HEAVENS IN JANUARY.

BY HENRY NORRIS RUSSELL, PH.D.

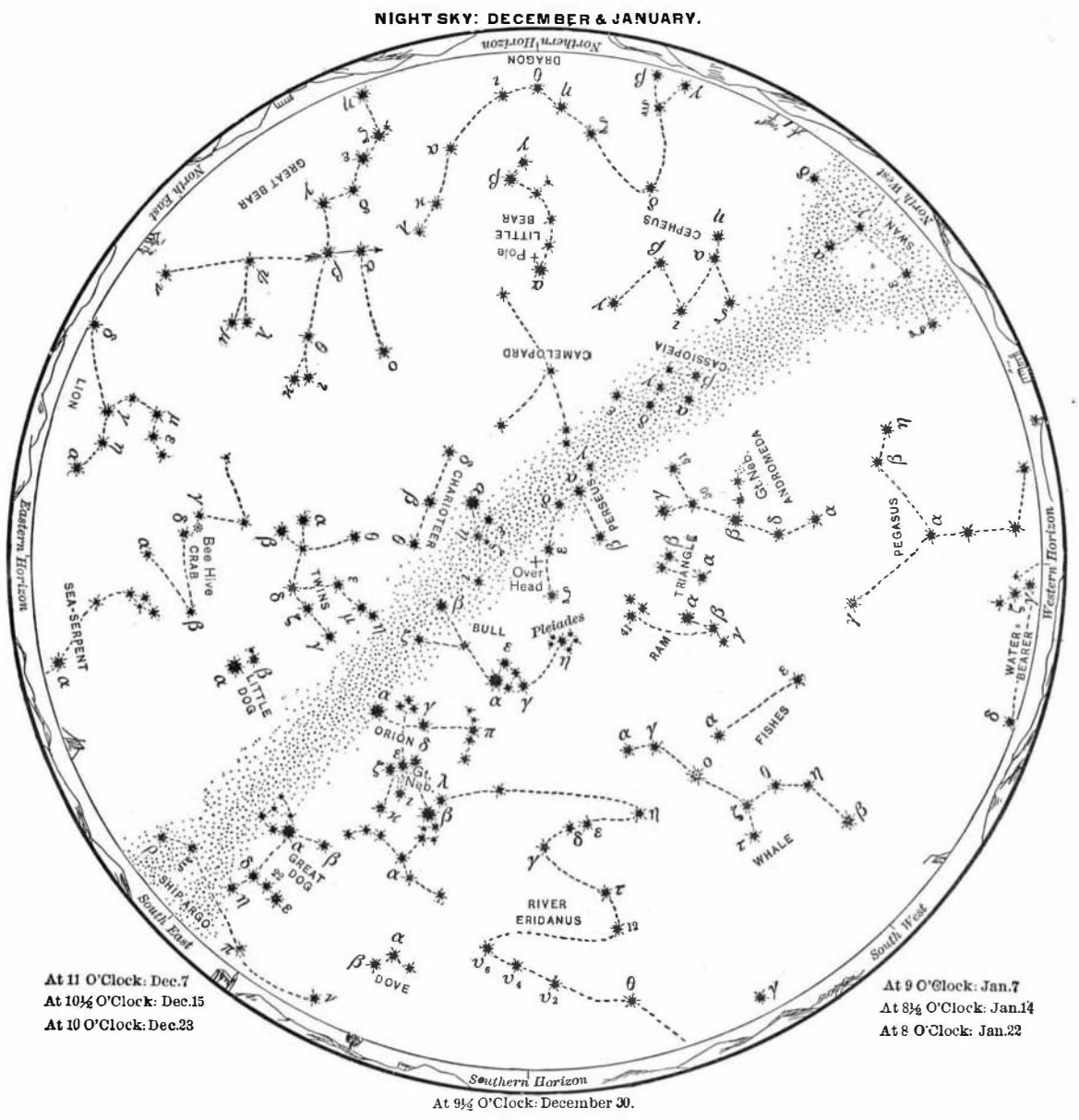
The principal astronomical event of this month is a total eclipse of the sun, which takes place on the 13th. The track of the moon's shadow is less conveniently placed than at some recent eclipses, as it lies almost entirely in central Asia. Beginning in southeastern Russia, the shadow crosses the Caspian Sea, and passes over Turkestan, then into the deserts of Mongolia, and leaves the earth in Manchuria. The only practicable stations for observation are in Russian Turkestan. The partial phase is visible over almost the whole of Asia.

Of more interest to us is an eclipse of the moon, which occurs on the morning of the 29th. This eclipse is not total, but may be called a large partial eclipse, since seven-tenths of the moon's diameter is immersed in the earth's shadow. Observers in the eastern United States will see very little of it, for it begins at 7:06 A. M., Eastern standard time, and the moon sets soon after. On the Pacific coast most of the eclipse can be seen, and the whole course of it will be visible in Hawaii and Alaska, and over a large part of eastern Asia.

The splendid winter skies are now in their glory. The principal constellations now in sight are shown on the accompanying map. Starting in the north, we find the Little Bear hanging very uncomfortably head downward from the Pole star. Below him is the Dragon, whose head is close to the horizon. The Great Bear is climbing toward the zenith, and fills a large part of the northwestern sky. On the right is the Lion (Leo) just rising, and farther south the head of Hydra the Sea Serpent. Above these is Cancer the Crab, a faint constellation, containing a fine star cluster, visible to the naked eye, and marked on our map by the name of the Beehive. Higher up are the Twins and the Little Dog, both fine constellations, the first containing the two bright stars Castor and Pollux, and the second a single very bright star, which since the days of the Greeks has borne the name of Procyon.

Nearly overhead is Auriga the Charioteer, whose principal star Capella (marked with the letter α on the map) is even brighter than Procyon. South of it, and also near the zenith, is Taurus the Bull, to which belong the groups of the Pleiades and the Hyades, the latter including the red star Aldebaran. Below this is Orion, the finest group in all the heavens, which needs no introduction. Below again is the Great Dog. Sirius, its principal star, is so much brighter than any other in the heavens, that it throws its neighbors into the shade, but even if it was blotted out, the constellation would be a conspicuous one, especially the irregular cross of stars some 15 deg. southeast of Sirius. Below Orion are the small constellations of the Hare and the Dove. To the right and directly due south is the long curving stream of Eridanus, which extends southward below our horizon to stars that we never see.

In the southwest is another very large constellation, Cetus the Whale. The remarkable variable Mira belongs to this group, and bears the letter *o*, by which it is indicated on the map. At the beginning of December it was unusually bright, of the second magnitude, and the brightest object in the constellation. It is now fading slowly, and by the end of January will probably be barely visible without a telescope. We may expect to see it again in September or October, in preparation for the next maximum, which is due about November 1, 1907. Aries the Ram is north of Cetus, and north of it are Perseus and Andromeda. The great square of Pegasus is low in the west, and Cygnus the Swan is setting in the northwest. The bright group of Cassiopeia, the less prominent one of Cepheus, and the unimportant Camelopard—all three near the Pole—complete our list.



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

THE PLANETS.

Mercury is morning star all through January. He is, however, visible only in the early part of the month, when he rises about 6:30 A. M.

Venus is likewise morning star, and attains her greatest brilliancy on the 4th. She is in Scorpio, and rises between 4:30 and 5 A. M. all through the month. With the telescope she appears as a crescent, which rapidly widens until it becomes nearly a half-moon.

Mars is morning star in Libra, and rises at about 3 A. M. in the middle of the month. He is a long way from the earth, and pretty faint. Jupiter is in Gemini, just past opposition, and dominates the evening sky. The markings on his surface, ever changing with his rapid rotation and the motions of his four bright satellites, make him one of the most interesting of all telescopic objects.

Saturn is evening star in Aquarius, and sets at about 9 P. M. in the middle of the month. Uranus is morning star, too near the sun to be observed.

Neptune is in Gemini, and comes to opposition on the 2d. His position is then in R. A. 6h. 48m. 33s. Declination 22 deg. 4 min. north, and his apparent motion at the rate of —7s. in R. A. and +9 sec. in declination. He is about midway between the stars ϵ and ς Geminorum, but is too faint to be seen without a telescope, or identified without a good star map, except by his motion, or, with a telescope of some power, by his disk.

Two comets are now in sight, both telescopic. Thiele's comet, mentioned last month, is moving northwestward from Leo into Ursa Major. A fainter comet, discovered by the Rev. J. H. Metcalf at Taunton, Mass., is in Eridanus, moving very slowly. Both are receding from the earth and sun, and growing fainter.

THE MOON.

Last quarter occurs at 9:39 A. M. on the 7th, new moon at 12:49 A. M. on the 14th, first quarter at 3:34 A. M. on the 21st, and full moon at 8:37 A. M. on the 29th (during the eclipse). The moon is nearest us on the 12th and farthest off on the 25th. She is in conjunction with Mars on the 9th, Venus on the 11th, Uranus and Mercury on the 13th, Saturn on the 17th, Jupiter on the 26th, and Neptune on the 27th—none of the conjunctions being close.

Princeton University Observatory.

American Cement in India.

BY CHARLES A. SIDMAN.

The continued increase in the use of cement is making it one of the largest exports we have. In these days of modern and sanitary building, it is used to a great extent for foundations, taking the place of the old-fashioned style, that of thinking that stone walls were the best for this purpose. Its uses are unlimited, and every day sees some new application. Foundations, fancy columns, bridges, rustic seats, walks, and numerous other articles are made out of this commodity. Consul General Michael, of Calcutta, reports that in India the use of cement is very extensive. They consider it the best for all particular work. It is used in laying brick walls in foundations, and if wood is used for structural purposes, it is laid in cement wherever possible. Floors, moldings, cornices, and outside and inside trimmings are made of sand and cement. Wherever cement can be used to guard against vermin, especially the white ant, it is freely used. Houses that have flat roofs are covered with brick dust and particles of brick mixed with cement and stamped down hard. Pitched roofs are covered with corrugated iron or tile, and then solidly covered with cement and sand. These roofs last well and require little repair. Artificial stone is extensively manufactured and used for building purposes and for pavements and walks. Floors are laid in cement and made ornamental by imbedding broken glass and china in figures in the body of the cement. The outside of the temples are made in the same way and are very attractive. Thus it will be noticed that cement is in general use and always will be in India. The imports of cement as long ago as 1870 were valued at $50,342, advancing in the fiscal year 1900 to 729,478 hundredweight, valued at $500,332, and in 1906 to 1,778,428 hundredweight, valued at $1,070,275. The imports of cement for the first four months of the present calendar year were 574,006 hundredweight, valued at $333,427. The supplies of cement for India come mainly from the United States, Great Britain, Belgium, and Germany. Inferior cement is not wanted, but the best cement is in good demand at good prices.

A novel and interesting feature of the new United States mint at Denver, Col., is the sweeps room, which is entirely different from that at any other similar establishment in this country. This is the department where the precious metal is recovered from the sweepings and other waste matter. In all the other government plants, the dry process is followed, wherein crucibles, which have become worn out in service, old floorings which have been torn up, sweepings from the floor and from old tin roofs on the building itself and those of adjoining structures, are put through grinding machines provided for the purpose, and the usual practice is to sell this ground-up material to the highest bidder, the bidders having been provided with samples on which to base their estimate of its value. In the new establishment at Denver the wet process has been adopted, and so effective is it in the operation of reclaiming the fugitive metal, that the smelters who have formerly bought the waste will no longer have anything to do with it.

In following the wet process, the crucibles are broken under the sledge and then passed through a grinding mill. Upon being broken up to such a size that the pieces will pass through an 80-mesh screen, they are then fed over and through an amalgamator having forty-two plates, into two settling tanks, where the waste is chemically treated. All shot gold or clippings are rolled into flakes in the bed of the mill, and are recovered as such when the run is completed.

The amalgamator material is pressed out and is melted into bars. The wet method dispenses with a number of very objectionable features, which are necessary with the dry process—for instance, the black lead crucible dust, which in other mints has not only caused much discomfort, but has been the means of seriously damaging the building.

THE MANUFACTURE OF STEEL PENS.

BY L. A. HAWKES.

When, in the year 79 A. D., the celebrated volcano Vesuvius belched forth fire, lava, and ashes, and destroyed, among others, the beautiful historic city of Pompeii, it at the same time preserved in the ruins of that city the first and only evidence that we have of the early use of metallic pens. In excavating the ruins of the city, specimens of metallic pens were found, which are now preserved in the British Museum and the museum of Naples. These specimens were made of bronze. Most of the early metallic pens were made of this material, although some were made of silver. The use of metallic pens was very rare, and before the introduction of steel pens, the implements most commonly used for writing were stilos, brushes, reeds, and quills, all of which are even up to this time used in some countries.

The quill pen, which was the direct predecessor of the steel pen, was so difficult to make, and its life was so short, that efforts were continually made to produce something that would last longer and supersede it. In the effort to do this various metals were used, among them steel. The forms of the first steel pens were copies of the quill pen, being both pen and penholder combined, or what is known to-day as the barrel pen. They were slit similar to the quill pen.

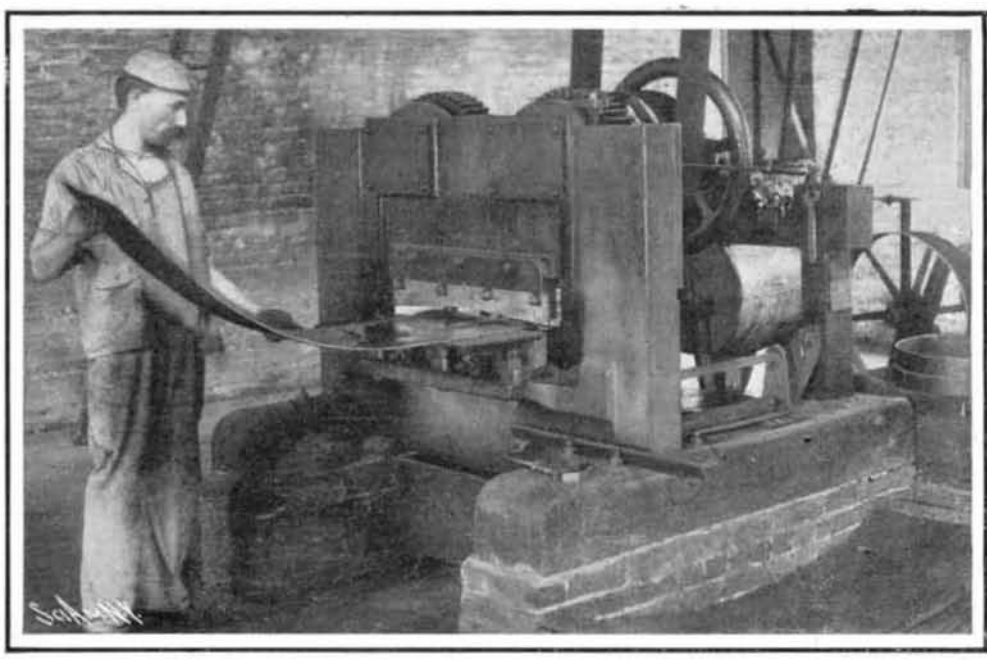


Fig. 2.—Cutting the Steel Into Strips.

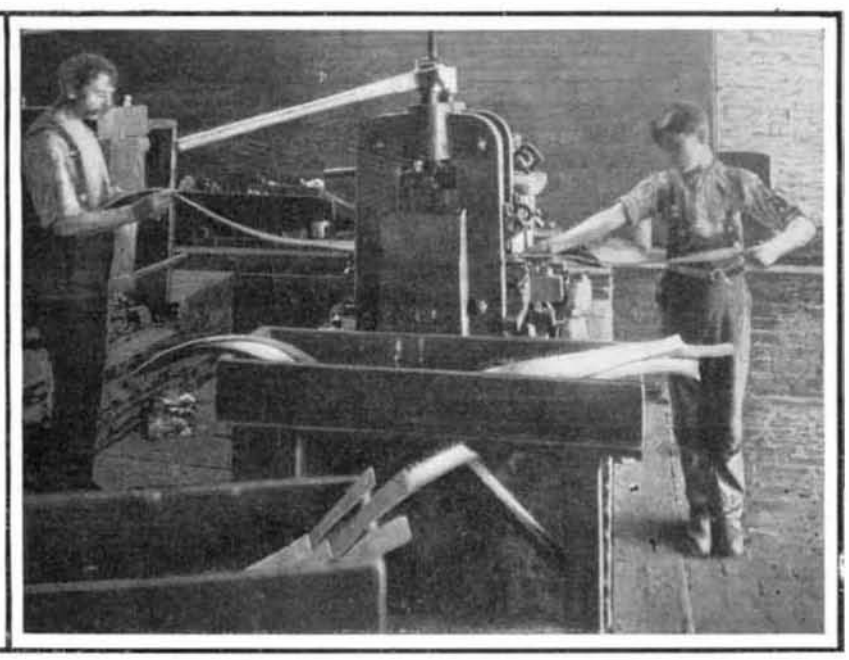


Fig. 1.—Rolling the Steel to the Proper Thickness.

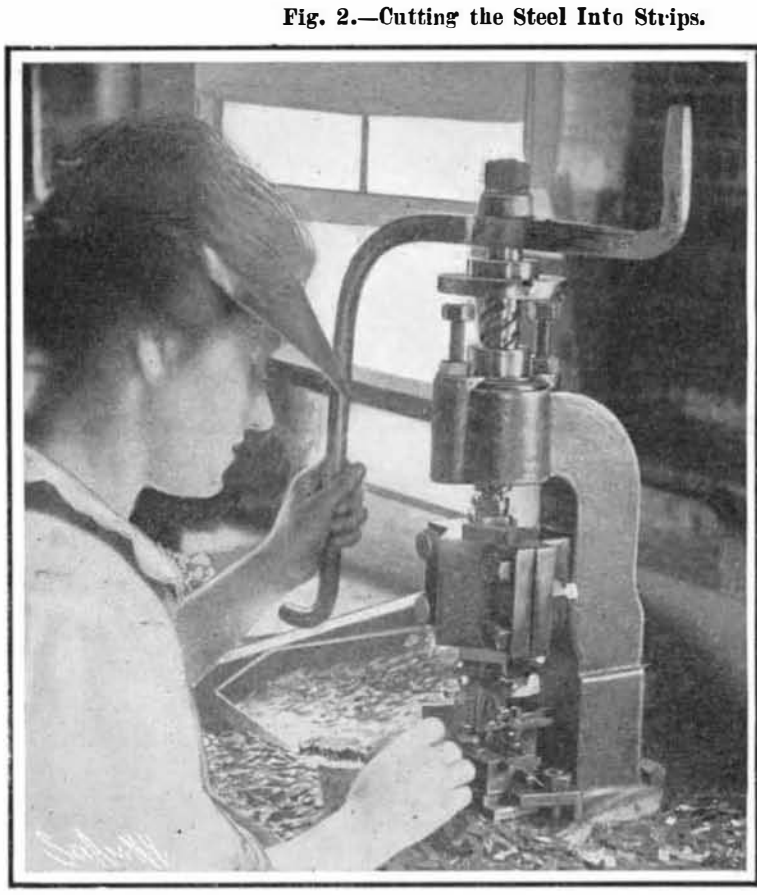


Fig. 3.—Cutting the Pens.

Fig. 4.—Marking.

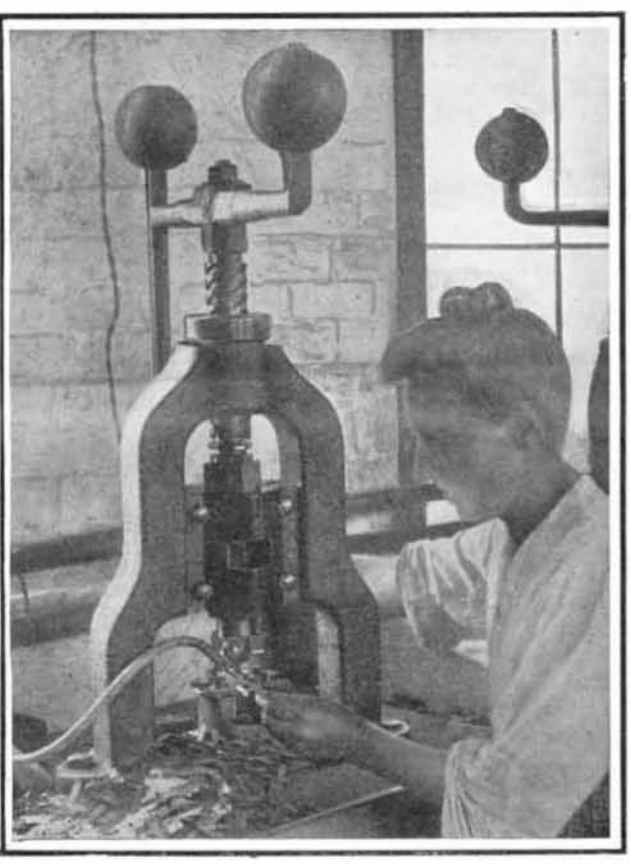


Fig. 5.- Raising the Pens.

Fig. 6.—Tempering the Hardened Pens.

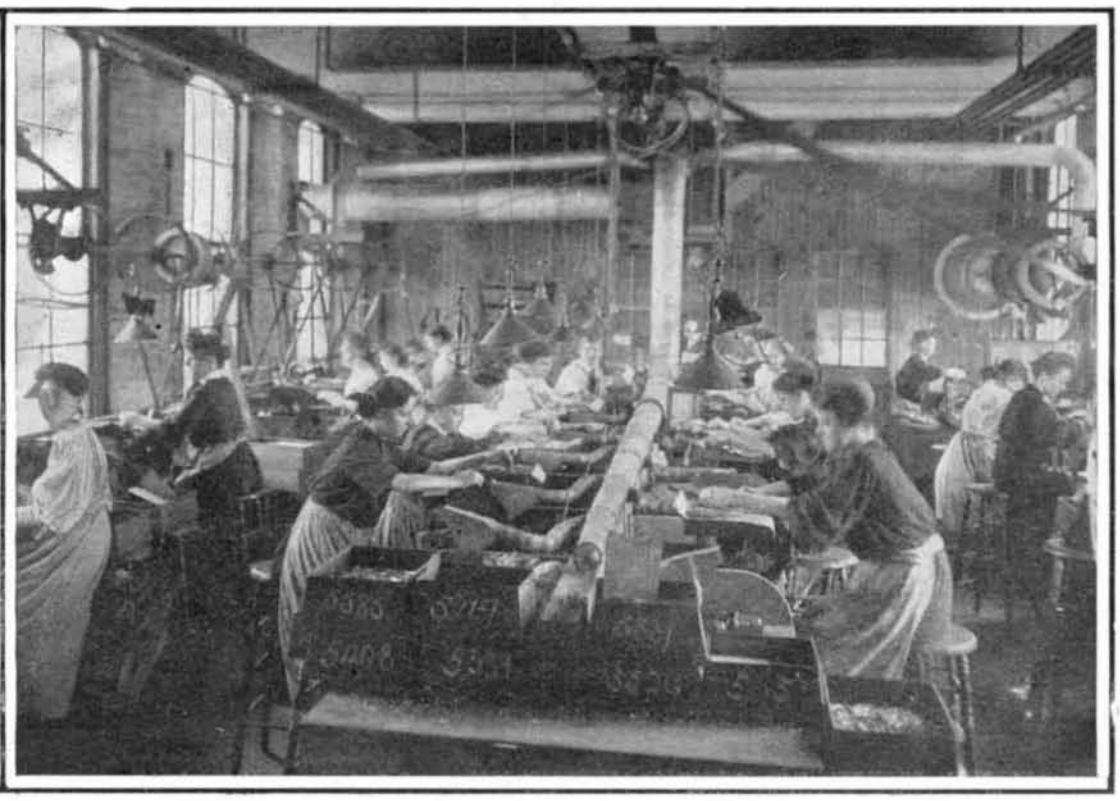


Fig. 7.—Grinding With Emery Wheels.

THE MANUFACTURE OF STEEL PENS.

This style of pen was used for a number of years, but was very expensive, because as soon as the pen was worn out, it was necessary to throw away practically both the holder and the pen, so that the nib part was made separate, and the barrel part became the tip of the penholder of to-day. This was a great economy, and soon the pen took its present form, and the penholder was made to hold it.

One of the objections to the early steel pens was their stiffness. This was overcome by the introduction of the side slits; by varying the size, shape, and position of these side slits, a pen can be given any resiliency desired.

The steel pen industry did not make any rapid advances until the adoption of the foot, drop, and screw presses about the year 1825; then they were manufactured in fair quantities, but their introduction was by no means rapid, for even as late as 1860 to 1865 the Quartermaster's Department furnished the United States army with the quill pens. The first steel pens sold anywhere from 25 to 50 cents each, so that one pen cost as much as will now buy from one-third to one-half a gross of the better grades. In other words, they cost from fifty to seventy-five times as much as they do now. The consumption has increased very rapidly, and at the present time the world probably produces from ten to twelve million gross annually, of which the United States produces two million five hundred thousand gross, and consumes over three million gross.

Although the pen may be mightier than the sword, its daily use by millions of people has made them insensible to its importance; and those who have given it a thought, believe that the sheet steel goes in one end of a machine and the completed pen falls from the other end. This is far from being the case, as there are from twenty to twenty-eight handlings, the number depending on the style of the pen.

The following description of the operations is of the manufacture as carried out at the works of the C. Howard Hunt Pen Company, manufacturers of round-pointed pens, Camden, N. J., and describes the most advanced methods and latest improvements.

The steel is imported from England, and consists of selected sheets, 19 inches wide, about 5 feet long, and 0.023 of an inch thick; it is of the very highest grade, American manufacturers not having attempted to make this class of steel.

The first operation is to cut the sheets into strips 19 inches long and wide enough to cut two pens with their points interlapping. These strips, which are rolled hard and are too thick to cut a pen from, are annealed by packing them in iron boxes and heating them at a low red heat for a number of hours. They are then gradually cooled under a hood to prevent drafts striking them. When cool the strips are soft and coated with a scale which is removed by a pickle of dilute sulphuric acid. They are now ready to be put through the rolling mill, and reduced to the required thickness, which averages about 0.009 of an inch. The rolling is known as "cold-rolling," the strips not being heated after the first annealing. This gives an increased toughness to the steel. The number of times necessary to put it through the rolls depends on how thin the steel is to be rolled. Each strip is tested with a micrometer gage, and should it be too thick, it is again put through the mills, and if too thin, it is laid aside for a pen for which a thinner steel can be used. The steel which started 19 inches long has been stretched to about 50 inches, and is then ready for the pens to be cut from it.

Fig. 8.—The Slitting Machine.

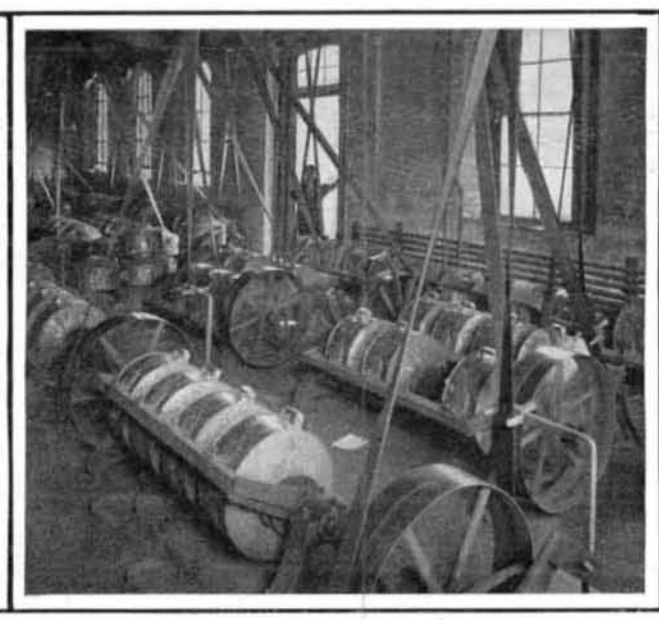


Fig. 10 Polishing and Coloring.

Fig. 9.—Examining for Defects.

Cheap pens are cut from steel that comes in large rolls ready for use, as it is impossible to roll this uniformly. The pens that are made from it are very irregular.

Pens are cut in screw presses provided with dies of the desired shape. About two hundred styles of dies are required for regular and imprint pens.

An operative can cut from forty to forty-five thousand pens in a day of eight hours, and her hand will move about seven miles in doing it. After the pens have been cut they have the appearance pictured in Fig. 12. Fig. 13 shows the scrap that is left after the pen has been cut from the steel.

Fig. 11.—Packing the Finished Article.

The blanks are now pierced and side-cut as shown in Fig. 14. These operations, to a large extent, determine the flexibility of the pen, and vary with the style of pen, some pens requiring two and three handlings in the piercing department.

The blanks having been cut from hard rolled steel, it is now necessary to soften them by annealing. This is done by putting them in large iron pots, heating them to redness for several hours, and then cooling gradually. They are then soft and pliable and ready to receive the name, which is the next operation, called marking, as is shown in Fig. 15. Some pens have a raised letter or design on them, called embossing. This is done in a marking press.

After marking, the pen is raised, that is, brought to the form that it is to have when finished. There are on the market about two thousand styles of pens. Fig. 16 shows one of the most popular of these, the Courier, No. 700. Raising is done in a peculiarly constructed screw press, and the pens are removed by compressed air.

Each pen is now carefully examined for imperfections in the previous operations, and as they are soft, it is necessary to harden them by heating them red hot, and dropping into cold oil. The oil is removed by centrifugal force and boiling lye, and the pens are then dried in sawdust. This makes the pen very brittle, so that it has no resiliency. In order to obtain the latter quality, the pen is tempered by gradually reheating it until it has acquired the greatest toughness and elasticity possible.

The pen now has a coating of oxide, which must be removed by scouring. This is done by placing the pens and a scouring material in tumbling barrels and revolving them until they are bright. Girls then grind the pens on emery bobs lengthwise and across the nibs. Some pens have only one operation in this department, while others have two and three. Fig. 17 shows a pen which has been cross-ground, and Fig. 18 one which has been both cross and straight ground. Pens are ground to enable them to hold the ink better, and also give them more resiliency.

The pens are now ready for slitting. As it is necessary to cut through the hardened and tempered steel without damaging the point, it can be readily appreciated that the tool for doing it must be one of the most delicate. It is a miniature shearing machine with knives of extreme hardness of absolutely perfect gage to hold the pen, so that the shears will always cut through the center of the point.

After the pens have been slit, as in Fig. 19, they can be used for writing; but they would be very scratchy and would stick in the paper. In order to overcome this, the points are rounded and made perfectly smooth.

The final examination is now given each pen; expert examiners sit before slanting desks on which is a slate of black glass; the pens lie on this desk and the examiners pick up one in each hand, pressing them on the glass and looking at the cutting, piercing, marking, raising, grinding, slitting, tempering, etc. Should the pens have any imperfections in any of these operations, they are thrown into separate boxes, so that each room can be charged with the amount of its waste. This waste is then put in iron pots and heated so as to prevent their being used, when they are sold for scrap steel. There are 1,728 chances to make a bad pen in every gross; consequently its manufacture requires vigilant care and inspection.

The pens are now polished, and, if they are to be left gray, are ready for the lacquering operation; if they are to be made bronze, blue, black, or any of the various shades, they are sent to the tempering room, and gradually reheated in a revolving cylinder until the required color appears upon them, when they are chilled quickly, so as to prevent the color changing. The pen is now practically finished; but if put on the market in this form, would rust very quickly. Each one is therefore given a thorough coat of lacquer, which

Fig. 12. Cut.

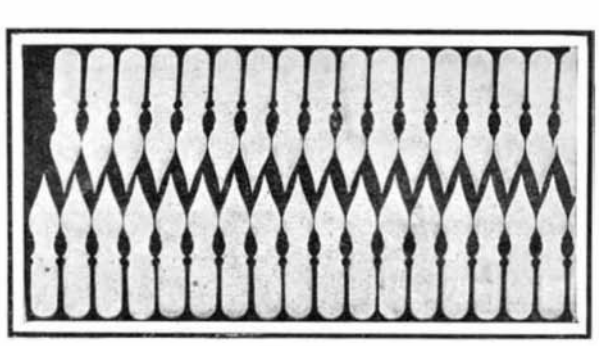


Fig. 13.

Fig. 14. Pierced.

Fig. 15. Marked.

Fig. 16. Raised.

Fig. 17. Cross ground.

Fig. 18. Cross and straight ground.

Fig. 19. Slit.

THE MANUFACTURE OF STEEL PENS.

preserves it. If the pens are to be plated with bronze, silver, or gold, these operations are performed while the pen retains its bright polish.

The pens are now ready to go to the boxing room, where they are "counted" by weight. It will be found impossible to put a gross of pens in the box intended for them unless they are laid parallel. In order to do this quickly and easily, they are put in a half-cylinder and shaken. This quickly places them in a parallel position, and by a very quick move of the operative they are dumped into the boxes, which are then ready to be labeled and packed.

There is a story widely copied by newspapers that the introduction of the typewriter had diminished the use of steel pens. This is not only untrue, but strange as it may seem, the typewriter has benefited the steel-pen business. It has done this, by increasing the volume of correspondence a hundredfold, and called forth return correspondence that would never have been sent.

Capt. Amundsen's Voyage and the Magnetic North Pole.

Capt. Amundsen's recent return from his Arctic expedition has prompted Fridtjof Nansen to publish his views on the importance of the achievement in Morgenbladet, a Norwegian daily newspaper. Because of the careful preparation of every detail, both scientific and practical, and the excellent manner in which everything has been carried out, in spite of the limited means at the disposal of the explorer, this voyage, in the opinion of Nansen, ranks among the most remarkable of polar expeditions. The most important aim of the daring Norwegian, viz., to locate the magnetic north pole, has been realized as successfully as could be hoped.

Our earth, as is well known, may be regarded as a rotating magnet, the poles of which (viz., the magnetic north and south poles) do not coincide with the geographical poles. In fact, the magnetic North Pole is situated about 30 degrees south of the geographical North Pole, toward Canada, somewhere in the neighborhood of the meridian 100 degrees west of Greenwich. The magnetic South Pole presumably lies at the antipodal point, at a similar distance from the geographical South Pole, in some unexplored Antarctic region. No expedition has thus far been able to advance to the vicinity of the magnetic South Pole. For this reason, as well as for the reason that it is nearer to ourselves, the magnetic North Pole has been more accessible.

Whether the magnetic North Pole constitutes a single point or several points, or even an extensive region, has not yet been ascertained. Amundsen's excellent observations, after having once been worked out, will however afford the most valuable material for solving this problem.

In the neighborhood of the magnetic North Pole the magnetic force, as is well known, is directed toward the interior of the earth, at right angles to the surface. The inclination is just 90 degrees, that is, a magnetic needle, suspended by a thread so as to be free to move in all directions, will adjust itself vertically with the northern end pointing downward, or else at an angle of 90 degrees to the horizontal plane.

For this reason, an ordinary compass proves quite inefficient at the magnetic North Pole or its neighborhood, the downward-working magnetic force being unable to direct the compass needle in any given horizontal direction. For the same reason, compasses will gradually become "lazier" as they approach these parts of the earth's surface. Magnetic studies carried out in the course of time under different latitudes have shown the magnetic forces and the deviation of the compass needle to be subject to highly remarkable and quite enigmatic variations, which are either of short duration (e. g., daily variations, and what are called magnetic storms) or of long duration, extending over many years. From these observations the magnetic poles themselves have been found to move in the course of time. To explain this fact, many theories have been advanced, which, however, are far from affording a solution of the problem, as with all our endeavors to arrive at a better understanding of these phenomena, we have not had trustworthy systematic observations at the neighborhood of the magnetic pole itself. This gap has now been filled by Amundsen's work, which was crowned by exceptional success, and which may be said to constitute the most valuable scientific material ever secured by any North Pole expedition, having been derived from the most interesting part of the Arctic regions, the neighborhood of the magnetic pole itself.

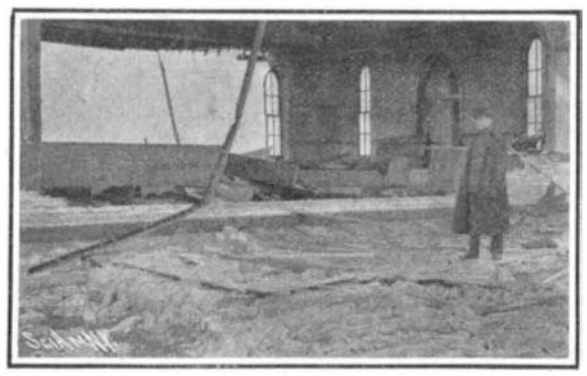
While the theory of terrestrial magnetism will thus be indebted to the voyage of the Norwegian explorer for a most valuable addition to its scope, other scientific branches as well are likely to benefit by it, because of the intimate connection existing between terrestrial magnetism and the electrical phenomena of the atmosphere, as well as the physical and other conditions of our earth.

A CHURCH BLOWN UP BY NATURAL GAS.

The town of Bunyan is located in the petroleum-producing district of western Ontario, and a number of the buildings are heated and lighted by natural gas, which is piped from wells in the vicinity. One of these buildings is the Baptist church at Bunyan. The edifice was constructed with heavy brick walls surmounted with a roof of shingles, while from the front section extends a brick tower with a shingle top. The church was heated by a large gas stove. The pipe conveying the gas became strained from the pressure, and the odor of the escaping gas caused a search to be made for the leak along the pipe which was laid under the flooring. To examine the pipe, one of the searchers lit a match, with the result that an explosion took place so violent that the side walls were almost entirely blown out, as shown in the illustration. Although as already stated they were composed of brick, all but a small portion of the rear and front walls were completely demolished, the material being scattered over the ground a distance of nearly fifty feet from the building.

Strange to say, the roof was but little damaged, the main injury being caused by settling in the center, where the supporting wall had been carried away. The front section and tower were uninjured, but a chimney in the rear was partly demolished from the shock.

The accident presents an interesting illustration of the direction of the explosive force, which appeared to



The Ruin Within the Church.

The Walls Blown Out.

A CHURCH BLOWN UP BY NATURAL GAS.

be almost entirely lateral, not even a hole being blown in the roof.

After-Burning in the Gas Engine.

According to the Engineering Times, Prof. Hopkinson, of Cambridge University, England, has used platinum resistance thermometers to investigate the explosions of homogeneous mixtures of coal gas and air at atmospheric pressure and temperature. The mixture was placed in a cylindrical vessel and fired by an electric spark at the center. The platinum wire used for the thermometer was exactly 1-1000 inch in diameter. When the flame approached the wire there was a sharp rise in its electrical resistance, and this could be easily measured, for the wire was placed in series with a battery of constant potential. When a thermometer was placed near the spark it was found that on ignition of the mixture there was a sudden rise of temperature to 1,200 deg. C. It was found that if the gas was fired in a closed vessel, whose volume did not alter, the differences of temperature in various parts of the vessel at maximum pressure after an explosion of this kind varied as much as 500 deg. C. With weak mixtures of gas and air it was found that the spread of the flame was much slower. With one volume of gas mixed with twelve volumes of air it was found that 2½ seconds elapsed before all the gas was burnt. With a mixture of one volume of gas and nine volumes of air the flame spread rapidly from the spark, and all of the gas was completely burnt within 1-40 second. The results are used to explain the phenomena of "after-burning" in the gas engine; and it is argued that the observed specific heat of the products of combustion, together with the loss of heat during the passage of the flame through the compression space, accounts for all of the peculiarities of the gas engine diagram.

Science Notes.

A realistic idea of the trade that is prosecuted in the imitation of old masters by unscrupulous dealers, especially for would-be collectors, is afforded by the recent discovery that has been made in the Art Gallery of Bath, England. Upon his death Sir William Holbourne bequeathed his extensive art collection to the civic authorities, and a building was especially erected to house the bequest. For some years this collection has been considered one of the most comprehensive and valuable extant. Recently, however, the pictures were minutely examined by an eminent expert, as doubts concerning their genuine character had been circulated, despite the fact that other experts had carefully investigated the collection and pronounced the pictures to be genuine. As a result of this last examination, however, no less than two hundred have been proved to be spurious, and worthless except as remarkably clever forgeries. The result of this discovery has aroused skepticism as to the *bona fide* nature of many of the art treasures possessed by other art museums and private collectors, not only in England but in other parts of the world as well. The majority of these imitations are the product of Continental artists, and are so cleverly and skillfully executed as to be almost impossible of detection.

In determining the difference between the longitudes of two places, the comparison of their time, as is well known, plays an important part. While this comparison has so far been carried out by use of the telegraph, telephones have recently been advantageously employed in determining the longitude of Brest as compared with that of Paris. According to the Elektrotechnische Zeitschrift, two chronometers striking half-seconds were used, of which one indicated mean time and the other astronomical time, thus allowing the coincidence process to be used. On the glass plate of each of the two chronometers was arranged a Hughes microphone inserted together with a battery in the primary circuit of a transmission coil, while the secondary winding was connected to the long-distance telephone circuit. The operators installed at Brest and Paris respectively could thus watch the stroke of the two chronometers while being in a position to communicate by telephone. A variable resistance inserted in the primary circuit of one of the two stations enabled the two chronometers to be synchronized, and the operator perceived the two strokes with the same ear and with equal intensity, thus seizing the coincidences with far greater accuracy than in the event of the stroke of the near and distant chronometers being detected with different ears. It was possible to reach results within 1/100 of a second of perfect accuracy.

A survey of the field of technical education shows, first, a group of high-grade engineering schools preparing young men for the leading positions in professional, industrial, and educational callings. These schools are increasing their laboratory facilities, year by year, and are steadily improving their instruction in mathematics, physics, and chemistry, as a basis for good engineering practice. The development in this field will be the extension of the work beyond the requirement for the bachelor's degree or the engineering degree. Just as medical schools add a year or more of post-graduate study, so engineering schools in the near future will extend their work into the realm of post-graduate work. The need of engineering education beyond the stage reached to-day in the ordinary college was apparent to such a far-sighted educator as the late President William R. Harper, of the University of Chicago. No engineering college has yet been organized in the university, but the plans contemplate a school that shall tower above all other schools of its kind as the university itself towers above the small college. A further survey of the field discloses a number of "cut, fit, and try-on" schools. These do not devote their energies to any one subject or stratum of education. They may teach art, high school studies in general, engineering, photography, stenography, cooking, dress making, library economy, or any other subject for which there is sufficient demand to form a class. These schools form an essential link between the older and the newer phases of education; they show the tendency of the age; in them the experimental educational work is done and later special schools are founded to carry on the work begun here in a small and tentative manner. As evidence of this, witness the course in library economy established by Armour Institute of Technology in 1893 and after a few years of successful life adopted by the University of Illinois; also the numerous schools of domestic economy following on the heels of the successful courses given at Armour.

The new Cincinnati waterworks are now ready to furnish about 12,000,000 gallons daily to the high service system of the city. This supply is not filtered, as it will be some time before purification works are built,

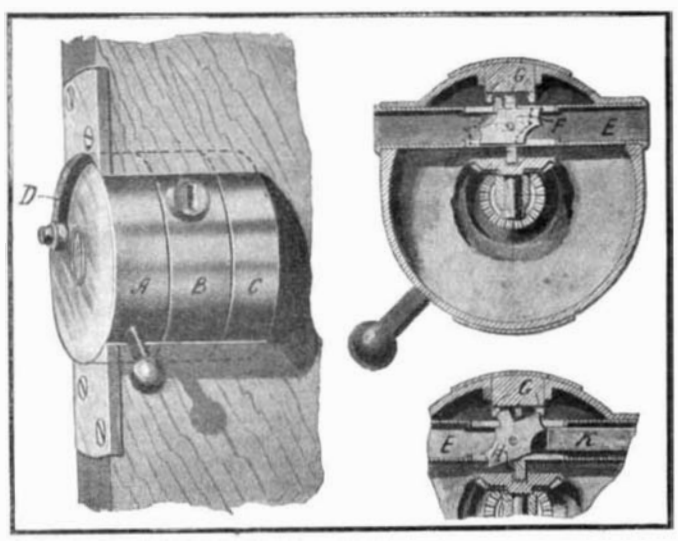
A New Flexible Steam Packing.

The modern practice of using steam at high pressures and temperatures has brought with it certain problems which did not confront the engineer of ten years ago with his low-pressure plant. The chief of these problems is undoubtedly the question of suitable packings, a question which grows rapidly more serious as steam pressures are increased. Practically the only high-pressure packings hitherto available have been either metallic, hence rigid and unyielding, requiring constant regrinding, or of rubber, which is not absolutely impervious to steam, has not the necessary wearing qualities, and cannot withstand high temperatures. Recently, a new type of packing has been invented by Mr. Frederick M. Ekert, which seems to overcome the defects of previous packings. The material is very tough and tenacious, and it is sufficiently flexible or plastic to conform itself to all irregularities, thus absolutely preventing leakage. It is composed principally of rubber and asbestos fibers with which certain pore-filling substances are mixed. The packing is absolutely impervious to water or steam, and is a non-conductor of heat. Furthermore, it is self-lubricating, owing to the presence of graphite in its composition. It is made into valve disks, which will withstand any pressure up to 450 pounds continuous service, and also in sheets for use on pumps, cylinders, steam chest covers, manhole covers, and the like. In addition to these, a nickel-protected disk is made for superheated steam, which is adapted to withstand temperatures up to 900 deg. Fahrenheit.

A similar material, in which cotton fibers are used in place of asbestos, Mr. Ekert provides for the manufacture of puncture-proof automobile tires, mattings, and the like.

A NOVEL DOOR LOCK.

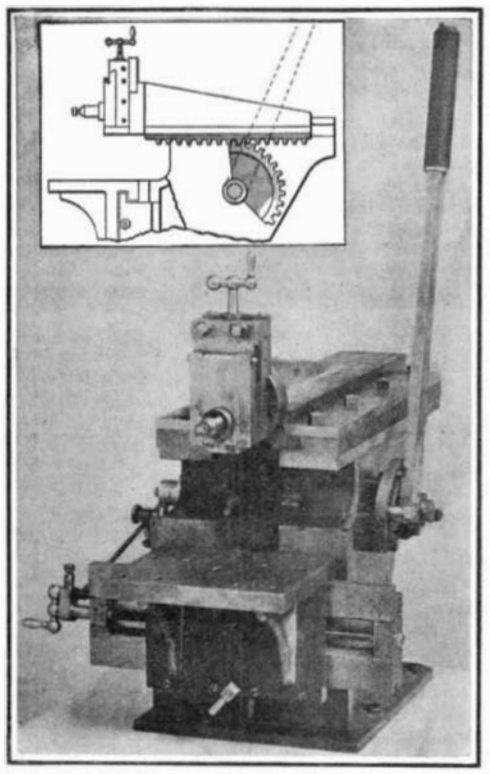
A door lock of decidedly unique form has recently been invented by Mr. Peter Ebbeson, of St. Paul, Neb. While the construction of this lock is not complicated, yet it has been ingeniously designed to prevent operation with a false key. Furthermore, it comprises a latch of such form as to prevent shaking or rattling of the door. As shown in the accompanying engraving, the lock consists of three disk-like sections, *A*, *B*, and *C*, the disk *B* being stationary and the others revoluble. The disks are mounted in a socket in the door and project from opposite sides thereof. The latch is operated by a pair of knobs at opposite sides of the door, which are respectively secured to the disks *A* and *C*. In the face of the disk *A* is an eccentric slot *D*, adapted to receive a stud projecting from the door frame. By operating the knob of disk *A* the latter may be turned to engage the stud in the eccentric slot, thus locking the door. The disk *C* is connected with the disk *A* by a series of bevel gears, so that by operating the knob of disk *C*, it is possible to rotate the disk *A* to latch or unlatch the door. In order to lock the door, a novel mechanism has been provided in the central disk *B*. As shown in the cross-sectional view, a barrel *E* is mounted in this disk. This barrel is provided with a bolt *H*, which is adapted to engage a slot in one of the bevel gears, and thus prevent rotation of the other two disks. In the barrel *E* is a tumbler *F*, which is carried on a short shaft mounted to slide in slots in the barrel. This tumbler is provided with a projection at its upper end adapted normally to register with the central one of three flanges *G*, projecting from a block above. Now, in order to unlock the latch, a key is inserted in the barrel *E*, and this presses the tumbler *F* to the position shown in dotted lines, when the projection thereon clears the central projection *G*, and the barrel may then be rotated to move the bolt *H* clear of the bevel gears. The tumbler is held in normal position by a pair of springs which bear against its shaft. It will be observed that the ends of the tumbler are of odd form, which the key must fit to prevent the tumbler from tilting on its axis when being pushed clear of the projection *A*. If a false key is introduced, as shown at *K* in one of the section views, the tumbler will be tilted up into engagement with the outer projections *G*.



A NOVEL DOOR LOCK.

HAND-OPERATED SHAPER.

The advantages of the shaper for finishing small work are well known in all machine shops. To provide these same advantages for small shops which cannot afford power-driven machines or even for large shops in which a shaper is only occasionally used, Mr. S. N. Malterner, of Canton, New York, has invented the hand-operated machine illustrated herewith. The machine consists of the usual frame provided with guide shears at the top to receive the carriage which is formed with the usual head, carrying an apron tool post of common form. Below the tool post is the table on which the work is clamped. The carriage is formed on its under side with a rack which is engaged by a gear segment rigidly attached to a transverse shaft mounted in the frame. At one extremity this shaft carries a hand lever whereby it may be rocked back and forth and thereby cause the carriage to reciprocate in the usual manner. On the frame of the machine is a curved bracket formed with a slot in which a pair of adjustable bolts are secured. These bolts project in the path of the hand lever and serve as stops to limit the stroke of the tool. If it should happen that the position of the work upon the table is such that the lever does not reciprocate at a convenient point, which is generally the uppermost or approximately vertical position, it is only necessary to remove either of the stop bolts so as to enable the gear segment to be moved entirely out of mesh with the rack. Then the carriage may be adjusted to the desired position and after the gear segment has again been moved into mesh with the rack, the stop bolt may be secured at the proper adjustment.



A HAND-OPERATED SHAPER.

Physical Constitution of the Heavenly Bodies.

Some of the noteworthy of the numerous conclusions arrived at by T. J. J. See in an article on the physical constitution of the heavenly bodies, published in Astronom. Nachr., are the following:

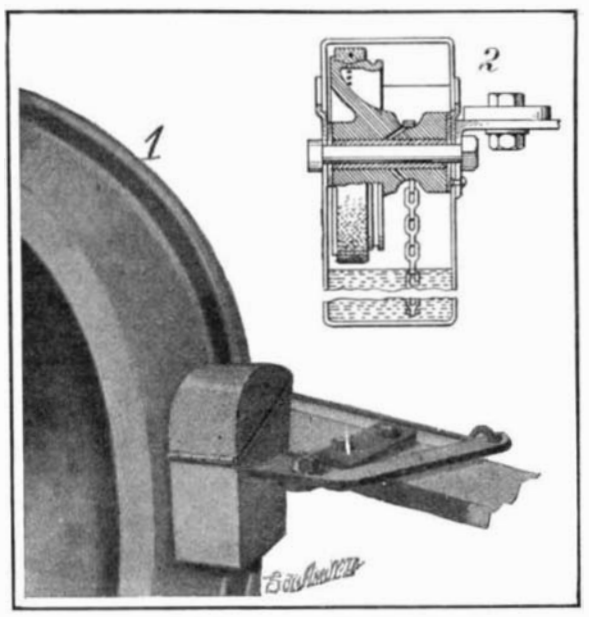
The mean specific heat of the sun must lie between 0.5 and 6.8; it could reach the latter value if all the elements present were as simple as hydrogen. The heat and light from the sun are held to be obtained from the interior solely by radiation, and not by convection currents; the gases in the interior are very transparent, but on the photosphere some elements, such as carbon, can give rise to clouds which are non-transparent to light. Based chiefly upon the density at the solar surface, the heat supply of the sun is held to be sufficient to last 10 million years at the present rate; or taking contraction into consideration, 30 million years. As regards the earth before it had a solid crust, the temperature probably was never sufficiently high for it to be self-luminous. On the major planets the surface temperatures are considered to lie between 300 deg. and 800 deg. abs., so that the surface can neither be thought of as rigid nor self-luminous; these planets are not cooling down at present, but are even becoming hotter. Prof. See considers the monatomic theory, as applied to the sun's condition, to be the only one which gives results which are in accord with known facts.

The Standardized Staircase.

A system of standards is the order of modern life, and in many directions standards are convenient if not, in some cases, indispensable. We have, for instance, standard gages for railways and tramways, standard threads for various screws, standard sizes for boots, shoes, and gloves, standard qualities for articles of food, standard weights and measures, coinage, and so on. But there are still some directions in which the need of a standard is not only indicated but is urgent. The desirability, for example, of standardizing the steps of all staircases is seen in the fact that so often a fall on the staircase is due to the irregularity in the height of the steps. A common cause of accident on the staircase is the kicking of the edge of a stair when ascending. In descending, also, an irregularity in one step may easily upset the equilibrium of a person. To the aged and infirm the descent of an irregularly stepped staircase is a source of terror. Yet how many staircases are constructed absolutely alike as regards the height of the steps? We should say very few; and not only is there little uniformity existing between different staircases but the steps themselves in the same staircase are often irregular. Staircases and the steps in them should be standardized; there should be uniformity of height and breadth, and in regard to the latter there should be room enough on the step to accommodate the whole foot from toe to heel, so that there is no undue call on the energies when ascending, as by going on tiptoe, so to speak, or any feeling of insecurity when descending by reason of there only being room for the heel. Serious falls on staircases are by no means rare and a common cause of such accidents is the fact that staircases are not standardized. Even in dark places the staircase, if standardized, would be more safely negotiated than a well-illuminated but irregular stairway. The perils of an ordinary ladder would be enormously increased if the rungs were placed at irregular intervals.—Lancet.

WHEEL-FLANGE OILER.

The curves of street railways are usually so sharp that it is necessary to keep them well lubricated in order to prevent undue wear and screeching of the wheels as they grind against the tracks. Aside from the expense of keeping the curves lubricated, the practice of greasing them is extremely objectionable to pedestrians who are liable to soil and ruin their clothing by contact with the oily substance. The accompanying engraving shows a method of obviating this objection which consists in oiling the flanges of the wheels instead of the tracks. The oiling device is arranged to be brought into operation at the will of the motorman so that the lubricant is applied only when needed and where needed, because it is on the flanges that most of the friction occurs. This oiler is not limited to street railways, but is also applicable to the curves of steam railways where much power has been uselessly spent because heretofore it has not been the practice to oil these curves. The device comprises an oil chamber in which a wheel is mounted to rotate. The wheel is provided with a wick which is seated like a tire on the outer rim. Oil holes lead through the rim of the wheel to the wick. The wheel does not touch the oil in the chamber, but a loose chain which hangs in the oil is turned by the wheel and serves to feed the lubricant to the rim whence it passes through the holes to the wick. In use the device is mounted on a bracket in such position that it can be swung against the wheel flange by the operation of a lever.



DEVICE FOR OILING CAR-WHEEL FLANGES.

A portion of the oil chamber is cut away permitting contact of the wick with the flange, and thus causing the wheel in the oil chamber to rotate and feed the oil to the wick. The inventors of this improved oiler are Messrs. F. S. Baird and E. W. Carroll, of Congress, Arizona.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

VIBRATOR.—E. B. JACOBSON, Pittsfield, Mass. The vibrator is for use in induction-coils, Ruhmkorff coils, spark-coils, gas-engine ignition-coils, and like coils, and devices employed in high-tension electrical work, the vibrator being arranged to prevent sticking of the contact-points, to allow minute adjustment and secure locking of the parts after the adjustment is made, to insure quick response and to avoid waste of platinum and of electric current.

Of Interest to Farmers.

MOWING-MACHINE.—G. ROBINSON and G. CUTSFORTH, Riddles, Ore. In this instance the invention is an improvement in mowing-machines, and relates particularly to a track-clearing attachment whereby heavy vines and grasses may be cut at the outer end of the sickle-bar to avoid clogging of the bar and to aid the divider in separating the cut from the uncut grass.

Of General Interest.

SURGEON'S NEEDLE-HOLDER. — H. H. CLARK, Santa Cruz, Cal. The invention has reference to surgical instruments; and the object of the inventor is the production of a device of simple construction which will facilitate the holding and manipulation of a surgeon's needle. It has substantially the form of a pair of forceps, presenting handles, pivotally connected and having extensions adapted to clamp together, so as to form jaws, adapted to receive the needle.

MUSICAL WIND INSTRUMENT.—J. S. BARLOW, Johnson City, Tenn. The object of the inventor is to provide an instrument having a range of approximately two octaves and permitting a beginner to readily learn to play the instrument and allowing the production of powerful yet soft tones without requiring undue physical exertion on the part of the performer.

RULE.—J. BENDER, Marion, Kan. In this case the invention pertains to rules, and it is intended especially to be used by artisans and others for measuring the distance between points where it is not feasible for the ends of the rule to project beyond the points between which the measurement is taken.

LIQUID-MEASURING DEVICE.—A. YOUDELMAN, New York, N. Y. The object of this invention is to provide a liquid-measuring device under the control of an operator and arranged for delivering liquids in accurately-measured quantities and without any waste or danger of wrong manipulation of the device by the operator.

AUTOMATIC LATCH FOR SLIDING DOORS.—J. R. HUGHES, Chama, Ter. N. M. The invention has reference more especially to sliding doors (gates and the like) for cars, barns, warehouses, etc. One of the principal objects is to provide a device automatic in operation. A further object is to provide an automatically-engaging latch for car-doors and the like which is entirely protected from accumulations about the same as dust and dirt or ice and snow and which is easy working and comparatively noiseless.

PUMP-ROD COUPLING.—LE ROY PITCHER, Oilcenter, Cal. The invention relates to oil-well and other pumps; and its object is to provide a pump-rod coupling arranged to permit the convenient disconnection of pump-rods from the pump to allow the withdrawal of the pump-rods without danger of disconnecting the pump-rod sections in case the pump-plunger is sanded up.

BOTTLE.—S. G. WISE, Gas City, Ind. The purpose of this invention is the provision of a simple, durable, and economic construction of bottle whereby the bottle will be difficult to refill and if refilled the bottle cannot for a second time be presented as an original package without evidence that it has been tampered with.

APPARATUS FOR THE AUTOMATIC DELIVERY, ON SALE OR HIRE, OF BOOKS, ETC.—H. POTTIN, 100 Rue St. Lazare, Paris, France. The apparatus comprises a number of compartments, each containing a book or other article, the compartments being normally closed by respective shutters. Each of the latter corresponds to an unlocking device which can be operated by hand through the medium of a shaft or other common member and of a coin previously inserted in the unlocking device. A summing up device registers the number of coins inserted in the apparatus.

STREET-CROSSING INDICATOR.—G. E. PALMER and M. H. COHEN, Butte, Mont. One purpose of the invention is to provide an indicator which will carry two sign-boards at angles to each other and which can be quickly and conveniently set up and applied to a corner of a building, no matter whether the corner is a right-angle one or one in which the corner is flattened or rounded off at the meeting of its members.

POSTAL CARD.—EDITH M. MINER, Rathdrum, Idaho. In this patent the invention is an improvement in postal cards designed more especially as a souvenir and advertising card. The object of the invention is the provision of a device of this character affording considerable space for writing, print, or pictures, and for obscuring the same from view while in transit.

SAFETY ENVELOP AND BOX.—W. H. DOBSON, Harrison, and W. GALLAGHER, Elizabeth, N. J. The invention is embodied in the improved construction whereby an envelop or box may be closed by engagement of the flaps or opposite folding portions thereof, the engagement being such that the envelop or box cannot be opened without breaking it or rupturing a portion of the same.

SHOE-POLISHING STAND.—W. O. BECK, Chicago, Ill. In the present patent the invention has reference to improvements in foot rests or stands for convenience in polishing shoes, the object being to provide a device of this character so constructed as to be readily attached to a closet-bowl so that the dirt removed from the shoes will fall into the bowl.

GRIP.—J. R. CRABILL, Carthage, Ill. Generally stated, the invention consists in constructing a cabinet or any carrying-case with a cell of such size as to amply admit a man's arm to substantially the depth of the elbow, leading into it preferably at one end, and a handle to be grasped by the hand at the bottom of the cell near the center of gravity of the loaded case, thus affording a bracing means entirely surrounding the forearm.

Hardware.

REAMER.—W. TURNEY, Hyde Park, Mass. This invention has reference to improvements in tools for reaming metal, the object being to provide an expanding-reamer having a plurality of cutting-corners and so constructed that there will be no vibration, thus resulting in an even and smoothly-finished cut.

JEWEL REMOVER AND SEATER.—H. STRAW, Anacortes, Wash. The invention relates to watch-maker's tools; and its object is to provide a jewel remover and seater arranged to permit convenient removal or insertion of close-fitting jewels to bring the same into proper position without danger of marring or otherwise injuring the jewels or losing the same.

Machines and Mechanical Devices.

LIQUID-WEIGHING APPARATUS.—W. W. GEORGE, Winchester, Ky. The invention pertains to improvements in apparatus for weighing liquid as it discharges from a keg or other receptacle, the object being to provide a device for this purpose of simple construction that will accurately discharge the quantity of liquid desired and then automatically close.

GRINDING-MILL.—P. P. BELT, Fredonia, and E. UTZ, Newton, Kan. The intention in this case is to produce a mill which can be adjusted so as to grind readily to different degrees of fineness, and which may be readily repaired if the grinding-teeth become broken. The invention relates to grinding-mills, such as used for grinding corn, coffee, spices, wheat, meat, etc.

BUTTON-CLEANING MACHINE. — C. G. HELLER, Newark, N. J. One purpose of the invention is to provide a machine for cleaning and polishing buttons, especially collar-buttons, made of composition material and to so construct the machine that the fins which are formed on the buttons in the mold and which remain thereon when the buttons are removed from the mold will be completely removed from the rims and posts or shanks of the buttons and such surfaces be rendered smooth.

BELT-GUIDE.—M. E. DE GREE and D. C. MCALISTER, Flaxton, N. D. The principal objects of the invention are to so construct a belt-guide as to prevent all wabbling and vibration on the part of the belt and guide itself; also to simplify the construction and provide a convenient device which will take up little room and be capable of construction at a small cost and readily repaired when injured in any manner.

COIN-FREED APPARATUS.—W. ABEL, 59 and 60 Friedrichstrasse, Berlin, Germany. This invention has reference to automatic apparatus for vending stamps, labels, or the like which are inserted in the machine in strips or hands. It belongs to those systems wherein the power requisite for the cutting off of an individual stamp or the like and for the forward movement of the band is obtained from one single source of power.

PUMP.—H. NAGEL and J. E. NAGEL, Brunswick, Neb. This improvement relates to pumps of that kind in which a vacuum-chamber below the piston and a compressed-air chamber above the piston serve to prolong both the inflow of water into the suction-tube of the pump and the outflow from the pump-barrel. It consists in the construction and arrangement of the pump-casing with its pressure and vacuum chamber and the piston and valves.

Prime Movers and Their Accessories.

ENGINE-STARTER.—F. L. ORR, Thurman, Iowa. Mr. Orr's invention refers to starters for engines, more particularly of the internal-combustion type, and has for its object novel and improved means adapted for use with any type of similar engine, whereby with power stored into a suitable receiver the engine may be effectively started from any point of rest of its crank-shaft.

ROTARY ENGINE.—S. S. SADORUS, Sarilda, Idaho. The patentee arranges within a suitable casing a rotary piston having side flanges at its periphery to form an annular steam chamber. The casing has fixed abutments at diametrically opposite points adjacent to the steam inlets, and the piston carries pivoted blades which when they pass the abutments, are forced upward by springs in position to be acted upon by the steam for turning the piston.

GASOLENE-ENGINE.—J. WALSH and E. SWANSON, Galesburg, Ill. In this invention the crank-case is used for compressing air for scavenging or clearing the cylinder of exploded gases by a prolonged blast through the agency of an automatic pressure-valve, the compression of the explosive charge being effected in an intermediate annular chamber between the cylinder and crank-case, in which an annular piston works, which piston is formed on the main piston and moves with it to alternately draw in and compress the charge for explosion.

BOILER-CLEANER.—C. H. PRESCOTT, East Liverpool, Ohio. One object of the invention is to provide a cleaner having a section slidably mounted in the rear wall of the boiler and having a nozzle which can be rotated to permit the steam to be forced through all the tubes of the boiler. Another is to provide a nozzle which may be withdrawn into a recess in the back wall of the boiler to protect the nozzle from direct contact with the heated gases of combustion.

ROTARY ENGINE.—C. MCQUOWN, Grove City, Ohio. The invention relates to an engine in which a stator incloses a piston, which is mounted on and eccentrically of the engine-shaft and arranged to be driven in the stator by pressure of steam, the movement and action of the steam being controlled by an abutment having a combined circular and oscillating movement within a housing, which itself is held to rock in an extension of the main stator. The engine may be constructed with any number of units, the piston-surfaces of which are set at 180 degrees apart, so as to secure regularity of motion.

Railways and Their Accessories.

RAILWAY-SWITCH.—G. W. LONG, Lindsay, Ind. Ter. The switch may be operated by a man on the car without stopping the car. It can be thrown from either position by a car coming in either direction, and the track mechanism, except the trips which are struck by the shoe on the car, can all be located, if desired, under the ties to prevent interference by horses and vehicles.

Pertaining to Recreation.

VELOCIPEDE.—Z. T. CARROLL, St. Louis, Mo. Mr. Carroll's invention is an improvement in velocipedes and particularly in combined rocking-horses and velocipedes. and the invention has for an object the provision of a novel construction whereby the figure of the horse may be caused to simulate a galloping action as the velocipede moves forward.

FISHING-REEL.—S. SYKES, Rhoades, Ariz. Ter. In the present patent, the invention is an improvement in fishing-reels and it has, among other objects, the provision of a reel that can be changed from a high to a low speed gearing controlled automatically by the pull of the fish.

PUZZLE.—JENNIE E. VAN ANTWERP, Dent, Minn. This puzzle consists of a round box having fixed therein partitions and a wedge-shaped apertured and grooved block, termed a "bridge," dividing the box into a plurality of compartments. In one of these are placed a plurality of spheres differing in size, the object being to so manipulate the box as to cause the marbles to pass from this compartment to the second and thence over the bridge to the third compartment.

Pertaining to Vehicles.

SUSPENSION MEMBER FOR SIX-WHEEL VEHICLES. — C. H. LINDECKER, Briançon, Villa Yvette, Hautes-Alpes, France. The invention relates to a system of suspension for six-wheel vehicles; and the object is to so construct the system that all the wheels will be always on the ground, however uneven the surface of the road may be, and that the load will always be portioned out among the axles in the same manner.

VEHICLE-WHEEL.—E. P. DAMON, Phillipsburg, N. J. In this instance the invention has reference to vehicle-wheels; and the object of the inventor is the production of a wheel which will have highly-resilient qualities operating to reduce the shock which passes to the body of the vehicle when moving over irregularities in the road-bed.

CHAFE-IRON.—C. T. MCCLELLAND, Olympia, Wash. Mr. McClelland has devised an improved construction of a rub-iron or chafe-iron for protecting wagon sides or bodies from wear or defacement of forward wheels in making sharp turns. It is composed of two parts, one being adapted to be secured to the wagon-body and to hold the other, which is the wear-piece proper, in such manner that it may be removed when worn out and a new one substituted with convenience and dispatch.

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

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(10281) J. B. asks: 1. What gas has the most ascending power to the square inch? How much ascending power has it to the square inch? A. Hydrogen is the lightest gas known, and has therefore the greatest lifting power in a balloon; 1,000 cubic feet will lift seventy pounds. 2. Can this gas stand being slightly compressed? A. Hydrogen can be compressed to any extent. 3. Can you give a receipt for partially or wholly petrifying wood and leather? A. If wood be soaked in copperas or sulphate of copper and dried, and the process be repeated till the wood is thoroughly saturated with the chemical, its structure when burned will remain in the peroxide of iron left. Petrified wood in nature is another thing. This is probably formed by the slow action of silica. As a particle of wood decays a particle of silica takes its place, and finally all the vegetable matter is replaced by mineral matter. This process has not been imitated artificially.

(10282) J. D. C. writes: Please send me a receipt for keeping cider sweet. Please tell me also if it will stay sweet in vinegar barrels. A. To preserve cider without fermentation, it is necessary that it be made from good fruit, rejecting all decayed apples, and keeping all apparatus in a clean and sweet condition during the manufacture of the cider. The barrels or casks into which it is put must also be clean and sweet. Vinegar barrels cannot be used, since they already contain the germs of fermentation. SCIENTIFIC AMERICAN SUPPLEMENT No. 313, price ten cents, contains instructions for making and preserving cider. In addition to the preservatives, given in that article, you may use salicylic acid, one half ounce to a cask of fifty gallons. It is important to exclude the air as much as possible from the cask all the time, and to avoid stirring up the preservative from the bottom of the cask where it settles.

(10283) M. P. C. asks: 1. Please give the formula of a solution for a carbon-zinc battery that is suitable for running a small motor. One in which the zincs may remain in when not in use. A. There is no cell using zinc and carbon in which the zinc ought to remain when not in action, excepting the sal-ammoniac cells, and these are not adapted for running motors. The best battery for the purpose is the plunging bichromate battery described in SUPPLEMENT No. 792, price ten cents by mail. 2. How many inches of zinc should there be to one of carbon? A. The best mode of arranging the zinc and carbon is to place two carbon plates with a zinc plate between them, all to be of the same size. Both surfaces of the zinc are then active. There is no rule to determine the number of inches of zinc to one of carbon. In the Leclanche cell a rod of zinc, ⅜ inch in diameter, is used for a large surface of carbon.

(10284) G. R. R. asks: 1. How to preserve eggs, so as to keep them good, a length of time. A. A good method of storing eggs is the following: Having selected perfectly fresh eggs, put them, a dozen or more at a time, into a small willow basket, and immerse this for five seconds in boiling water containing about 5 pounds of common brown sugar per gallon of water. Place the eggs immediately after on trays to dry. The scalding water causes the formation of a thin skin of hard albumen next the inner surface of the shell, the sugar effectually closing all the pores of the latter. The cool eggs are then packed, small end down, in an intimate mixture of one measure of good charcoal, finely powdered, and two measures of dry bran. Eggs thus stored have been found perfectly fresh and unaltered after six months. 2. Can you give a recipe for a cheap and modern stove polish? A. Stove Polish.—Mix 2 parts copperas, 1 part powdered bone black, and 1 part black lead with enough water to give proper consistency, like thick cream. Two applications are to be recommended.

(10285) L. C. R. asks: 1. What is the composition of the enamel used to insulate the wires in electric heating apparatus and rheostats and how can I prepare and apply it? A. Clean and brighten the iron before applying. The enamel consists of two coats—the body and the glaze. The body is made by fusing 100 pounds ground flint, 75 pounds borax

and grinding 40 pounds of this frit, with 5 pounds of potter's clay in water, until it is brought to the consistence of a pap. A coat of this being applied and dried, but not hard, the glaze powder is sifted over it. This consists of 100 pounds Cornish stone in fine powder, 117 pounds borax, 35 pounds soda ash, 35 pounds niter, 35 pounds sifted slaked lime, 13 pounds white sand, 50 pounds of pounded white glass. These are all fused together, the frit obtained is pulverized. Of this powder 45 pounds are mixed with 1 pound of soda ash in hot water, and the mixture dried in a stove is the glaze powder. After sifting this over the body coat the cast iron article is put into a stove, kept at a temperature of 212 deg. to dry it hard, after which it is set in a muffle kiln to fuse it into a glaze. The inside of pipes may be enameled (after being cleaned) by pouring the above body composition through them while the pipe is being turned around to insure an equal coating. After the body has become set the glaze pap is poured in in the same manner. The pipe is then fired in the kiln. 2. What kind of cells should I use when necessary to add an extra battery to a Queen Acme bridge and how should they be connected? A. We cannot tell. We advise you to consult the makers of the bridge.

(10286) J. H. asks: 1. Can you tell me if it is possible to get mica in solution, if so, how? A. Mica is not soluble. It may be ground to a powder and formed into a paste with shellac or some varnish. 2. Is there any form of silica soluble in water, or any other simple solvent? A. There are soluble silicas. Soluble glass, sodium silicate, or potassium silicate, is of this sort. These substances are often called water glass. 3. I once saw some small clay vessels made on the potter's wheel; after a vessel was finished, the exhibitor poured some transparent liquid upon it from a bottle, which glazed and hardened it at once. Can you give a formula for such a liquid? A. You will find a large number of formulas for glazes in the "Scientific American Cyclopædia of Receipts, Notes and Queries," price $5 by mail. We do not know to what glaze you refer in your inquiry.

(10287) T. V. C. asks: In an essay on the spectroscope an illustrative analogy was thus given: An observer near a railroad will notice that the whistle of a locomotive changes in pitch as the engine approaches or recedes. Is this true, and why? A. It certainly is true that the tone of a locomotive whistle rises very suddenly and sharply as the locomotive rushes up to one, while it is sounding the whistle. This is a matter of easy observation. The pitch falls again as the locomotive rushes away from one. The effect is due to the change in wave lengths of the sound. The velocity of the engine is added to that of the sound in approach and subtracted in recession. So the wave lengths are shorter as the engine approaches, and the pitch of the note rises. The principle is called Doppler's principle, and may be found in advanced textbooks of physics. Forty miles an hour will sharpen a note a half-tone.

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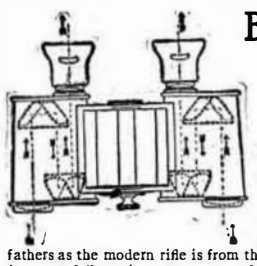

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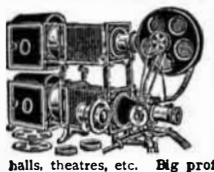

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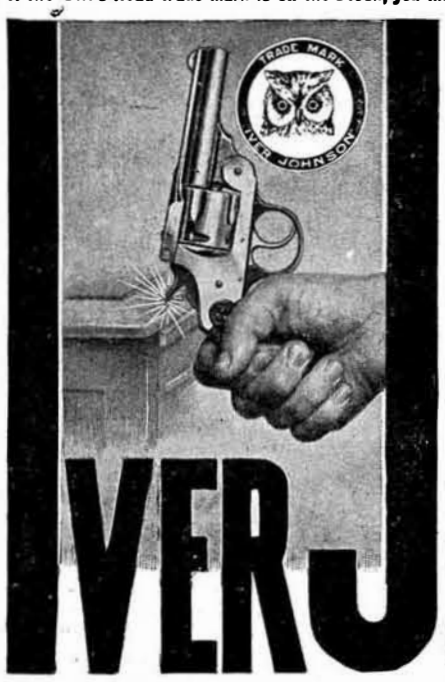

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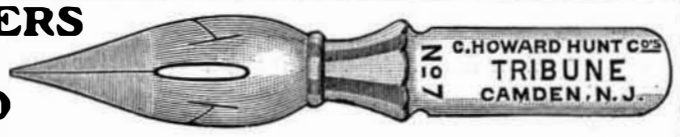

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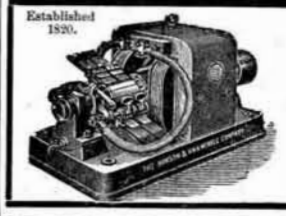

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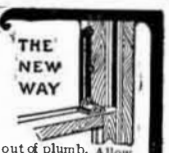

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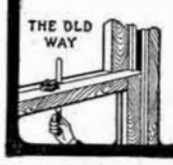

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