SCIENTIFIC AMERICAN

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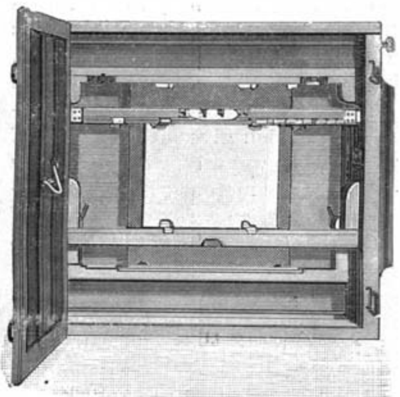

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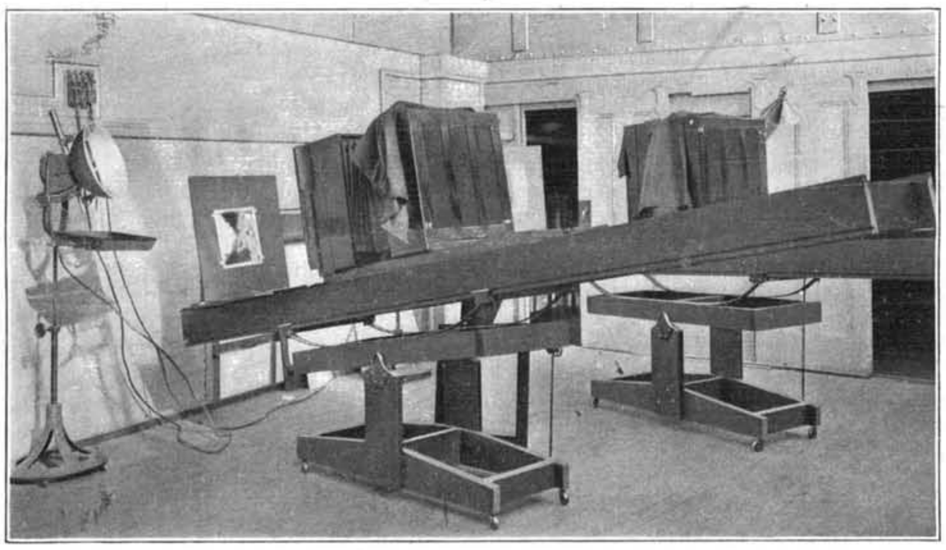

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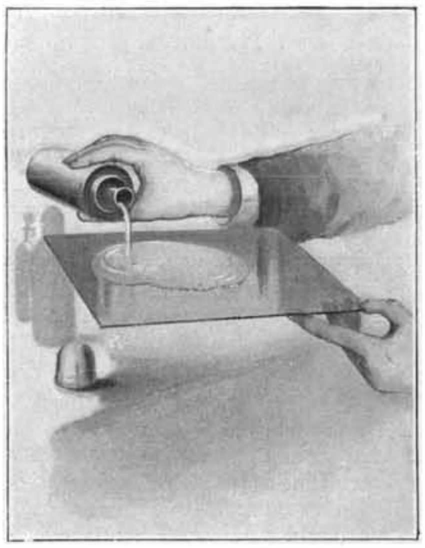

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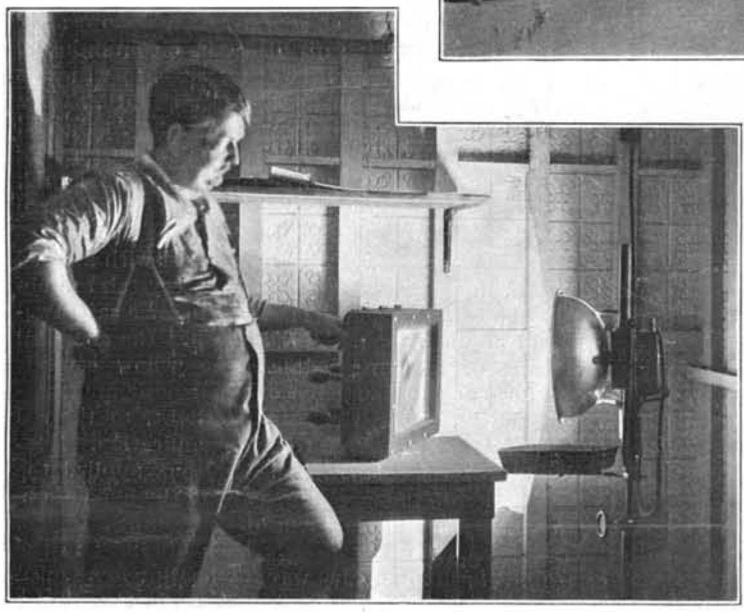

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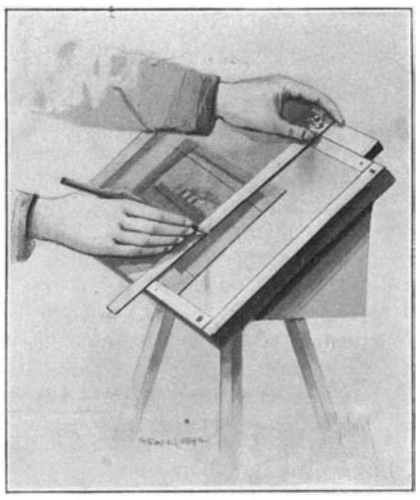

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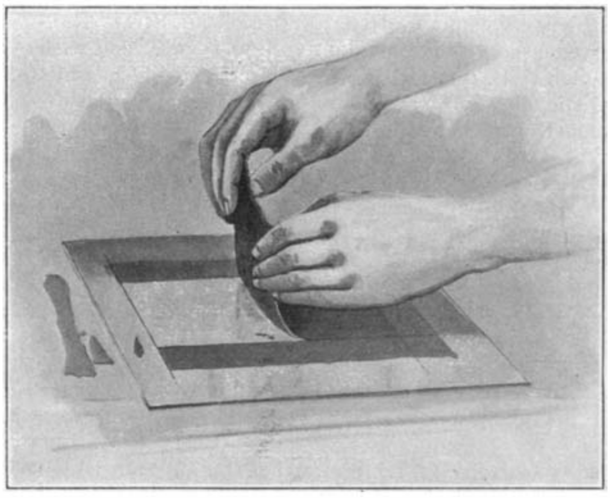

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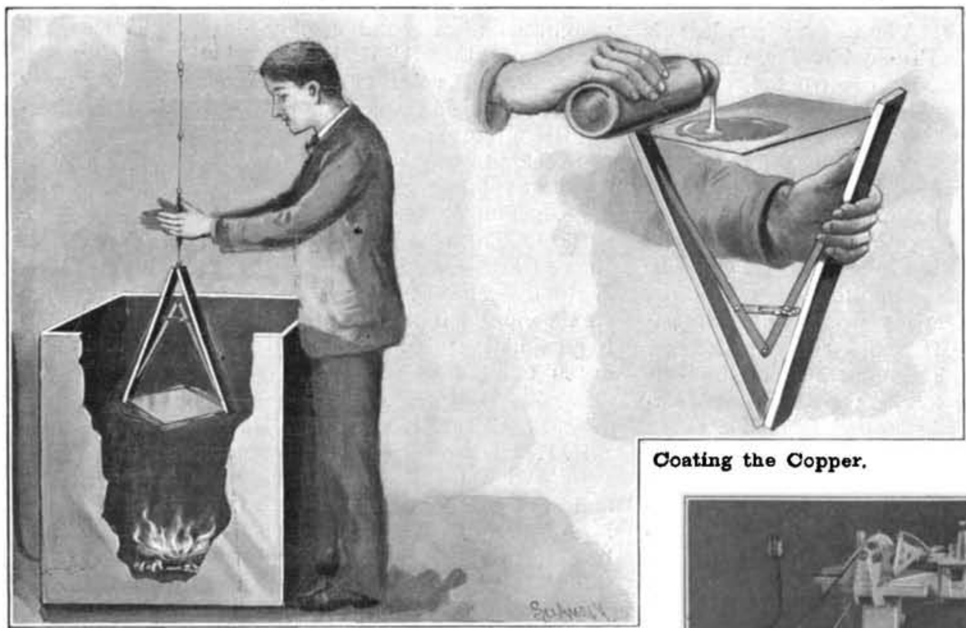
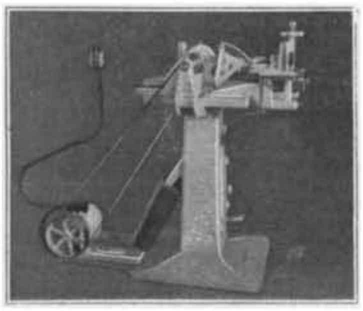


Coating the Copper.

Whirling the Sensitized Copper Plate.

Finishing the Plates.



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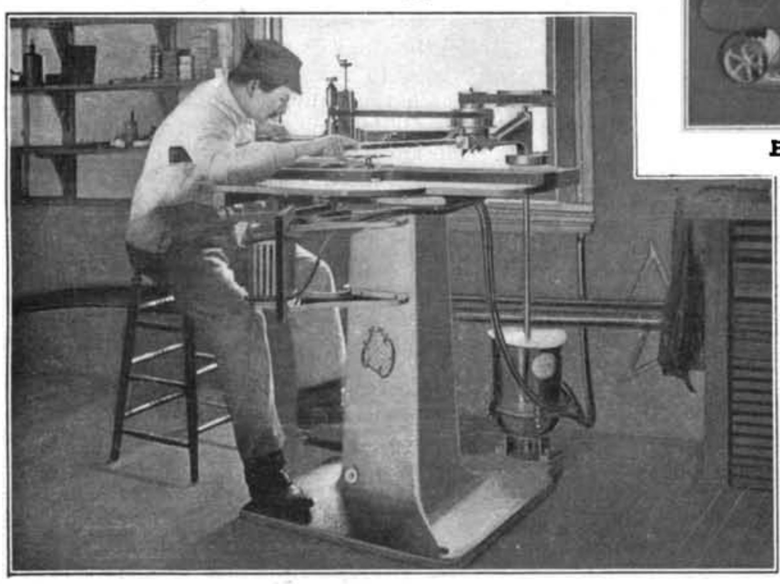

Routing the Plates.

Finishing and Proving Plates.

THE MAKING OF A HALF-TONE ENGRAVING.—[See page 153.]

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FROM CABLE TO TROLLEY.

Considerable interest is attached to the change of motive power which is now being carried out on the Broadway cable line in this city. It may be said without fear of contradiction that there is no stretch of street railway in the world which even approaches this line in the magnitude of its traffic. There are certain periods during the rush hours of the morning and evening when the cars are being run under ten seconds headway, and even under these conditions they are packed to their utmost capacity. With such a traffic to provide for, it required no little courage on the part of the management of the Metropolitan Street Railway Company to undertake to relay the old road with heavier rails, put in place the electric cable conduit and the man-holes and hand-holes for the insulators, and perform the various other operations incidental to the change, without any serious interference with the regular schedule of the line. The work has now been in full swing for several weeks, and considerable sections of the road have been completed without any further inconvenience to traffic than a lowering of the running speed in the more crowded sections of Broadway. The preliminary work was done two years ago, when the cable conduits were laid in place throughout the whole road, the present work being confined to the relaying of the steel and the necessary changes in the substructure of the line to provide for the electrical conductors.

The first step was the removal of the old rail, which weighed 85 pounds to the yard, and the insertion of the new 107-pound rails in its place. While this was being done a gang of men were engaged in drilling through the concrete and cutting open the sheet iron tubing of the cable conduit to make way for the manholes and hand-hole boxes. The insulator hand-holes occur at intervals of 16 feet; they are set upon a bed of concrete, a form is placed around them, and the concrete rammed into place. On every 200 feet there has been built beneath the track a brick cross conduit, in which is carried the electrical connections to the main cables. As soon as the hand-hole boxes were bolted to the track rails and to the slot rails and concreted, and the brick conduits built, the Belgian block paving was relaid and the street restored to its normal condition.

The superiority of the new and extremely heavy rails —heavier than the heaviest rails on the steam railroads—over the old rail, as shown in the improved riding of the cars, will be greatly appreciated by the public. The old rail was found to be in excellent condition except at the rail ends, where the weakness of the old splice bars, which were not over 20 inches in length and were unprovided with bottom flanges, allowed the joints to sag under the heavy traffic, until the heavy "pounding" of the cars had become a positive nuisance. The new rail is being spliced with what are probably the heaviest "fishplates" ever employed in steam or street railway traffic. The angle bars are 3 feet in length and 8 inches in depth. The bottom flange extends laterally to the edge of the rail base, where it is turned down vertically to a depth of 3 inches below the rail. The bottom edge, moreover, is heavily bulbed. This gives the needed girder depth, and places the metal where it will do its best work. The permanence of the joint is further assured by providing no less than eight 15/16-inch angle bolts; and the whole character of the construction is such that the "fishplate rail joint," if it ever had an opportunity to show its maximum efficiency, will surely have it now.

A similar change is being carried out on the Lexington Avenue cable line, and when this is completed all that will be necessary will be to insert the T-rail conductors through the man-holes, and bolt them to the insulators. It is proposed by the company to make the final change in power in one night, by stringing out a large force of men along the tracks, who will simultaneously lift the conductors into place, bolt them up and make the necessary electrical connection

AMERICAN AND BRITISH ENGINEERING COMPETITION.

Among the industries which, because of the impetus and specialization which they have received in this country, may be classed as distinctively American, is that of structural steel work, in the designing and manufacture of which we have made enormous strides during the past few years, both as regards the variety of shapes placed upon the market, and the cheapness and high quality of the product. The cause of our supremacy is to be found in two particular branches of engineering work, in which also we have achieved distinction, namely, bridge and roof work and the erection of tall buildings of composite construction. The bond between the bridge builder and the structural steel mills has been one of mutual helpfulness. The demand for bridge steel, and in later years for structural material for steel buildings, has stimulated and encouraged the manufacture of the special shapes required; while the great steel works of the country, in their turn, by specializing this particular class of work, have been able to afford the builders the choice of a wonderful variety of shapes at a cost which is lower than that in any country in the world.

The eighth article of the extremely interesting series on American Engineering Competition, originally published in The London Times and now running in the SCIENTIFIC AMERICAN SUPPLEMENT, is devoted to this subject of structural steel. The observations of The Times correspondent are based upon his investigation of three of the largest structural steel concerns in the country, namely, the Keystone Bridge Works, the Pencoyd Works, and the Berlin Iron Bridge Works, and some of the most striking features of the plant and organization of these world-famed establishments are dwelt upon by the writer, of whom it will be admitted, by the way, that in the whole of his pilgrimage among the industries of this country he has shown a ready appreciation of the distinctive features of American methods and practice. Thus: "The energy with which Americans 'make' business is remarkable. Steel-makers are always trying to force people to use steel; they manufacture markets out of nothing. An architect says he cannot put steel in place of wood—the steel manufacturer employs an expert to show that it can be done. He does not sit down and abuse the architect for his want of enterprise, but sets to work to force his hand." As an instance of the creation of markets, the pressed steel car industry is quoted. Three years ago the pressed steel car was unknown. At the present time there are over fifteen thousand in use. This business, which started in 1889 in a small way, has grown in one decade until the various establishments of the company can produce 130 cars per day, their output being limited only by the difficulty in obtaining steel.

As an Englishman, The Times correspondent is naturally interested in the Pencoyd Works, where the memorable Atbara Bridge was constructed. By the head of the firm he was assured that there was nothing unusual in the so-called rapid filling of the order, and that it was not true, as was stated in England, that a bridge already in course of construction had been diverted from its original destination and shipped to the Soudan. The writer was attracted to the Berlin Iron Bridge Works by seeing in Berlin proper, that is, in the German capital, a large iron foundry which had been made at the Connecticut works and shipped across the Atlantic. "The Germans themselves know something about steel-making and how to make it cheaply, "and I was, therefore," says The Times correspondent, "a good deal interested in seeing works which could manufacture such a heavy thing as an iron foundry, pay railway freight on it from the middle of Connecticut to a sea port, pay freight across the Atlantic, and then again further freight from Hamburg to Berlin, and yet compete successfully with the German makers." Asked how it was possible to perform such a feat in a State which is not a steel-making State, the manager of the works attributed their success to making a close study of the needs of the customer. Thus, one particular department is under the control of an expert foundryman, who is engaged solely in designing iron foundry buildings, the result being that if the company are told how many castings of a given type are to be produced, they will supply a foundry specially laid out for the purpose.

This individual case is a typical one of the plan of employing experts for designing special plants, special factories, special tools; and it is undoubtedly one of the secrets of our successful competition. It gives us a great advantage over Great Britain, where the expert specialist is comparatively unknown, at least in many lines of engineering work. In a certain well-known street in Westminster are to be found engineers by the dozen who will design a whole railway system: roadbed, bridges, ties, track, locomotives, cars, signals, and station buildings. Such a system undoubtedly produces versatile men of wide experience, but it stands to reason that in some particular lines they are quite unable to compete with a specialist whose whole training and life-work has been limited to one special branch of engineering. What is true of the engineers is true in a less degree of the contractors and, as we have seen, of the manufacturers; and there seems to be lacking that common interchange of ideas and hearty co-operation, which mark the relations of these three classes in this country.

CRYSTALLINE IODIDE OF MERCURY.

M. F. Boudroux has recently made a number of experiments, in which he forms the crystalline iodides of mercury directly, by the wet process, and has presented his results to the Académie des Sciences. Mercuric iodide in the crystalline form is usually formed by dissolving the amorphous form of this body in a solution of iodide of potassium or in hydrochloric acid. The solution is concentrated by boiling, and, on cooling, deposits octahedral or quadratic prisms of a brilliant red. Its yellow modification is prepared in two different ways: by sublimation, which gives it the form of orthorhombic prisms, or by the wet way, when an excess of water is added to a solution of mercuric iodide in alcohol. M. Boudroux finds that when a small quantity of iodide of ethyl or of methyl is left in contact with a great excess of a mercuric salt at its maximum concentration point, there results a production of mercuric iodide. The formation of this compound is due to double decomposition, which is favored by the feeble solubility in water of the organic iodide, and the mercuric iodide, being formed very slowly in the liquid, is deposited in certain cases in large crystals. This experiment succeeds with chloride, nitrate and sulphate of mercury, but it is with the acetate that the finest crystals are produced. The method of operating is as follows: In a flask is placed 200 parts distilled water, containing 10 parts, by weight, of acetate of mercury, to which is added 5 parts iodide of methyl. After agitating for a few moments, the whole is allowed to rest. At the end of twenty or thirty minutes small crystals appear on the walls of the vessel and at the surface of the liquid. These are at first of a yellow color, then follow flat red crystals in increasing number. At the end of twelve hours the bottom of the vessel is covered with fine red crystals. In this way flat transparent crystals are obtained of a brilliant color. These are in some cases two-fifths of an inch long. This body has the chemical properties of mercuric iodide. The yellow crystals which form at the first stage of the deposit are transferred slowly, under the action of light, to the red iodide, of which it appears to be a modification. Having obtained these results, M. Boudroux applied the same reaction to the mercurous salts in the hope of obtaining the crystalline form of mercurous iodide, Hg_2I_2. This body has already been obtained in the crystalline form in the dry way, by heating in a sealed tube a mixture of iodine and mercury in the proper proportions, and in the wet way by boiling for several hours an excess of iodine with a saturated solution of mercurous nitrate and cooling slowly. The experimenter obtained the desired reaction by adding to a cold saturated solution of mercurous nitrate a very small proportion of methyl or ethyl iodide and agitating the mixture; at the end of one or two minutes a slight cloud was formed, which rapidly increased, then brilliant yellow crystals were formed abundantly and deposited on the walls of the vessel or collected at the surface. This compound, whose appearance resembles that of lead iodide crystals, is the mercurous iodide. Light decomposes it gradually, and iodide of potassium connects it into mercuric iodide. When heated in a capillary tube, it turns red near 70° C., and melts at 290° to a black liquid.

EXPERIMENTS OF M. MOISSAN.

M. Henri Moissan has lately succeeded in forming two new borides of silicon, having the formulæ $Si\ B_3$ and $Si\ B$. The experiments were made with the aid of M. Alfred Stock. A silicide of carbon has been formed by Schutzenberger, in an amorphous state, having the formula $Si\ C$, and the same compound, prepared by Mr. Acheson, was the point of departure for the carborundum industry. M. Moissan has already shown that the boride of carbon, CB_6, can be prepared in great quantities in the electric furnace. The silicide and boride of carbon have similar properties with respect to resistance to reagents and hardness; the former will scratch the ruby, but not the diamond, while the boride will in some cases scratch the face of a diamond. The analogy existing between carbon and silicon makes it possible that a like compound exists of boron and silicon. The experimenters tried at first to prepare the boride of silicon by a direct union of these elements, but the combination is only effected at a very high temperature, and the first attempts, with the electric furnace, were unsuccessful, as under these conditions the material of the containing vessel comes in to complicate the experiment. If a carbon crucible is used, boride and silicide of carbon are formed, and, besides the various gases, carbonic oxide and dioxide, nitrogen, etc., react upon the boron and silicon at this high temperature. Accordingly, a special disposition was needed; a tube of refractory earth was taken, 8 inches long and 2 inches diameter, whose ends were stopped by plugs of the same material, through which passed two carbon electrodes of 1 inch diameter. The distance between the electrodes at the center was 5 inches, and the tube had an opening in the side for putting in the mixture, consisting of 5 parts crystallized silicon and 1 part of pure boron. To assure the passage of current at first, the ends of the carbons were united by fine copper wires. The side opening was closed by a cover, and the whole well luted with refractory clay; the apparatus was then placed in a sheet iron box, surrounded by dry sand. An alternating current of 45 volts was used. This could be regulated at will. The heat lasted from 50 to 60 seconds, with a maximum current of 600 amperes. The electrodes were advanced as they burned off, to avoid forming an arc. The borides of silicon were thus formed in a bath of silicon in fusion, using the latter to conduct the current.

After cooling a melted mass is found, which is then broken into small pieces; these present the appearance of melted silicon. This substance is treated with a mixture of hydrofluoric and nitric acids, which dissolve silicon; the residue is washed with water and dried. From the mass, blackish crystals are separated by sifting, and these are placed in a silver crucible with melted potash, heated at the fusing point for half an hour; this dissolves out all the amorphous substances. After again washing and drying, the crystals are obtained in a pure state. These are blackish and quite homogeneous, with brilliant luster. They contain two different compounds of boron and silicon, as the experimenters have proved after a long analysis. One or the other of these may be dissolved out by the proper reagent; thus by treating the mixture with a great excess of boiling nitric acid, the form $Si\,B_3$ remains. If the mixture is melted with potash, this time quite free from water and at a high temperature, the former compound is destroyed, leaving the other, $Si\,B^6$. These two new compounds belong to the series of bodies formerly mentioned, and of which the silicide and boride of carbon have hitherto been the only representatives. Like these, they are very hard, and will scratch the ruby. The boride $Si\,B_3$ has a density of 2·52. It occurs oftenest in plates of rhombic form, black in color, which, when very thin, are transparent, with a yellow or brown tint. On the contrary, the boride $Si\,B_6$ is always found in thick crystals, opaque, and with rather irregular faces; its density is 2·47. These two bodies are conductors of electricity; when heated slightly they are attacked by fluorine with brilliant incandescence; chlorine attacks them at a red heat, but less degree, and bromine acts but slowly at a high temperature. Heated in air or oxygen, they oxidize with difficulty; nitrogen has no effect at 1,000° C. They are not attacked by the halogen acids and very slowly by boiling concentrated sulphuric acid. Nitric acid attacks rapidly the form $Si\,B_6$ and the other form more slowly. Anhydrous potash, when melted, attacks the form $Si\,B_3$ with great energy, sometimes with incandescence; the other form is decomposed slowly and at a higher temperature.

PARIS EXPOSITION—ELECTRICAL CONGRESS.

BY THE SPECIAL CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The International Congress of Electricity was formally opened on the 18th of August in the Palais de Congrès of the Exposition. The large hall contained an assembly of prominent electricians and engineers from all countries. The different governments had sent official delegates, as did the various scientific and technical societies, such as the Société Française de Physique, the Société Internationale des Electriciens, the Chamber of Commerce of Paris, the Elektrotechnisches Institut of Carlsruhe and the Berlin Electrotechnical Society, the British Institution of Electrical Engineers, the American Institute, and others. Upon the platform were the delegates and members of the committee. The opening address was delivered by M. Mougeot, Sub-Secretary of State in charge of the Postal and Telegraph Department. M. Mascart, the eminent French electrician, as President of the Organization Committee, delivered the principal address, of which the following is an abstract:

The Committee wishes to express its thanks for the manner in which the members have responded to its invitation; it is to be hoped that this Congress, in bringing together the different members will contribute to strengthen the relations which may have been formed in the past and create new ones. M. Mascart passes in review the work of the early scientists, Volta, Ampère, Faraday, Arago, and dwells on the prosperity which the science and industry has reached at the present time and the work it accomplishes in its various branches; the utilization of the forces of nature for the production of electric energy, the transmission of power to long distances, the revolution in the means of transport, the important work accomplished by the electric furnace in the production of rare metals and alloys, and the outlook for the future in this direction; he speaks of the electric light and the wonderful effects which have been produced at the Exposition, the telegraph and telephone, with the new systems of multiplex transmission, aerial telegraphy, and the applications of electricity in physiology and medicine; the new discoveries relating to radiations from Crookes tubes and from different substances promise to throw new light upon the constitution of matter. It is in this extensive domain that the deliberations of the Congress are to take place. At the first Electrical Congress, held at Paris in 1881, were united the scientists of all countries; among those present, whose loss is now to be regretted, were Helmholtz, Kerchof, Wiedemann, Hopkinson, Hughes, Siemens, Ferraris, and others. M. Mascart brings out the fact that important results accomplished by the first Congress were due to the spirit of good-will and of conciliation which prevailed, and hopes that the present Congress will carry on its work in a similar spirit.

After this address, which was warmly applauded, the list of officers was presented and adopted. M. Mascart was made President of the Congress and the list of Vice-Presidents included Messrs. Moissan, Kohlrausch, Sir William Preece, Prof. Perry, etc., and from the United States Messrs. Carl Hering and Kennelly. The Congress was divided into five sections, with a president for each: 1. Scientific methods and measuring apparatus; M. Violle. 2. A. Mechanical production and utilization of electricity; M. Hilairet. 2. B. Electric lighting; M. Fontaine. 3. Electro-chemistry; M. Moissan. 4. Telegraphy and telephony; M. Wünschendorff. 5. Electro-physiology; M. d'Arsonval. M. Mascart read a telegram from Lord Kelvin, regretting that ill health prevented his attending the Congress. Besides the five sections named, a commission has been formed of the government delegates which will examine questions of international interest. An extensive programme of visits and excursions was arranged. Prince Roland Bonaparte invited the members to a reception at his residence.

After the announcements had been made, Prof. Ayrton, delegate from the British government, expressed the thanks of the foreign delegates for their reception by the French government. This was followed by a similar address from Prof. Dorn, representing the German Empire.

MARCONI'S LATEST DEVELOPMENTS—SYNCHRONIZED MESSAGES.

At the annual gathering of the British Association for the Advancement of Science, in 1899, Prof. Fleming of University College, London, addressed the gathering upon Wireless Telegraphy, and incidentally mentioned that while transmitting messages from Boulogne to Dover they were read at Chelmsford some 118 miles from the point of transmission. This, undoubtedly, was a remarkable performance, but it also emphasized very forcibly one drawback which has long occupied the unremitting attention of Marconi. That is, the possibility of one or more stations reading a message intended for another. Such a circumstance naturally destroys the privacy of the message, and although it is not a very significant matter in the ordinary way, yet it would be a very serious drawback, in case of war, for one belligerent to be able to intercept and to read a message that was being transmitted between the vessels of the other belligerent. Marconi quickly realized the serious nature of this disadvantage, and at his station at Poole, in Dorsetshire, England, he has been endeavoring for a long time past to successfully synchronize his messages—that is, to construct a transmitter, the message sent from which can be only received by the apparatus which has been tuned to receive it.

He has successfully solved the problem, by means of variable conductors and capacities, by the use of which certain instruments can only receive certain messages. By his latest system, Marconi can dispatch from a certain point any number of messages, and each message will be received only by that receiver that has been synchronized to the transmitter, so that jamming of words and confusion of messages upon the various receivers are obviated.

Marconi has set up his station at Poole, because that place is so remote and he is safe from interruption. Twenty odd miles away across the Solent is another station at the southwestern corner of the Isle of Wight. Between these two points messages are being transmitted throughout the day, almost without cessation, and this is how several important discoveries and improvements have been made by the inventor. While experimenting with his sychronizing system, Marconi had several opportunities of proving the capabilities of his device. At Portsmouth the English Admiralty were carrying out experiments with wireless telegraphy in connection with the fleet, and naturally several of these ether waves crossed Marconi's line of transmission between Poole and the Isle of Wight, the effects of which upon his instruments the inventor regarded with the utmost satisfaction, since they proved that he had finally surmounted the most perplexing disadvantage of his system.

Marconi has also made some other important discoveries. He now utilizes cylindrical tin cans, about five feet in height, in lieu of the vertical wires, since they furnish more convenient capacities and radiators. He is lengthening the distance over which messages may be transmitted, and although his experiments at Poole can be conducted only on a limited scale, yet he is confident that when he works upon a larger station, they will be equally successful, and there is no doubt but that many important developments in ether telegraphy will be divulged in the near future.

At the present moment Marconi has a sufficiency of work on hand. The North German Lloyd Steamship Company are having one of his systems installed at Berkum (Germany), to be used in connection with their fleet of vessels. Apropos of this, Marconi has been carrying out many experiments with a view to applying the system practically to shipping, so that greater safety may be assured to vessels at sea. Then the International Company of France are having the coast of that country, metaphorically speaking, lined with his installations, so that communication may be maintained between the vessels of the French Navy and any point of the mainland, which would play an important part in case of a war between England and France, since by this means the latter nation could manipulate their troops according to the information received from their battleships, and thus be able to work the land and sea forces hand in hand. Then six stations are being set up in the Hawaiian Islands and will soon be in working order. Many vessels in the English Navy are also having the system installed.

EXPLOSION OF A NAPHTHA LAUNCH.

The recent explosion on a naphtha launch at New Rochelle, N. Y., in which two persons lost their lives and a third was severely if not fatally injured, again emphasizes the need of greater care both on the part of the boat-builder and the boat-owner. The launch in question was built on the usual lines of small, vapor-motor boats. In the stern the engine was placed, to which naphtha was fed by pipes leading from a storage-tank in the bow. For some time this tank had been in a leaky condition; and the oil that escaped was a source of constant danger to the occupants of the boat. A time at last came when the vapor from the leaking oil happened to mingle with the air in the lockers or recesses in just the right proportions to explode, if the proper degree of heat, say, from a lighted cigar or a match was presented. Whether the explosion at New Rochelle was thus caused, it is at present impossible to ascertain; but that the catastrophe would have been averted if the storage-tank had been repaired in due season, seems reasonably certain. Although launches, as a rule, are constructed with great care, a due regard for the safety of negligent purchasers should induce boat-builders still further to reduce the danger of explosions. In launches in which the vaporized naphtha is led back and condensed at the source of supply, the storage-tank is inclosed in a water and air-tight compartment. Although there may be apparently no reason for similar precautions in launches of the non-condensing type, and although the leakage of a properly-made storage-tank is of rare occurrence, the water-tight compartment should, nevertheless, be employed, for reasons which the New Rochelle explosion have brought home forcibly enough.

ACCUMULATORS WORKING UNDER WATER.

The municipal electric plant of Munich furnishes the remarkable case of a battery of accumulators which continued to work when submerged under water. The station is situated on an island formed by the Isar, and during the inundations of last year was partially submerged. The batteries of accumulators, which were on the ground floor, were first reached, and were soon entirely covered. One of the batteries was used on the city lighting circuit, and the other was connected in parallel with the dynamos for the traction system. As the tramway service had to be discontinued, the second battery was removed from the circuit, and it was thought that the batteries for the lighting circuit would also have to be cut out, as the fly-wheels of the engines were half under water, except two. Nevertheless, as it was almost indispensable to light at least the principal streets of the city, it was decided to try to operate the submerged battery. The attempt was successful, and the battery, which had been constructed to give 6,000 ampere hours with a 600-ampere discharge, was able to furnish 4,000 ampere hours during the night; the remainder was lost in discharges in the water. Encouraged by this success, the engineers charged the battery on the following day, and the discharge was repeated under the same circumstances. Two days after the water had lowered sufficiently to give access to the battery rooms; it was found that the density of the acid had fallen, but not to a very great extent; from 22° B. it had fallen to 20° B. only. It is thus seen that there was scarcely any diffusion. Outside of a layer of mud a quarter of an inch thick upon the top of the plates and the connecting rods, the inundation had left scarcely an appreciable trace. It was supposed at the beginning that it would be necessary to replace the acid of the batteries, which represented a considerable expense, as they contained more than 30,000 gallons; but as the acid held its strength, as shown above, a slight strengthening was all that it required.

STEAM TIPPING-CART.

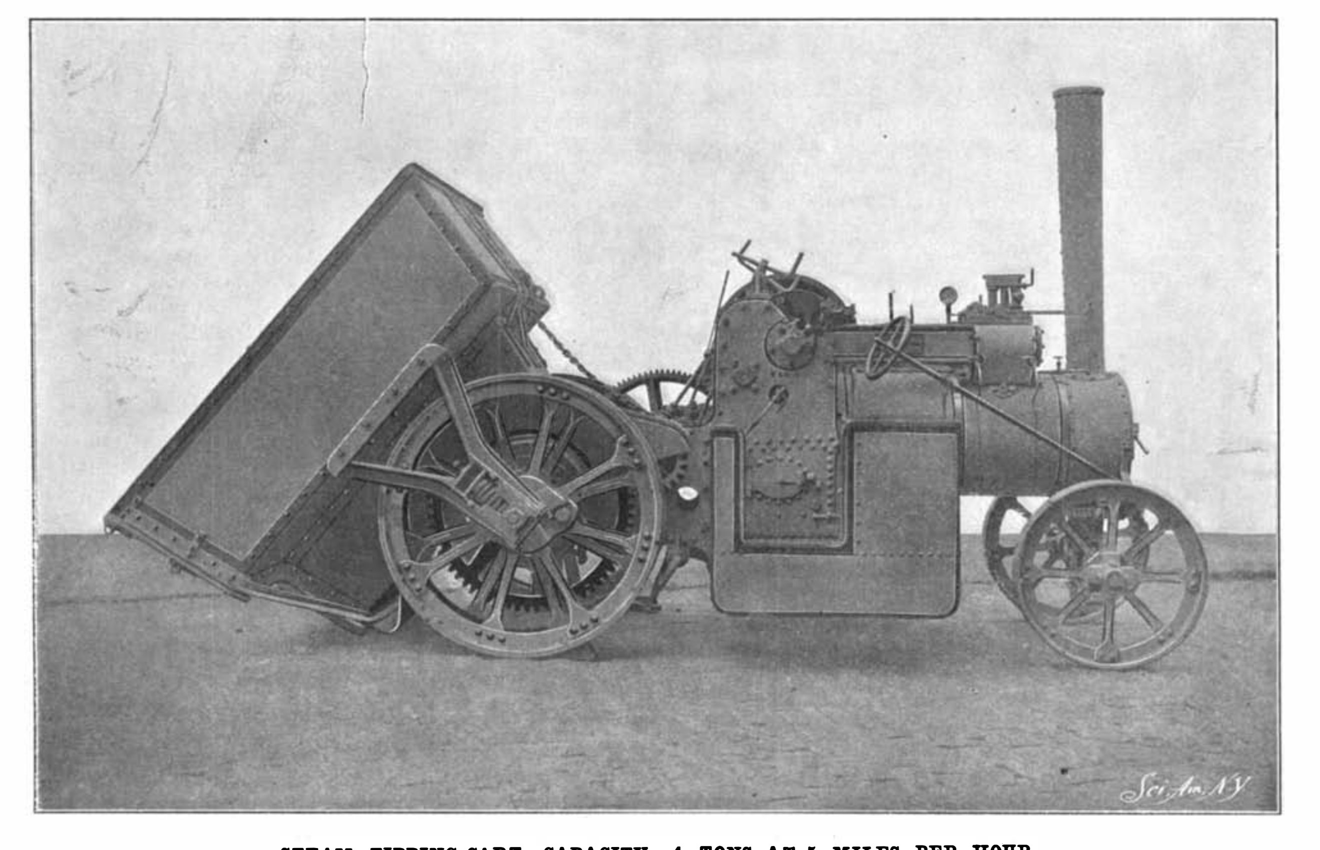
The automobile is slowly making headway as a means of transporting freight on the highways, and of handling material in engineering work. The several defects which were inherent to the early types of engines for road haulage purposes, severely militated against their adoption. But the question of motor haulage of heavy loads over roads has successfully emerged from the experimental stage, and engineering firms are now turning their attention to the construction of vehicles especially adapted for this class of traffic.

One of the most novel, and at the same time most useful contrivances manufactured for road traffic is the steam tipping-cart, constructed by Messrs. Mann & Company, of Leeds, England. In appearance it is not unlike the conventional traction engine which is commonly adopted for the haulage of heavy freight. It differs from this class of locomotive, however, in the fact that, instead of hauling individual trucks, the cart carrying the load practically forms part and parcel of the engine. The advantage of this is obvious. It dispenses with any connecting pins; it is not so unwieldy; it occupies less space; and it is far easier to handle.

The engine is a small one of the compound locomotive type, mounted upon springs. All castings, wherever possible, are made of steel. All the working parts are properly cased in. The engine is fitted with a single eccentric reversing gear, which can also be utilized as a brake; and it is provided with two traveling speeds. All gear wheels and brackets for carrying shafts and axles are of crucible cast steel, and no pitch chains are used. The boiler is of the locomotive type. Two water tanks are provided, which are of sufficient capacity to carry the engine from seven to ten miles, according to the condition of the road. The exhaust steam from the engine is passed through a superheater, before passing to the smokestack. A noticeable feature of this motor cart, which distinguishes it from other types of steam wagons, is that the footplate and coal bunker are not placed behind the firebox, as in the case of the ordinary road locomotive, but on one side, while the water tank is placed on the other.

At the rear of the engine is carried the tipping-cart, which is carried upon its own wheels. The latter, however, are exactly of the same diameter as the rear wheels of the engine, which are placed farther back than usual, and there is just sufficient space to enable the wheels of the cart to fit outside those of the engine. The two sets of wheels can be bolted together, if necessary, so that the engine wheels become driving wheels instead of trailers. By this means the whole weight of the cart and its contents is utilized to obtain a better grip or adhesion to the road, thus obviating slipping. The wheels in both cases are fitted with smooth tires instead of with cross strips, which are liable to damage the roads; while the broad smooth shod wheels act somewhat in the same manner as those of the steam roller.

The engine itself weighs a little less than three tons. The weight of the cart is one ton, with a carrying capacity of five tons. The load can be readily and easily tipped at its destination, and by means of a windlass fitted to the engine can be quickly hauled back into its normal position. The engine is economical in the consumption of fuel, only requiring about ten pounds of ordinary gas coke per mile with a full load. It can attain a speed of five miles an hour with comparative ease, and will climb gradients as steep as 1 in 5. It will travel as readily and as satisfactorily backward as it will travel forward, and for this reason is easily manipulated under cramped conditions. This cart was recently subjected to a severe practical test at the Yorkshire Motor Car Show held at Bradford. The competing motor wagons had to travel over a course 2½ miles in length, which included some stiff gradients and three very sharp turns. The tipping-wagon was laden with four tons and covered the outward journey at a mean speed of 5·4 miles per hour, and the return journey at an average speed of 4·75 miles per hour. In the subsequent awards, it secured the gold medal.

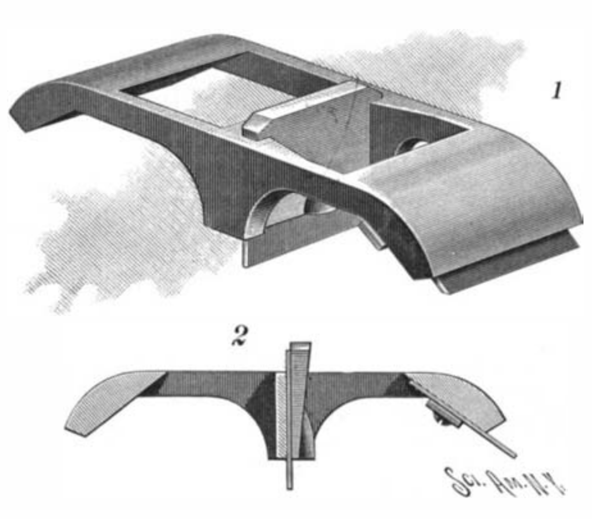


STEAM TIPPING-CART. CAPACITY, 4 TONS AT 5 MILES PER HOUR.

AN IMPROVED SCRAPER.

The device which is illustrated in our engraving is a carpenter's or painter's scraper, of such construction that it involves no complicated parts. The scraper is the joint invention of Michael Mullin, Isaac N. Watson, and John A. Hall, of 738 East Long Street, Columbus, Ohio. Fig. 1 is a perspective view of the invention and Fig. 2 a longitudinal section.

The scraper comprises a metal stock with straight sides and curved ends. In the sides are vertical guides (Fig. 2), adjacent to which is a cross-plate. The vertical guides receive a scraping-blade and a hard-wood



A NEW PLANING AND SCRAPING TOOL.

key, the blade being held flat against the cross-plate and wedged firmly by the key in any desired position. The key is formed with a projection or knob, by which it can be driven out of position.

One of the curved ends of the stock carries an end blade which is clamped against the plane under surface of the curved end by a cleat. The other end of the stock serves as a gage to the action of the first-mentioned or middle blade.

The tool is held with the stock in horizontal position and with the middle scraping blade against the work. If it be so desired, the tool may be tilted so that the gage-end of the stock may be used to control the action of the middle scraping-blade. The second or end blade is of great service in working in corners and other places difficult of access, and when thus used the other end of the tool, as well as the middle scraping blade, is raised out of contact with the work. By properly beveling the blades, various kinds of work can be performed. For example, by suitably beveling the middle scraping-blade, the tool may be used as a plane by lowering the gage-end of the stock into contact with the work and pushing the tool forward with the blades in front.

Restoration of Discolored Platinum Prints.

Platinum prints in which the whites have yellowed in consequence of the whole of the iron salt not having been removed may be restored by immersing them in a bath made by dissolving half an ounce of sodium carbonate and 300 grains of "chloride of lime" in 8 ounces of water.—Gaedicke.

American Machinery Exports.

Exports of American tools and machinery do not show the shrinkage in volume which recent reports would indicate. Some concern has been expressed by leading export houses by reason of a falling off in foreign orders due to the high prices of iron and steel. In this connection it will be interesting to note that the exports of builders' hardware, saws, and tools during the fiscal year 1900 were the largest in the history of our export trade, being $9,646,017, against $7,842,372 in 1899, $6.627,466 in 1897, and $5,509,188 in 1896, prior to which year the exports in this line had never aggregated so much as $5,000,000. In exports of sewing machines, typewriters, electrical and other intricate machinery there are also gratifying increases. Comparing the export figures of the fiscal year just ended with those of 1898 and 1899, it is found that sewing machines increased from $3,136,364 in 1898 and $3,264,344 in 1899 to $4,540,842 in 1900; electrical machinery from $2,052,564 in 1898 and $2,736,110 in 1899 to $4,328,917 in 1900; locomotive engines from $3,883,719 in 1898 to $5,592,403 in 1900; typewriters from $1,902,153 in 1898 to $2,697,544 in 1900; metal-working machinery from $4,618,683 in 1898 to $7,193,390 in 1900; and all other machinery from $13,336,930 in 1898 to $21,913,202.

While our chief market for machinery is still to be found in European countries, an increasing proportion is being sold in the Far East, especially in British Australasia, Japan, and India. In 1898 our exports of builders' hardware and tools to British Australasia amounted to $877,635, in 1900 they aggregated $1,325,793; in 1898 our exports in this line to Japan were $76,500, while in 1900 they were $106,251. Our exports of typewriters to British Australasia in 1898 amounted to $60,039, while in the fiscal year 1900 they were $101,000; to Japan, the exports of typewriters in 1898 amounted to but $4,220; in 1899 they had increased to $7,262, and in 1900 to $16,579, of which sum $2,211 were exported during the month of June alone, thus forecasting in some degree the possibilities of future development in this article of export. Commenting upon the increase in exports of typewriters, a prominent American manufacturer is quoted by The New York Commercial as saying:

"The demand for American typewriters was never greater, and our machines are pretty good globe-trotters. We have just made a shipment to Puntas Arenas, on the Straits of Magellan, at the extreme southern point of South America, and another lot of typewriters has been sent north to Vladivostock, Russia, for the use of the Imperial Government. Many of the missionaries and foreign business men in China use our machines, and nearly every American regiment in the Philippines has from three to five machines; and, as business increases at Manila under American auspices, there will be a big demand for typewriters. The typewriter has become well-nigh universal in its use, and is found in all the large business houses in the principal cities of the world, and its keyboard represents nearly all languages. The exceptions are the Japanese and Chinese. As their characters are upright and composed of many hundred figures or signs, it seems practically impossible to produce them on the typewriter's keyboard."

A Curious Accidental Fire.

An extraordinary accident occurred at Waukesha, Wisconsin, on August 6. A motorman was handling a burned-out motor. The controller came in contact with a celluloid collar he was wearing, and his neck was at once encircled by fire. He was severely burned, and it is believed that he will not recover. Celluloid collars and cuffs should not be worn by those whose vocations require them to be near open lights, fires or electricity. The motormen on the Milwaukee trolley cars received an order from the president of the company that they must not wear celluloid collars.

American Coal for London Gas Production.

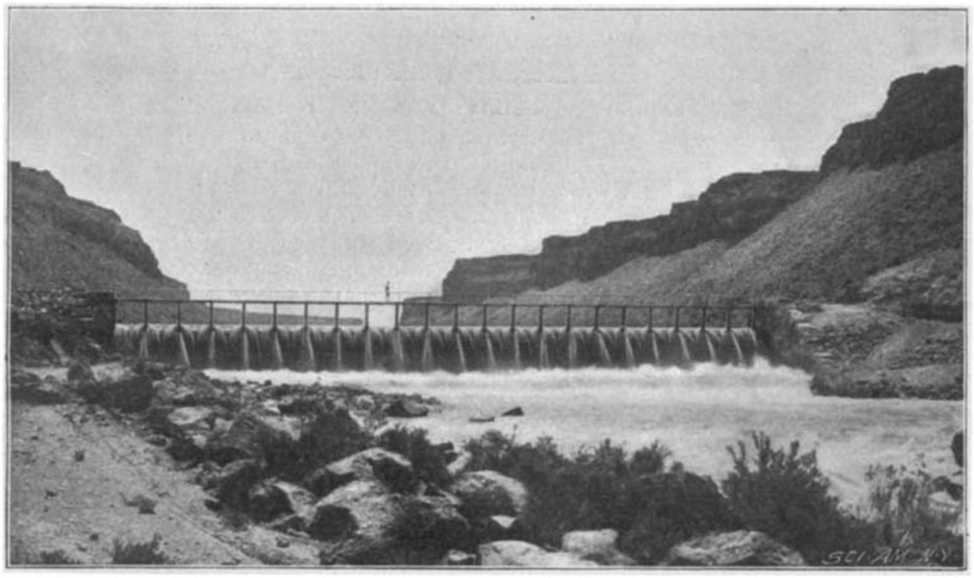
The South Metropolitan Gas Company, of London, has given an experimental order for 4,000 tons of coal to a Pennsylvania colliery.

IRRIGATION IN IDAHO.

BY WALDON FAWCETT.

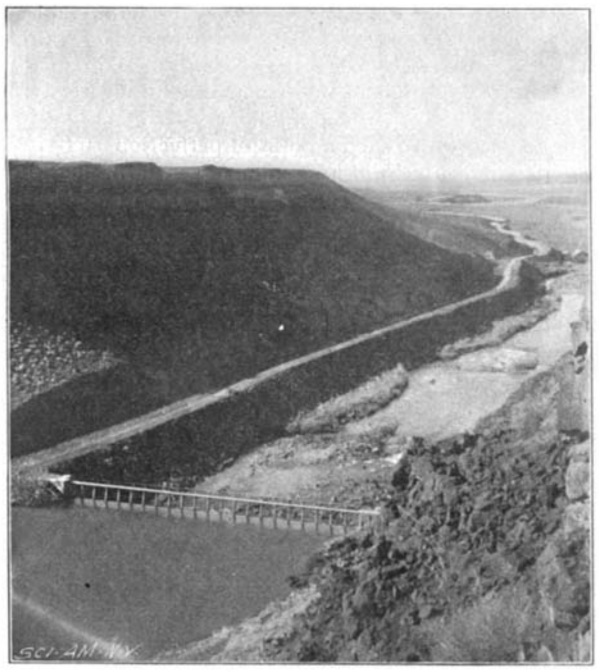
Interest in the irrigation enterprises in the Western States seems to increase rather than diminish as their scope is, of necessity, broadened by the development of that portion of the country. Nowhere has greater progress been made during the past few years in the provision of irrigating works, designed in accordance with the best modern engineering principles, than in the State of Idaho. There are, in the State at the present time, more than four hundred canals, varying in width on the bottom from 10 to 100 feet and aggregating more than 2,000 miles in length.

The State constitutes an excellent example of the possibilities of accomplishment of the most approved system of irrigation. Out of a total area of about 86,000 square miles in the State, over 25,000 square miles are agricultural lands. All varieties of spring and fall wheat are grown successfully, the average yield being thirty bushels to the acre. In some instances the yield in the northern part of the State has attained to one hundred bushels per acre. Barley, oats and rye have been grown profitably even in portions of the State unprovided with irrigation ; but hay, timothy, clover and alfalfa are the leading crops. In the irrigated districts, especially, these grow abundantly and there is a yield of from six to eight tons per acre for the season.



BRUNEAU DAM.

There are few sections of the State where irrigating works are not at least in process of construction. In Ada County, one of the oldest counties in the State, the irrigated lands aggregate 40,000 acres, while the lands not yet covered by any system of canals for irrigation are set down at 135,000 acres. The latter figure is, however, being rapidly reduced by a number of canal projects now nearing completion. One contract calls for the completion this summer of canals which will irrigate fully 20,000 acres not now reached by any system. It is customary for outsiders to combine with local capitalists in carrying out projects of this character.



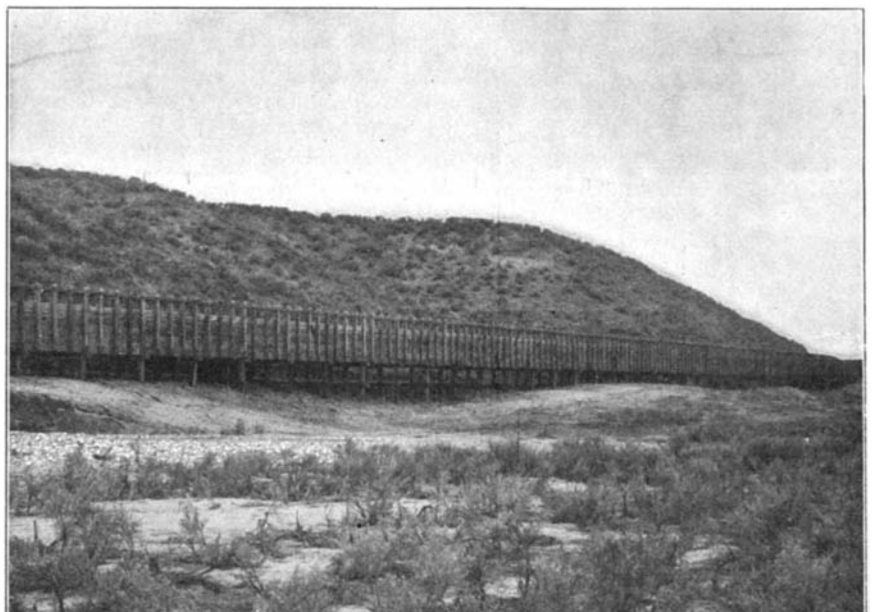
BRUNEAU DAM AND CANAL.

Idaho is fortunate in the possession of numerous lakes, which may be made to serve advantageously as the fountain-heads of irrigating systems. For instance, Bear Lake, a body of water eighteen miles in length by twelve in width, serves as the source of supply of upward of a score of canals, the aggregate length of which is in excess of two hundred miles.

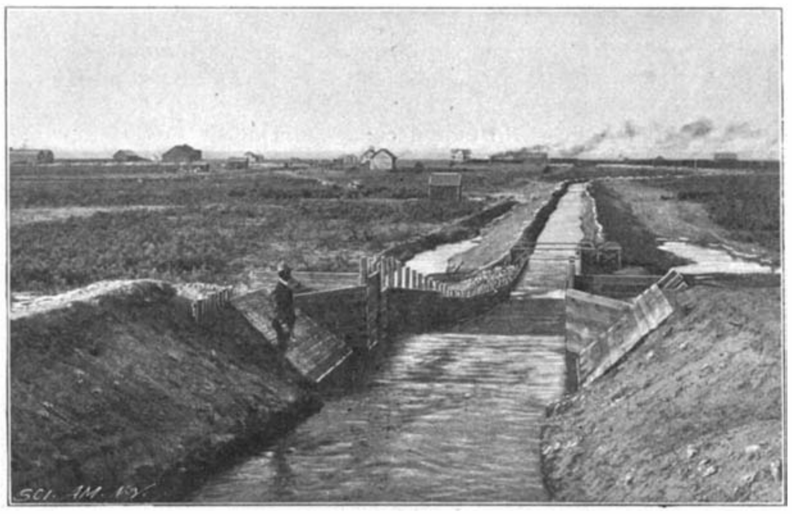
The rivers of the State are similarly utilized. As an example, there may be cited the case of the Snake River, in Bingham County. The river flows through the county from north to south. From this stream twenty canals, some of them forty feet in width, and aggregating 360 miles in length, are led off. Even with this water system, however, there are thousands of acres of high lands which cannot be reached by any of the irrigation systems. Some idea of the possibilities of the State may be gained from the fact that there is not in Boise County at the present time a canal or a mile of railroad, yet here are located the famous Payette Lakes, at many points on which soundings have failed to find a bottom.

The Idaho agriculturalist is enthusiastic upon the subject of irrigating canals. He takes the stand that while transportation facilities may do much toward aiding him to reach more profitable markets with his produce, the irrigation system is a more absolute necessity. Thus Fremont County, which has 120 miles of railroad, has 353 canals, with a total length of 975 miles, and with a carrying capacity of over 400,000 miners' inches. The average elevation of this entire county is fully 5,000 feet above the sea level. A portion of the country is covered with rugged mountains, from which course innumerable pure streams, furnishing water for the irrigation of broad and fertile valleys between. The foothills are also supplied with abundant snows, which insure a never-failing supply of water for irrigation, but there are in this county alone upward of 3,000,000 acres of land which cannot be brought under cultivation successfully simply because of the fact that they lie above sufficient water-courses for irrigation.

Many of the smaller canals, especially where the lay of the land is such as to make their construction easy, are solely the result of local enterprise. On this co-operative plan the greatest benefit accrues to the farmers themselves, and with a small annual maintenance fund the canals are kept in good repair. As an illustration of the benefits to be derived from the use of this system of irrigation and canal operation the Butte and Market Lake Canal is often cited. Under this canal there are now some seventeen thousand acres of land lying near and surrounding the town of Market Lake, all within six miles of the town, with a perpetual water right ceded to the land, subject to maintenance only. Persons who have lived in Idaho for some years maintain that from five to ten acres upon any of the irrigating canals are sufficient to insure any family a comfortable living if set out in fruits and properly cultivated.



FLUME ON FAYETTE CANAL.



PHYLLIS NEAR NAMPA.

A New Telephone.

Monsieur Piérard has been relating to the Société Belge d'Electriciens the results of some curious and interesting experiments that he has been conducting with the telephones provided with line wires in the ordinary manner, but not equipped with either a battery or magnet. In his instrument M. Piérard converts the transmitter into a vibrator. A platinum point is fixed to a screwed spindle. When a sound is projected into the instrument it vibrates a metallic diaphragm, a platinum disk attached to the back of which is brought into contact with the platinum point on the spindle. The inventor then placed this instrument, which he calls a "vibrator," in an electric circuit containing a battery and an induction coil, the secondary of which is an ordinary telephone receiver. He succeeded in transmitting musical notes, but not words, since the harmonic overtunes were not reproduced. He then removed both the battery and the primary coil, thus dispensing with the electromotive force. Even then music at a distance of 100 feet, which could not be heard by the unaided ear, was plainly audible. The effect was similar to that which may be obtained with the string telephone, only the action was not of the same kind, since, whereas in the string telephone, it is absolutely essential to keep the string perfectly taut, in this case the wires were quite loose. He then placed a coil, the secondary of which had the same resistance as the receiver coil, in his vibratory circuit, and the effect was appreciably increased. In his experiments M. Piérard employed diaphragms composed of numerous metals, and of varying thicknesses. The metallic diaphragm in one case was composed of an alloy of copper, nickel, and zinc, but when the platinum point touched this, no transmission was observed. He then fixed a platinum disk to this diaphragm and immediately tunes were transmitted. He then substituted the disk of platinum with one of zinc with the same result. Copper and iron separately employed were effective to a small degree, but aluminium failed to transmit any sound, probably because it could not be soldered to the platinum contact plate. M. Piérard is inclined to the belief that the electromotive force that was generated, was due to the contact of the metals, the intensity of the effect varying with the area of the contact plate soldered to the other metal.

AT Lithgow, New South Wales, there has just been erected the first open-hearth steel furnace of the Siemens new type. By means of this installation scrap is converted into mild steel ingots by making a bath of molten pig iron and melting the scrap into it by means of the gas flame. The steel flows into a ladle running on rails, and is thus carried over a pit nearly 7 feet deep by 4 feet in width and 30 feet in length, in which the ingot moulds are placed. A Priestman traveling jib crane serves to lift out the ingots and to place them on the trolley, when they are carried to the rolling mills, reheated, and rolled off into sections of the desired dimensions. The roof over the furnace, which latter has a melting capacity of 5 tons, is 70 feet span, has a height at the pillars of 21 feet, and is 60 feet in length.

Correspondence.

Insect Strategy.

To the Editor of the SCIENTIFIC AMERICAN:

Apropos of article entitled "Strategy of the Ants," which appeared in issue of the SCIENTIFIC AMERICAN, July 21, 1900, I would say that when away from my business as mechanical engineer, natural history has been my hobby for years. An instance of ant sense that came under my notice several years ago, was as follows:

I had just killed a wasp and left the carcass on the ground, waiting for my friends the ants to remove it. Along came one fellow, walked all around the wasp's body, making notes evidently of size, quality of flesh, etc., and off he went and brought up a small army of his brothers. Of these some fell to and devoured the soft portions of the body which would not keep, while others began to dissect ready for storing the harder portions which would keep for winter consumption. The day was gusty, and my attention was attracted in particular to one little chap who was trying to get to his ant-hill with a wing he had severed from the body. He would struggle along two or three inches, when a sudden gust of wind would blow him and the wing back further than he had advanced. He put up with this till he found it hopeless, then carefully laying the wing down and piling the largest grains of sand he could lift on it so that the wind would not blow it away, returned to the body of the wasp and got three of the ants who had been feeding while he worked and brought them back to where the wing was, at the same time evidently explaining to them the difficulty of carrying such a bulky piece on a windy day.

They all got on the side of the wing where the heavy strengthening rib is and began to roll the wing up just as one would roll a flag around its staff. When this roll was finished, three cuts were made through it by three pairs of ant mandibles, and the four short, easily hauled rolls of wasp wing were successfully carried to the ant-hill by four industrious ants.

A curious instance of the ability of an insect to successfully measure distance was evidenced once while I was traveling through northern Argentina.

I first made the acquaintance of my friend on the back veranda of a little village tavern. I was lying in a hammock. About 2 feet from me was a 3 by 3-inch hand-rail of wood, supported by wooden balusters. As I lay there I noticed a fly alight on the top of the wood. While I watched him the fly apparently turned into a spider. I could not believe my eyes, but on closer inspection I saw that a spider had jumped from somewhere and alighted on top of my fly. I thought this worth watching and found that this was his method of procedure. A fly would alight on top of the railing, the spider would take in the distance at a glance and would disappear down the side of the rail, walk along toward the fly, but out of sight, until he reached the place on the side of the rail at right angles to the position occupied by the fly when he last saw it. Then he would walk nearly to the top of the rail and fasten his web, then walk down, paying out his web as he went, till he was as far from the place where he had fastened his web as was the fly, then one vigorous leap, the web swinging him round in the arc of a circle, and he would alight on top of the fly.

I have never seen one miss this seemingly difficult leap, except when the fly left his position before the spider had finished his preliminaries.

E. A. SUVERKROP.

Philadelphia, Pa., August 21.

The Newport Automobile Races.

It is thought that records for fast riding will be broken at Newport September 6, 1900. Public interest is becoming aroused in the coming races to be held at Aquidneck Park on Thursday, September 6.

Newport society has taken up the automobile in earnest, and the races will be well supported; in fact, will be among the events of the season. A large number of entries have already been made, including Mr. W. K. Vanderbilt, Jr., who is expected to ride in his famous German racing machine, and who has also entered his steam carriage built by The Locomobile Company of America.

Mr. Harold Vanderbilt has entered his three-wheeled tricycle and other tricycles; steam, gasoline and electric carriages will be driven by many others, including Mr. George I. Scott, Mr. Max Muller, Mr. Knight Neftel, of Boston. The New England Electric Vehicle Transportation Company will also probably enter one of their racing machines.

Handsome prizes have been offered, many of which are cups offered by W. K. Vanderbilt, Jr., Mrs. Herman Oelrichs, Mrs. O. H. P. Belmont, The Locomobile Company of America, and The New England Electric Vehicle Transportation Company. One of the most interesting occasions of the season is expected, and those interested in horseless carriages will have a splendid opportunity of comparing various styles of vehicles. The time records, it is expected, will be broken, and an exciting, as well as an interesting day, is assured.

Carriages will be divided into four classes, viz.: Gasoline, steam, electric, and three-wheel tricycle.

Races in each class will be run in heats, the winners in each heat qualifying for the final heat in that class and the winners of the final heats in each class will be eligible to compete in a race comprising all classes. The distance of each race will be five miles.

In case of the attempt of an operator to prevent a carriage from passing him after the overtaking carriage has obtained an overlap, the offending operator will be disqualified.

Laundry Machinery and Practice.

In the modern laundry, machinery has come to take the place of the old hand labor to such a degree that it may be said without undue exaggeration that the civilized world, especially in American cities, washes itself entirely by machinery. Even when the return to hand-laundered goods is the fashion, and the work is done openly in the windows by experts, machinery figures as a prominent factor in the operation. In most cases the hand-irons are modern inventions, heated by electricity and not by the old-fashioned slow method on the stove. It is estimated that an ironer who has to keep changing his irons every minute or so loses about half his time, and that one provided with an electric iron can perform nearly double the amount of work with no greater effort.

There is no justification for any modern laundry to use chemicals for washing clothes, for washing machines are so perfect to-day that dirt can easily be washed out of clothes, and there is no good reason for resorting to chemicals to accomplish this work. There are scores of washing machines on the market, big and little, but the large laundries usually employ machinery that makes quite an expensive plant when finally put up. The washing is done by means of two cylinders, one within the other, and made either of metal or wood. The clothes are put into the inner cylinder, which is perforated on all sides with little holes, and the door then closed. Powdered or liquid soap is also put in the cylinder, and hot water or steam is admitted through valve connections at the top. The outer cylinder is little more than a cylinder jacket for the inner one, and the space between them is very slight. The inner cylinder is made to turn continuously, first in one direction, and then in the other, and the water can be changed without opening the doors. Thus, the clothes get a thorough shaking up and twisting, and then a first, second and third rinsing in hot or cold water. The dirty water oozes out through the perforations and runs off, while fresh water is introduced through the valve connections on top. Clean water can thus be constantly dashed over the clothes, while the old is carrying off the dirt below. The last step in the washing process is to introduce cold blued water, and then the clothes are removed.

The next machine in the process through which the clothes pass is the big centrifugal wringer, which is a nicely adjusted machine that can wring clothes almost as dry as if exposed to the sun for a few hours. It is so totally different from the average housewife's conception of a clothes wringer that it is worth looking at. It has anything but the conventional type appearance, and looks more like a big wash-tub or bowl-like barrel than a wringer. It is really composed of a big iron and copper bowl, the latter fitted in the former and perforated with many holes. This extractor, as the inner copper bowl is called, revolves at the rate of a thousand revolutions a minute. The clothes are put in this revolving extractor, and the water and moisture are thrown out through the perforations by centrifugal force. The water thus ejected falls into the outer bowl of iron, and runs off below. This method of wringing the clothes has been found to be more economical, quicker, and less destructive to the materials than the old-fashioned way of squeezing them through two rollers.

The third process in the modern laundry is the starching, and this, too, is performed by machinery. There are several kinds of starching machines on the market, and some large laundries have several patterns to suit the different classes of work on hand. Some clothes require very little starching, and the machine for these is very simple and does little more than turn the clothes over a few times in the starch. Clothes that require the starch to be worked thoroughly in the material, such as shirts and collars, are put in starchers, which actually knead the starch in the fabric as successfully as the housewife's hand could do it. The starchers are more simple in arrangement than most of the other machinery, and some laundries are not provided with them, and the work is all done by hand. Laundries that make a specialty of "dry washing" can easily dispense with the starching machines, for clothes thus cleaned are merely washed and dried and returned to the owners without being starched or ironed. Many housewives in cities prefer this method, sending most of their washing to the laundries, and having the starching and ironing done at home.

The drying room of the laundry is fitted up with long rows of racks or frames, which can be kept moving on rollers by means of a belt, and any set of these dryers can be operated separately or together. The temperature of the drying room is regulated to suit the occasion, and it can be kept at any degree desired. Usually the temperature is so high in the drying room that it is uncomfortable, and sometimes dangerous for employes to enter it, and the need of being able to operate the drying frames from the outside so they can be filled or emptied at will is quite imperative.

There are dampening machines to which the clothes go next, and these are sometimes in the form of patent sprinklers or simply surfaces which are brought in contact with the clothes for a fraction of a minute. When the clothes pass from the dampeners they are in perfect condition for the ironers. The machines for ironing clothes are probably more numerous and complicated than for any other part of laundry work. Inventors have devised some sort of machine for ironing simply and quickly almost every article of human wear. Machines for ironing shirts, collars, sleeves, wrist-bands, yokes, cuffs, and similar parts of our washable dress apparel have long been in use. Every time a new-fashioned article of underwear is devised by a dressmaker, the inventors of laundry machinery find a new demand for their labor, and if the article has come to stay, some new wrinkle for ironing it quickly and simply will be invented sooner or later.

In a great many laundries fine hand work is the only rule for anything like collars, shirts, and cuffs, but the vast majority of us have these articles ironed by machinery. Collars and cuffs are first ironed flat by machinery, usually by running them through two heavy rollers, and then they are separately ironed on special machines. The turn-over collars are put through a special machine, which folds them over and straightens the edges to the required natural curve. Shirt-ironing machines are made to fit bosoms so perfectly that when the goods are finished one would hardly be able to distinguish the work from that performed by hand. Yokes, sleeves, and wristbands likewise have their separate machines which fit into them snugly and give in a few seconds the shape and effect that the hand-worker obtains only after a long time of skilful work.

Machinery for ironing has proved of the greatest benefit in doing up flat goods, such as hankerchiefs, pillow cases, sheets, napkins, and tablecloths. An immense amount of work can be accomplished in a short space of time by one of these machines under the operation of a girl or woman. The modern mangle has been developed to such a point of perfection that it is capable of ironing all the flat goods of a large laundry as fast as they can be turned out of the washers and drying rooms.

The mangles are of all sizes, from those constructed for hotel use to the big fifteen-ton machines with rolls from seven to nine feet in length. The latter size of machine is only suitable for the largest laundry, but where the amount of work justifies the erection of one it well pays for the investment. It will turn out all the goods that several girls can feed to it, not only smoothly ironed, but folded and creased properly for immediate delivery. Laundry machinery is a distinct branch of trade, and manufacturers of the machines confine their attention to these alone. New machines and inventions are, of course, being introduced every year by these big concerns, but already the list of laundry machines is so great that hundreds of pages of a catalogue are required to describe them. —G. E. W.

A Hot-Box Cooler.

Two Western inventors have devised a simple hot box cooler. It consists of a pipe which is thrust into the journal-box, being held in position by a hook. The pipe is attached to a rubber tube which runs up to a pail of water which is secured to a grab iron by a short piece of iron pipe. The rubber tube is supplied with several encircling suspension brackets which contain a small nail that is driven into the side of the freight car at desired points of suspension. The water siphons down from the pail, cooling the journal and keeping the waste wet. The arrangement can be quickly applied to any freight car.

"Gall of the Earth."

The faculty of the Chattanooga Medical College is now making experiments with the weed known as "Gall of the Earth," with which a mountaineer recently cured himself of a mad dog bite, and by which he cured others suffering from snake bites. It is sometimes known as the "rattlesnake's master." The weed is now being transplanted for cultivation and experiment. It is now in bloom and bears a small white flower. The Horticultural Department of Clemson College, Charleston, S. C., is also experimenting with it.

A New Park for Washington.

A new park is to be built at Washington, D. C., south of Pennsylvania Avenue and B Street, S. W., and also a parkway between Potomac Park, or reclaimed flats, and the Zoological Park. Samuel Parsons, Jr., the well-known landscape architect, will draw the plans.

Engineering Notes.

Extra firemen were assigned to help the regular firemen on heavy freight locomotives of the Central Railroad of New Jersey during the months of July and August.

The order of 208 guns and two destroyers for the Turkish Navy has been placed with Messrs Krupp of Essen, notwithstanding that the tender of Messrs Armstrong, Whitworth and Company, of Great Britain, was over $400,000 less than that of the German firm.

The English Admiralty are experiencing the effects of the high price of coal in England. They have just signed contracts with Cardiff firms for the supply of 150,000 tons of Welsh steam coal at prices varying from $6.50 to $7 per ton. This is the highest price the Naval Department has ever paid for this coal, except in the time of strikes. The whole consignment has to be delivered at the naval depots during the next four months. An American engineering firm has also recently signed a contract for 30,000 tons of coal with a north of England colliery.

In the early part of this year several private firms of ship-builders in Great Britain, who had torpedo-boat destroyers upon their stocks under construction, offered the same to the British Admiralty. The Naval Department has closed with five of these offers, which involves a total cost of $1,753,000. One of these destroyers, which was constructed by the well-known Elswick firm, is fitted with the new turbine motor similar in design to that invented by Messrs Parsons, the constructors of the "Viper." For this vessel alone $322,550 were paid. With this extra expenditure, and together with one or two other items, the British naval estimates for 1900 represent the total of $143,959,500.

Now that the Boer war is confined to the northern corner of the Transvaal, the Natal government has commenced the reorganization of its railway system, which was destroyed by the Boers during their incursion into British Territory. The English engineering firms are being flooded with orders for locomotives, wagons, carriages, and steel rails, to replace those destroyed or damaged during the war, and also to provide additional rolling stock, which will be required to meet the increasing trade of the colony. So far the contracts have been placed with English firms entirely. Contracts have been placed for the reconstruction of the bridges, and the orders are being pushed forward with all possible speed.

The commercial prosperity of Great Britain is still strongly in the ascendant. According to the Board of Trade returns, which were published a few days ago, the imports from foreign countries and British possessions during the month of July amounted to $201,320,835, representing an increase of $1,643,975 over the corresponding month of last year. The total value of imports for the seven months of this year ending July was $147,495,165, or an increase of $96 299,630 upon the same period for last year. The exports of British produce and manufactures for the same month amounted to $122,752,785, or an increase of $6,772,995 upon the value of the exports during the month of July, 1899, while the total value of the exports for the first seven months of this year is $844,636,605, or an increase of $96,047,345.

A curious accident occurred on the Derbyshire portion of the Great Central Railway of England during the spell of tempestuous weather at the beginning of August. A terrific cloudburst occurred over the Derbyshire hills during the gale, and the hillsides were transformed into raging torrents of water, which uprooted trees and swept away all obstacles that opposed their progress. Thousands of tons of rocks and great masses of earth were carried along by the water and swept upon the railway, completely burying it for a distance of over two miles. Fortunately, no trains were passing over the destroyed section at the time of the disaster, otherwise the loss of life would have been terrible. Over 5,000 men were immediately requisitioned to clear the track, which occupied more than two days' incessant work.

Now that the price of coal has increased to such an enormous extent in England, as a result of the vast quantities which are exported to foreign countries, attempts are being made to obtain a cheaper fuel, especially for the benefit of the poorer classes. Experiments are being made with peat. At Tregaron, in Cardiganshire, there is a vast bog, 4,000 acres in extent, in which the peat extends in veins varying from 20 feet to 50 feet in thickness. It is stated to be very rich in carbon, and attempts are to be made to extract this carbon and to compress it into briquettes, after the process advised by some German scientists. These briquettes are stated to be equal to the best steam-coal, and it is estimated that the fuel could be sold in large quantities on the ground, at the small price of $1.25 per ton. The most difficult question, however, is that of transit to the principal centers. Where canals can be used for transit the cost of conveyance is very small, but the high railway rates preclude it from being carried to the remote towns and sold at a reasonable figure.

Electrical Notes.

The Great Western Railway of England is lighting its corridor trains by electricity obtained from dynamos driven from the car axle. Storage batteries are carried for use when the running speed is slow and for stops.

By arrangements with the two governments of France and Germany, a telephone service has been inaugurated between Paris, Frankfort, and Berlin. The charge for the use of the wire between Frankfort and Paris is 80 cents for three minutes, and between Paris and Berlin $1.25 for the same time.

A new submarine cable is about to be laid between England and Germany. This is the fifth cable, and a comprehensive idea of the increase in the cable traffic between the two countries may be gathered from the fact that, whereas in 1896, when the fourth cable was laid, the annual number of cablegrams was 1,867,868 per annum, no less than 2,465,613 cablegrams are now annually transmitted.

The Trinity House Brethren, who control the lighthouses of Great Britain, have granted permission for the installation of Marconi's wireless telegraphic system between the lighthouse at the Mumbles and the mainland at Ilfracombe on the west coast of Devonshire. The pole for carrying the high wire at Ilfracombe is 116 feet 3 inches in height; measures 1 foot 5 inches in diameter at the base, tapering to 3½ inches at the top; and weighs nearly two tons. The pole, which is the largest in the country, has been placed at a depth of 6 feet in the solid rock.

The London County Council have at last received Parliamentary sanction to convert the horse tramways which they have recently purchased throughout the metropolis into electric tramways. The underground conduit system will be employed, as public opinion has successfully protested against the overhead trolley system on the plea of marring the beauty and interfering with the traffic of the streets. The length of tramways to be converted to electric traction comprises 115 miles, so that it will be some time before the whole system is working electrically.

The corporation of the town of Frankfort (Germany) is enlarging the municipal central electric station, and has just placed an order for a 400 horse power single phase turbo-alternator. The present capacity of the central station comprises four 500 kilowatt units and two 1,000 kilowatt units, and two more of the latter are now in course of erection. The total capacity of the motors connected with the mains is over 5,000 horse-power. The turbo-alternator which is now being constructed will be the largest ever made. It will register 1,360 revolutions per minute and will generate a current at a tension of 3,000 volts, and when working on an inducted load having a power factor of 80 per cent, will yield, if necessary, the full output of 4,000 horse power.

A few days ago an alarming accident occured in the Strand, London. By some means, the underground electric circuits were fired, with the result that the lid over a manhole in the footpath was blown high into the air. Large sheets of flame then shot into the air for a height of about ten or twelve feet, attended at frequent intervals with sharp explosions. The alarm was immediately given to the fire brigade, who were quickly on the spot, but it was instantly recognized that their efforts were of no avail in the quelling of the conflagration. They consequently had to stand by and simply watch the results of the erratic behavior of the electric current. In a few minutes, however, an electrician was on the scene and he quickly subjugated the outbreak by severing the wires. Such accidents as this are of frequent occurrence throughout the metropolis, but at this precise point the number of wires is very great, which rendered the incident far more serious than is generally the case.

Mr. Gregor Blanck, the Hungarian who has invented a loud speaking telephone, is at present in London, negotiating with the British Post Office and the National Telephone Company, for the introduction of his instrument upon their system. The Post Office has informed the inventor that if he can construct an instrument with which it will be possible to telephone a distance of about a thousand miles, with ease, and without having to shout into the instrument, so that the words may be distinctly distinguished at the other end, they might be disposed to avail themselves of the invention. The inventor has been busily engaged upon a machine for this purpose, and by the aid of a very powerful inductive coil has succeeded in telephoning over a distance of a thousand miles, and will shortly experiment with his improved instrument before the authorities of the Postal Department. The crux of the invention is that by means of the coil, articulation of the speaker is intensified as the words pass along the wire. Besides connecting the instrument with the telephone, the inventor will attach it to electrophone, and by this means one will be able to sit in a room and listen to what is happening at the theater, without having to insert the tubes into the ear, as is now necessary. The sound would proceed from the electrophone in much the same manner as they are recited by the phonograph.

Automobile News.

Cyclists should take warning and not ride behind motor-carriages. In England a wheelman was riding behind a horseless carriage; the latter was brought suddenly to a standstill, and the cyclist sustained a serious injury to the brain.

The recent hot weather with which New York was visited brought into prominence the fact that the general introduction of the trolley has mitigated the scenes of animal distress which were so common when the cars were hauled by horses. According to The Electrical World, during one hot season the Third Avenue line lost 600 horses in a few weeks, besides having 300 in the hospital. The horse of the cab and dray is also being gradually emancipated by the slow but sure introduction of automobile vehicles.

The Austrian Army is giving the automobile a series of severe tests, in its army maneuvers this year, to determine how far it is applicable to the battlefield. The military authorities have ordered twelve Bollée-Ditrich automobiles from the factory in Baden, which will be employed in connection with the ambulance corps. The staff officers are also going to be mounted on automobiles, motocycles being requisitioned in their cases. The experiments will be very exacting, since the maneuvers will take place in the Carpathian Mountains, a territory hardly adapted to the successful employment of automobiles to any great extent.

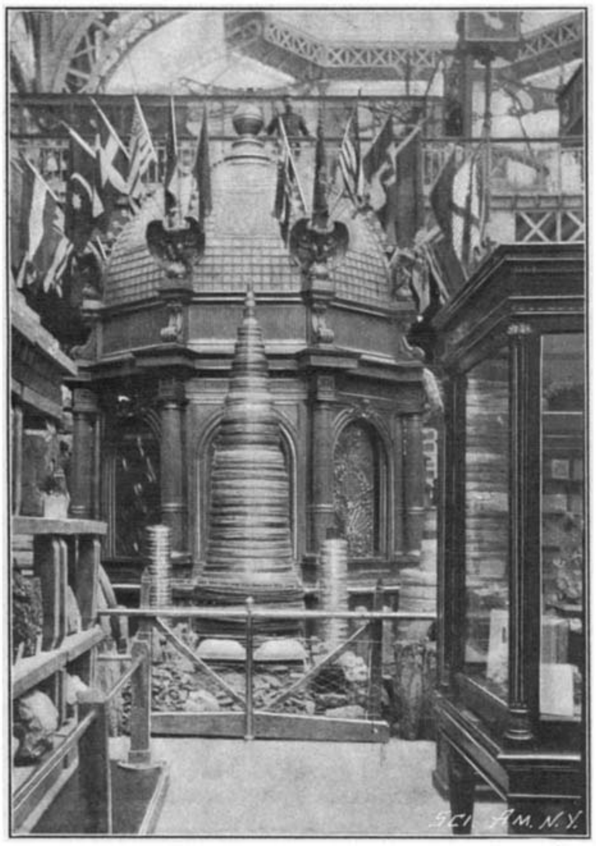
A clergyman in England undertook to drive his De Dion voiturette after a few hours' coaching, says The Motor Car Journal. He was spinning along at a rapid pace when a cyclist suddenly cut across the road. It was the first emergency in which he had been involved, and consequently he had not that instantaneousness of action which is essential to the motor-driver. The car crashed into the cyclist broadside, and then the whole mix-up went into the ditch. The passengers were not seriously hurt; but the motor car had its axles broken, while the bicycle was completely wrecked. Mr. T. Ireland, of Belfast, had another nasty experience near Bangor. A shying horse caused him to swerve his car so indiscreetly that it turned right over, shedding the occupants precipitately. Once again good fortune prevented any serious bodily mishap.

A new steam-automobile has been brought out by the Mann Company, of Leeds. It is designed to transport loads of four tons; it is a four-wheeled vehicle, carrying in the rear a truck with a platform 11 feet long by 6 feet wide; its extreme dimensions are 6 by 17 feet. The platform is independent of the tractor, and is carried upon its own wheels, which are of the same diameter as those of the machine and spaced at a considerable distance; the wheels of the rear truck are united to the motor by gearing, so as to render them equally effective; the advantage of this combination is that all the weight is utilized for adherence. The wheels are of iron and steel; those in front have 35 inches diameter, those in the rear, 46 inches, the tires being 5½ and 12 inches wide respectively. The tractor resembles a road-locomotive. The furnace, of locomotive type, has the fire-gate placed on the side next the conductor; it has four square yards of heating surface. The water-tank has a capacity of 230 gallons, and the coke-box contains 200 pounds. The engine, of the compound type, has a high-pressure cylinder of 4 inches diameter; that of the low-pressure is 6½ inches, with a stroke of 8 inches. The valves are operated by eccentrics provided with reversing arrangement of special construction. For starting on high grades, a valve permits the introduction of high-pressure steam into the low-pressure cylinder. The feed-pump is furnished with a by-pass by which the supply is regulated; an injector is also provided. The transmission from the main shaft to the axles is made by steel gearing and differential; two changes of speed are provided, one being two and one-half times the other. Strong brakes are provided for all the wheels. The weight of the vehicle complete, without water or combustible, is 6,500 pounds, the truck weighing 2,400 pounds. The vehicle was tested at the time of the Bradford Exposition. It was loaded with four tons of wool in bales and four passengers, besides the conductor. It left Bradford at 10 h. 25 m. A. M., and came back to the starting point at 8 h. 27 m. P. M., having made a certain number of stops to take water or fuel, etc. Taking account of the different stops, which lasted 3 h. 47 m., an average of 4·6 miles per hour is obtained. The consumption of coke or coal needed to keep up the pressure during the stops was 330 pounds; under the above conditions, about 10·4 pounds of coke were burned per mile. The total quantity of water consumed was about 600 gallons. The starting and stopping was effected rapidly and without difficulty on level or on grades; the noise is not excessive for a vehicle of this kind, and there is scarcely any smoke or steam. The committee considered this type of vehicle as one of the most satisfactory solutions of the problem of freight transportation on roads. The cost of transporting a ton of merchandise per mile will not likely exceed $0.07, compared with $0.15 for horse transportation.

PARIS EXPOSITION.—UNITED STATES MINING AND METALLURGICAL EXHIBIT.

Among the exhibits in the Palace of Mines and Metallurgy at the Paris Exposition, that of the United States has a prominent place, and is considered one of the finest displays in the section. The success of the exhibit is due largely to the efforts of Messrs. F. J. V. Skiff, who has general charge of the United States section, W. S. Ward, assistant director, and V. C. Heikes, expert, and to the co-operation of Mr. Adolf Ekman, in charge of the California Mining Department. The façade, as seen in the illustration, is of massive and elegant construction, the materials being bronze, iron work and marble; the latter is used for the columns and panels, showing different varieties. The central and adjacent portion and a third space in the rear are occupied by an extensive collection of the different minerals of the United States. At one end is the display of the Standard Oil Company, and at the other the metallurgical exhibits, with a handsome pavilion in the center. In the central space, the display of ores and minerals is very complete. The illustrations show the arrangement of the cases. In one corner, three cases are taken up with non-metallic specimens; the large block of soda in the corner case comes from Wyoming; it is about two feet cube, and forms part of a deposit varying from one to sixteen feet in thickness and covering large areas; with it is a collection of borax from California; among other specimens are bone phosphates, monazite sands, talc and asbestos from Colorado. In the upright cases are collections of iron ores, etc. Another set of cases contain malachite and azorite from Arizona, rough and polished; the collection of copper ores and native copper is especially fine, including all the principal varieties. A large silver nugget is shown, weighing 338 pounds, taken from the mines at Aspen, Col.; it is valued at $3,244. Another collection is that of gold quartz and ores, many of the specimens being from the Cripple Creek mines, also telluride ores, raw and roasted, and gold dust from the Yukon River, zinc ores, gold and silver-bearing lead and others.

Among the great profusion of specimens may be noted a large block of magnetite, a collection of nickel ores, antimony, iron ores, etc. The exhibit of gold ore and nuggets from California form one of the interesting features of the section. It has been arranged under the direction of Mr. Ekman. The central case shown in the illustration contains fine specimens of nuggets and of gold in different forms. At the top is a specimen of crystallized gold weighing 180 ounces and valued at $3,700. It was taken from the mines owned by Mr. Fricot, who has contributed many of the finest pieces. A rare specimen of gold in calcite has been loaned by Mrs. F. Zeitter, and among other fine pieces is a plaque of crystallized gold from Tuolumne County, and a number of large nuggets from the Beaudry mines. Crystallized gold from the Davidson mine is shown; and gold dust, quartz gold, etc., are well represented. Besides the California specimens, the central case contains gold from Leadville and specimens loaned by the Colorado Scientific Society. An adjoining case contains a large number of California specimens of great interest. In the adjoining space is a systematic collection of minerals of the United States, arranged and labeled; these are contained in seven large cases, and have been contributed by the Michigan School of Mines, Colorado College, Cornell and Princeton Universities, the Massachusetts Institute of Technology, and the University of Chicago. A collection of crystals to illustrate crystallography has been sent by the Field Columbian Museum of Chicago. The space devoted to the library



PAVILION OF AMERICAN STEEL AND WIRE COMPANY.

contains a full set of publications of the United States Geological Survey, the surveys of each State are represented; a large case contains various publications. In this room is a case with a fine display of carborundum from the Niagara works, showing masses of crystals, moulded forms, etc. The space to the right of the central room contains the interesting collection of Tiffany & Company, showing precious and semi-precious stones of the United States. This collection, which is shown in the illustration, has been bought by a prominent capitalist and presented to the American Museum of Natural History. In front is a large section of rhodonite, besides large quartz crystals and arrowheads, fine sections of agate, amethyst, etc. The sphere seen at the top is cut from rock crystal. At the sides are specimens of malachite, rough and cut, from the Arizona mines. An interesting piece is a section of meteorite containing periodot; cut and uncut gems of all kinds are shown, including beryl, sapphire, tourmaline, etc. A smaller case contains specimens of petrified wood from Arizona, with sections of trees, also collections of precious stones. Prof. Binns, of the Massachusetts Institute of Technology, has arranged a collection of clays of the United States, burned and unburned, and another collection by Prof. Fuller shows different varieties of building stone. In the rear of the central room is an exhibit of American coal, with numerous specimens of all kinds, also representative sections of coal-veins, enclosed in glass columns to show the strata. Next to it is the exhibit of the Barber Asphalt Company. An adjoining space contains a number of specimens of ores; Mr. H. P. Stowe contributes a set showing the treatment of ores. A collection of steel shells is to be seen, and a fine model of the Robins' conveying belt.

The metallurgical display is quite extensive, and has been arranged to the best advantage. The fine bronze pavilion shown in the illustration has been erected by the American Steel and Wire Company, a syndicate of forty large companies. It contains exhibits of steel in various forms, and around it is a collection representing the manufactured products of the different metal, in the form of wire, rods, sheet metal, etc. Four cases contain screws, wire, nails, springs, etc. On the left of the illustration will be seen part of the display of the Copper Queen Mining Company, of Arizona, showing plates, ingots, and other forms, the total weighing 147,600 pounds. One of the illustrations shows a fine model of a California gold stamping mill, to be seen in this section; it is about 7 feet high, including base. It has been built under the direction of the California Commission by the Union Iron Works, of San Francisco. The machinery is driven by a small electric motor, illustrating the different processes by which the ore passes to the crusher, stamping mills, concentrator, etc. Next to it is the exhibit of the Colorado Fuel and Iron Company, showing rails, sections, piping, bolts, etc. Near it is the petrotome of Prof. Dwight, of Vassar College, used for making sections of minerals; a number of specimens of ore are shown. A model of a California sluice box is to be seen, with a collection of photographs from various mines. The Iron Age Library contains a collection of all the catalogues relating to the industry, and next to it is the exhibit of the American Tin Plate Company, in the form of a pavilion constructed of tin or sheet iron in plain and ornamental work; it contains a large display of tin and iron plate. The exhibit of the Crescent Steel Company is worthy of note; it shows a variety of dies, punches, and tools of various kinds, most of which have been loaned by different manufacturers after having been in use for long periods; the record of each piece is given; some of the dies have struck off millions of pieces.

The farther end of the section is occupied by the pavilion of the Standard Oil Company, under the supervision of Dr. David T. Day. It is handsomely decorated; above is a frieze showing oil wells, transportation, etc. In the rear is a large oil painting showing the burning streams of petroleum as known to the Indians, and the early history of its discovery. Below it is a fine piece of work, representing a section of the oil region of Pennsylvania, in large size, with the

UNITED STATES MINING AND METALLURGY EXHIBIT AT THE PARIS EXPOSITION.

geological formations as determined by the boring data. On page 152 are shown miniature derricks and the surface of the country. The pavilion contains a large collection of different oils and petroleum products, vaseline, paraffine, etc.

THE MAKING OF A HALF-TONE ENGRAVING.

The general introduction of photo-mechanical engraving processes has wrought a revolution in the publishing world. Possibly it has not been as far-reaching as regards books, as in the case of periodicals, but it has changed entirely the character of many magazines and weekly papers, and now it is possible even for daily papers to make half-tone plates which are adapted for printing on octuple presses in a space of time which a few years ago would have seemed nothing less than marvelous. The new processes have permitted of double and treble the number of illustrations being used, owing to their comparative cheapness. As for the quality of the work, it is safe to say that these processes should be used to the exclusion of all others for reproducing works of art and certain classes of subjects in which the inter position of artists or artist-artisans is not desirable.

The very general adoption of the half-tone process for the illustration of high-class periodicals and books practically sounded the death-knell to wood-engraving, which is fast becoming almost a lost art, having comparatively few exponents of note at the present writing, so that in a few years wood-engraving will be practised, perhaps, only in art schools.

Omitting an historical outline of the steps by which the half-tone process has been developed, we will proceed at once to describe a thoroughly modern process establishment, taking up the various steps in the making of a half-tone plate, from the time the copy is placed before the camera until a reproduction of it is printed in the periodical. The plant which we have selected for the purpose of illustration is located on the fourteenth floor of a building devoted almost entirely to printing, and being next to the Brooklyn Bridge the building enjoys remarkable advantages as to light. When the copy, which is usually a photograph or a wash drawing, is brought into the establishment, the requirements of the customer as to time of delivery, character of plate, fineness of screen, proofs, etc., are entered upon numbered cards, which are temporarily filed away (to later receive data as to size of plate and cost of making), the operative data on the cards being noted upon slips which follow the plates through the various stages of manipulation in the shop. If the photograph needs retouching it is sent to the retouching room, where several artists are employed. The retouching of photographs is practically a new profession, and the results which are obtained by this treatment are very remarkable. On a machinery subject it is possible for the retouching to exceed in cost five or ten times the expense of making the plate.

The copy is taken up to the photographic gallery, which occupies a mezzanine story immediately under the roof, where both daylight and electric light through powerful arc focusing lamps are available, the latter being used chiefly on cloudy days.

The first step in the production of the half-tone plate is the making of the half-tone negative, which differs from the ordinary dry-plate negative in that the half-tone image is recorded in the shape of a series of dots and spaces due to the use of a finely-ruled glass screen. The camera beds are made very long in order to obtain the proper reduction in cases where the copy is large and the desired plate small. The copy is fastened to the copy board, which stands vertically at right angles to the runway at one end of the camera bed, the latter being adjustably supported by springs attached to the stand proper, the object of the springs being to absorb vibration, or, to put it in another way, to insure the simultaneous vibration of the camera box and copy, so that the relation of one to the other is absolutely the same throughout the time of exposure. Having moved the camera box back and forth along the bed until the image is of the desired size, the camera box is then firmly secured to the bed by a turn of a binding screw and the image is brought into sharp focus on the ground glass. The photographer is now ready

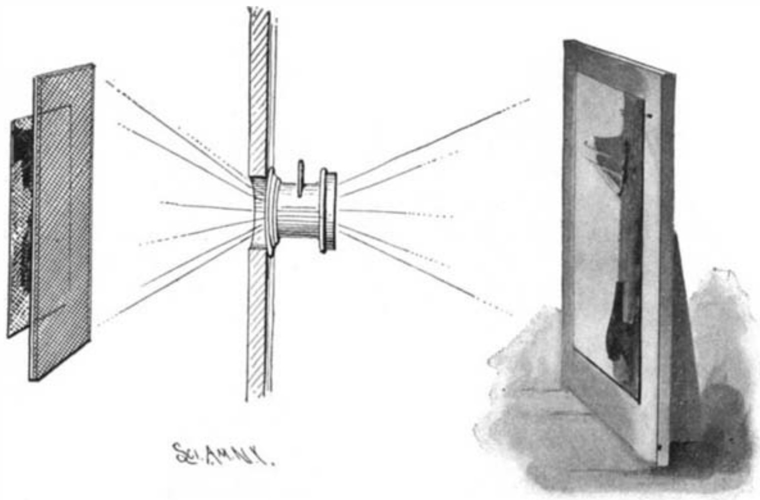
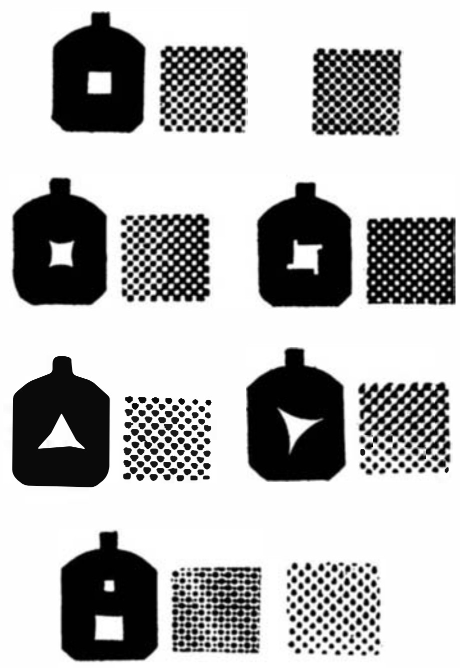


DIAGRAM SHOWING THE RELATIVE POSITION OF PLATE, SCREEN AND COPY.

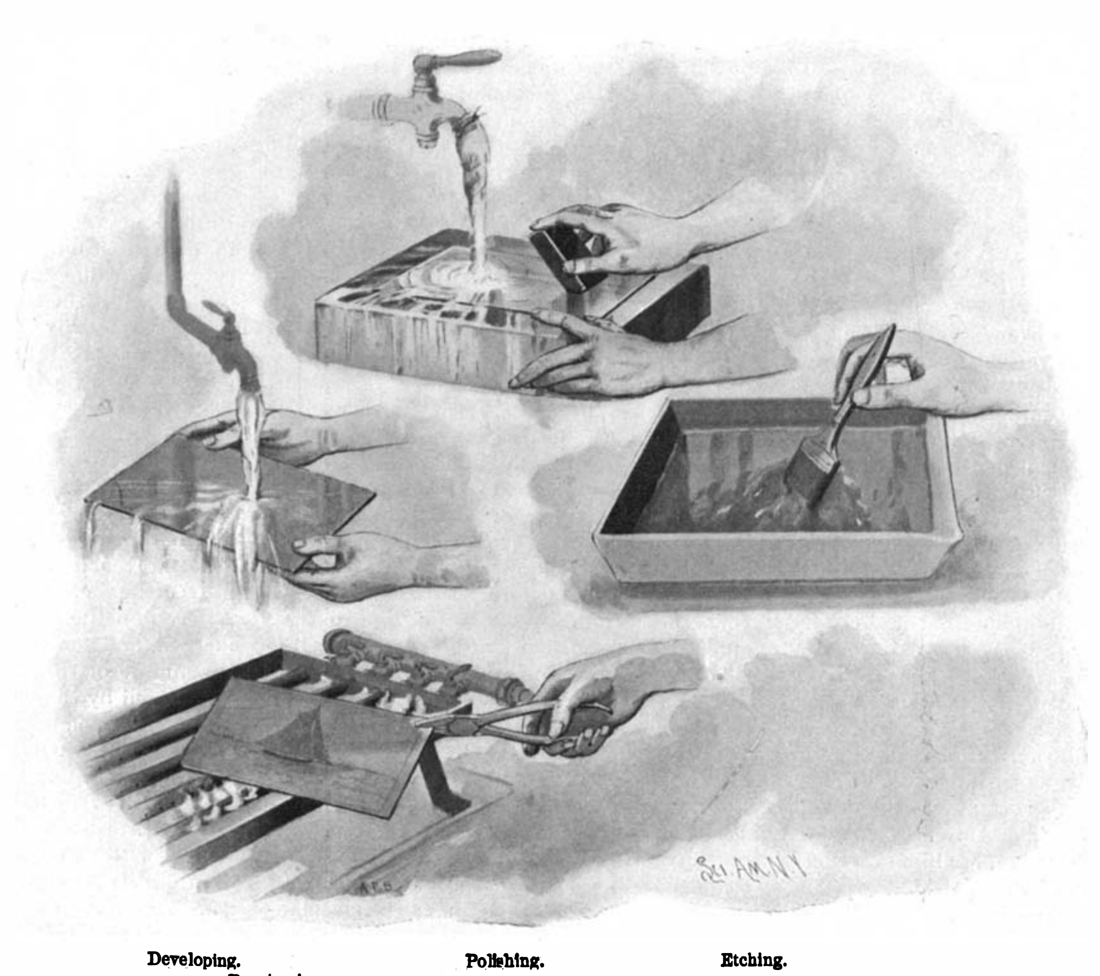
to prepare his wet-plate, the wet-plate process being particularly adapted for photo-engraving purposes, owing to the facility with which it can be manipulated to get desired results. He takes a perfectly clean piece of glass, previously albumenized, free from dust, and flows over it an iodized collodion, obtaining



MODIFICATION OF THE DOT BY DIAPHRAGMS.

an even coating by allowing the collodion to run off at one corner of the glass plate.

When the collodion sets, the plate is then sensitized by placing it in a silver nitrate bath. When sensitized the plate is put in the plate-holder and is then ready for the exposure. The process plate-holder is of special construction and is adjustable so as to hold any



Developing. Burning in. Polishing. Etching.

VARIOUS STAGES IN THE TREATMENT OF THE COPPER PLATE.

size plate up to the limit for which the camera was designed. The holder also contains the ruled screen which is placed at a very short distance from the sensitized plate, between the latter and the lens, as indicated in the accompanying diagram. This diagram also serves in a measure to show how the production of the dots of the half-tone negative is effected.

The half-tone screen is made up of two plates of glass that have been carefully ruled on one side, the plates being cemented together, ruled side to ruled side, in such a way that while the lines are ruled diagonally across each plate, the lines of one plate run at right angles to those on the other when the two plates are put together, producing a mesh representing from eighty to two hundred and fifty lines per inch. In making half-tone plates the coarseness of the screen employed depends upon the use for which the plate is intended. For a large number of periodicals the one hundred and seventy-five line screen is one which gives general satisfaction, that screen having been used in making the engravings which accompany this article.

The dot in the half-tone negative represents the double effect of the screen and the diaphragm, which is inserted in the tube of the lens. The forms of some of the diaphragms are jealously guarded by photo-engravers. Square and round-hole diaphragms, as well as many other types are employed, as shown in our diagram, the kind of diaphragm used depending upon the effect desired in the negative. When the print from the half-tone block is examined, it will be found that the size of the dots and spaces vary, the dots being smallest in the high lights of the picture, growing larger in the dark portions, the inter-spaces growing correspondingly small, and disappearing entirely in the absolutely black parts of the picture. The form of the dot can also be modified by the use of different intensifiers. The first diaphragm to be used having been inserted in the lens-tube, the plate-holder having been secured in place and its slide drawn, the cap is removed from the lens and the exposure begins, the time of the exposure depending upon the character of the copy, intensity of light, effect to be secured, etc. At night or when daylight is not sufficiently strong, electric light is used.

Having been exposed, the plate is taken to the dark room and developed, the kind of developer used depending upon the judgment or particular practice of the operator, the expert varying his manipulation with different subjects within surprisingly wide limits. The image appears in about five seconds, and the plate is fixed with a solution of potassium cyanide. If the negative is not of the required density, it is intensified. The negative is allowed to dry, when it is coated with a solution of rubber, and this coating is followed by another of collodion for the purpose of securing greater body in the negative to permit of its being handled. In order to secure a printed image like the copy it is necessary to reverse the negative. Should the negative not be reversed then the right hand side of the printed proof would represent the left hand side of the photographic copy. This is done by stripping the film from the plate. The glass is placed in a specially designed "squaring frame" having squared metal edges, and after adjusting the T-square and squaring the negative, as shown in one of our engravings, the portion of the film which it is desired to transfer for printing is cut with a sharp knife, so that when placed in an acid bath for the purpose of loosening it from the glass the desired portion may be readily removed, reversed, and transferred to another and thicker glass plate, which is used in printing the picture on the sensitized copper.

The copper plates come already polished, but it is necessary to give them a high finish before using. This is accomplished by rubbing them with willow charcoal and water. The copper plate is dried and coated with a sensitizing solution, which is flowed on in the same way as the collodion was on the glass plate. The copper plate is placed in an A-shaped clamp and the sensitized coating is evenly distributed over the plate by means of what is called the "whirler," the construction of which will be readily understood by reference to the engraving. The clamped plate is hung face downward toward the floor in a large box having a gas stove at the bottom, and is fastened to a swiveled wire support so that it can be whirled rapidly. The motion causes the coating to be evenly distributed by centrifugal action and at the same time plate is dried. The half-tone printing frame does not differ materially from the ordinary photographic printing frame, except that it is much more strongly built and is heavier. In the front of the printing frame there is a sheet of plate glass about an inch thick. The negative is placed in the printing frame next to the front glass with the face of the negative in contact with the sensitized copper plate. The back of the printing frame is then secured and by means of a number of hand screws great pressure is applied so as to hold the copper plate in the closest possible contact with the negative. Either daylight or electric light can be used for printing. One of our engravings shows the latter method, the required exposure with electric light taking more time than with daylight. When the plate is taken out it is placed under a jet of running water, by which means the image is developed. Following development the copper plate is gripp d with a pair of pliers and held over a gas stove, as indicated by one of our illustrations, for the purpose of "burning in" the image, after which process the plate is placed in an etching bath of chloride of iron, wherein it receives the first etch. What are termed flat proofs of the plate are then made on a "Washington" hand proving press, and if the flat proof indicates the presence of those qualities in the plate that have been sought, the plate then passes to the "router."

In the case of a vignetted subject, where the tint is allowed to die away around the edges, the plate is clamped in what is called a "routing" machine which is designed to give a speed of three or four thousand revolutions per minute to a small cutter whose section is varied according to the part of the work it is intended to perform. The routing machine, like all the other machinery of this establishment, is run by an independent electric motor. The router follows around the edges of the tint, cutting away all superfluous metal. Except in the case of silhouettes, there is little routing in subjects which are not vignetted, but in some cases the sky or background of a picture which is defective is removed by the router. In the case of what are known as "square" plates, a bevel groove is run all around the plate at a short distance from the printing edge to allow for securing it to the wooden block on which it is to be mounted, and also to permit of the excess metal being readily cut off.

If an examination be made of most half-tone plates, it will be found that there is a black line bounding them with a white line just inside the black one. Both lines, together with the grooving, are made on the plate by a beveling machine, which is something like a planer and a milling machine combined. The plate is securely clamped to a movable bed, which is moved by hand, planer fashion, so as to bring the plate under a steel graver, which cuts the black line and the white line in the plate. The current is then turned on to the motor, causing a circular beveling cutter to rotate at a high rate of speed. The bed carrying the copper plate is then run under the cutter, which "mills" a groove. This is done with all four sides of the half-tone.

The plate is now ready for the "finishers," upon whose artistic judgment much of the success of the plate depends. The finishers "stop out" or paint out with asphaltum varnish those parts of the engraving which are not to be re-etched. In the accompanying illustration of the finishing operation, the workman on the right is engaged in painting out the locomotive, to the smallest detail, so that the background may be lightened by re-etching. The finishers take out all imperfections in the plate, improving it as compared with the original copy by means of roulettes, burnishers, and wood engravers' tools. The extreme high lights are often put in with the engravers' tools, a sample of which work will be seen in the cut of the grooving and scoring (technically styled "beveling") machine, in which the high lights are emphasized by white lines. The high lights of the picture having been re-etched, and the shadows burnished where necessary, in order to secure brilliancy without a sacrifice of the delicate middle tones, a proof of the plate thus "finished" is inspected and passed upon, the full quota of proofs are "pulled," and then the plate is ready for mounting or "blocking." Holes are drilled for the nails that are to secure the plate to the wooden block, which is cut to the proper size, the excess metal being cut away before blocking. Nothing but the best seasoned maple, specially prepared, is used for blocking. Such, in brief, are the many and complicated steps necessary to make a satisfactory half-tone plate. It needs not only a considerable plant, but also expert and conscientious work at every step of the process. We are indebted to The American Machinist Press, whose photo-engraving plant we illustrate, for courtesies in the preparation of this article.

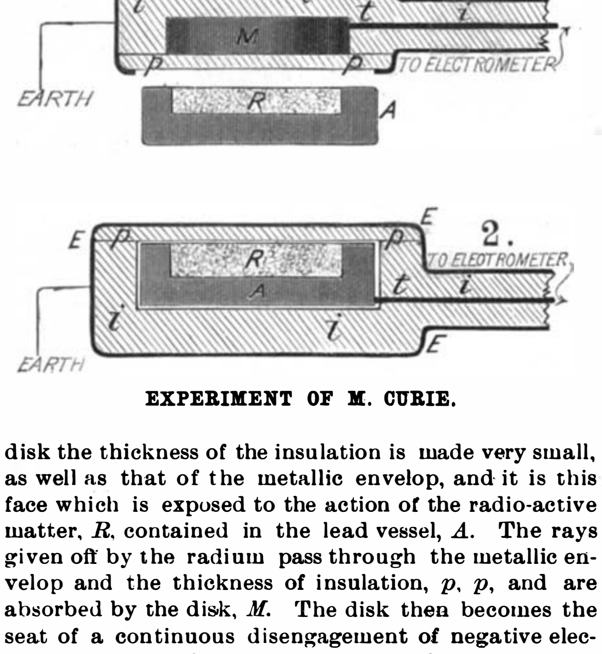
SILCHESTER, Hants, England, still continues to yield valuable specimens from the old Roman city, and an exhibition of some of them was recently held at Burlington House, London.

EXPERIMENTS ON THE CATHODE RAYS.

M. Curie, in continuing his researches upon the waves given off by radium, has brought to light a remarkable phenomenon in connection with this form of radiation, namely, that these waves are possessed of an electric charge. They thus show a close relation to the cathode rays. It will be remembered that M. Becquerel has shown that the rays given off by radium may be deflected by the magnetic field, like the cathode rays, and that M. Curie, in a former series of experiments, showed that two kinds of rays were given off by that body, only one of which is thus deflected, the other remaining unchanged. It is the former series of waves that are to be considered in the present experiments.

The cathode rays, as M. Perrin has shown, are charged negatively, and this charge may be carried through a metallic envelop which is connected to earth, as well as through an insulating screen. It is found that in those cases where the cathode rays are absorbed, there is a continuous disengagement of negative electricity. M. Curie has now shown that the same phenomenon takes place in the case of the rays given off by radium; like the cathode rays, they are charged negatively. As this charge is much weaker than that of the cathode rays, special precautions must be taken in making the experiments, in order to reveal the presence of the charge by the electrometer. The action of the air was found in some preliminary experiments to have an objectionable influence, and it was found, in fact, that it was impossible to observe the phenomenon unless the air is excluded, to a certain extent, from the path of the rays. The radio-active matter must be placed, therefore, in a vacuum tube, or surrounded completely by insulating material. The latter method is the most convenient to carry out, and the experiments were made in the following manner:

A metal disk, *M*, Fig. 1, is connected by a rod, *t*, to a sensitive electrometer, the disk and rod being completely surrounded by insulating material, *i*, *i*, *i*, and the whole covered with a metallic envelop, *E*, *E*, *E*, connected to earth. Opposite one of the faces of the



EXPERIMENT OF M. CURIE.

disk the thickness of the insulation is made very small, as well as that of the metallic envelop, and it is this face which is exposed to the action of the radio-active matter, *R*, contained in the lead vessel, *A*. The rays given off by the radium pass through the metallic envelop and the thickness of insulation, *p*, *p*, and are absorbed by the disk, *M*. The disk then becomes the seat of a continuous disengagement of negative electricity, as is seen by the action of the electrometer and a delicate current-measuring instrument. The current thus produced is very small; with the radio-active matter having a surface of 2·5 square centimeters and a thickness of 0·2 centimeters, a current was observed having for its order of magnitude 10^{-11} amperes, the rays having passed through 0·01 millimeter thickness of aluminium and 0·3 of ebonite before being absorbed by the disk. For the disk different metals were used, such as lead, copper, zinc, etc., and for the insulating material, ebonite and paraffine; the results were about the same in all these different cases. The current is naturally diminished when the source of the rays is further removed, or when less active matter is used.

A second experiment was made in which the lead vessel was placed in the center of an insulating mass and in connection with the electrometer, as shown in Fig. 2, the whole being enveloped by the metal covering, connected to earth as before. In this case, it is observed that the radium takes a positive charge, equal in value to the negative charge of the first experiment. This is due to the fact that the rays pass through the insulation and the metal covering, carrying off a negative charge and leaving the interior conductor with a positive charge. It will be observed that the second form of radiation given off by the source does not enter into action in these experiments, these rays having been already absorbed by the metallic covering, as they have but little penetrating power.

The experiments thus show that the rays given off by radium carry an electric charge, in the same manner as the cathode rays, though in less degree. Up to the present the existence of an electric charge which is not connected with ponderable matter has not been admitted, and, therefore, it must follow that the radio-active matter is the seat of a continuous emission of particles which are negatively electrified, and which will pass through a conducting or dielectric screen without discharging.

The World's Great Fires.

U. C. Crosby, late President of the National Fire Protection Association, has compiled a very interesting list of the world's great fires. In describing some of the most important disasters he says:

"London was nearly destroyed by fire in 798; again in 982, 1212, and 1666. The latter fire is known in history as the Great Fire; it burned over a territory of 436 acres, including 400 streets; 13,200 buildings and property-values upward of $53,000,000 were destroyed. Edinburgh was nearly destroyed by fire in 1700. Lisbon was burned in 1707. Venice was destroyed by fire in 1106 and again in 1577. Berlin was destroyed in 1405. Berne in 1634 and again in 1680. Hamburg was nearly destroyed by fire in 1842; 4,219 buildings were burned, and 100 people lost their lives; property value destroyed, $35,000,000. Copenhagen was burned in 1728; 1,650 houses destroyed; again in 1795, and 1,563 houses burned. Stockholm in 1751, with 1,000 houses destroyed. Moscow in 1752, visited by a large fire; 18,000 houses destroyed. Again in 1812; this time the fire set by Russians in order to prevent the French occupation of the city; 38,000 houses were destroyed, and over $150,000,000 of value.

"Constantinople has been the scene of numerous and costly fires; in 1729 a great fire destroyed 12,000 buildings and nearly 6,000 people. In 1745 another great fire lasted five days; again in January, 1750, 10,000 buildings destroyed. In April, the same year, another fire, with $15,000,000 of property destroyed. Again, later in the year, a fire destroyed 10,000 houses; in 1756, 15,000 houses were destroyed and 100 lives lost. In 1782, 10,000 houses were burned; in 1791, between March and July, serious fires destroyed 32,000 houses, and nearly the same number were destroyed again in 1798. In 1816, 12,000 houses and 3,000 shops were destroyed. In 1870 Pera, a suburb of Constantinople, was nearly destroyed, 7,000 buildings and over $25,000,000 property value being consumed.

"Smyrna had great fires in 1763, 1792, and 1841, destroying from 2,000 to 12,000 buildings at each fire. Great fires have occurred in India, China, and Japan; in many cases large cities were entirely destroyed. In Quebec, in 1845, 1,650 buildings were destroyed, and the same number in May and June following; and in 1866, 2,500 buildings and 17 churches were destroyed.

"St. John, N. B., 1837; nearly all the business portion was destroyed. In 1877 the 'great fire'; over 200 acres burned, and 10 miles of street; about $13,000,000 of property-value. St. John's, Newfoundland, in 1846 was nearly destroyed and $50,000,000 of property-value burned; again a big fire in 1896. Montreal in 1850 had a great fire; 250 buildings destroyed; in 1852 about 1,200 buildings were destroyed. Various cities in South America and West Indies have been destroyed by fire; in some cases property-values of $30,000,000 and upward were destroyed; a large loss of life resulted also.

"The United States has a record of destruction of property by fire not equalled by any other country. Charlestown, Mass., in 1796, $300,000; in 1838, 1,158 buildings. Savannah, Ga., in 1820, 463 buildings and $3,000,000 value. New York, in 1835, 530 buildings, 52 acres burned over, and 15,000,000 of property destroyed; in 1845, 300 acres burned over, $7,500,000 value, 35 lives lost. Pittsburg, Pa., in 1845, 100 buildings; $1,000,000 property value. St. Louis, Mo., in 1849, 15 buildings; $3,000,000 value; in 1851, 2,500 buildings destroyed. Philadelphia, Pa., in 1850, 400 buildings. San Francisco, in 1851, 2,500 buildings, and a number of lives lost; property value, $10,000,000. Portland, Me., in 1866, over one-half the city; 200 acres burned over, and 1,743 buildings destroyed. Chicago in 1871, known as the 'Great Fire'; 2,124 acres nearly covered by buildings entirely burned over, including 17,430 buildings; many lives were lost, and property value of upward of $106,000,000 was destroyed. Boston, Mass., in 1872; 65 acres of the mercantile section burned, including 776 buildings; nearly all of brick-and-stone construction; property value, $75,000,000."

THE French Naval Department has been conducting further experiments with its submarine vessels. At Toulon the "Gustav Zédé" left the harbor submerged, and continued her journey under water, until the middle of the roadstead was reached. This was considered by the officials conducting the experiments to be a phenomenal performance. The "Morse" and and the "Narval" went through their trials at Cherbourg. According to the opinions of the officers surveying the experiments, the "Morse" is considered the more satisfactory, since it plunges with more ease, and travels with more freedom than the other vessel, which occupies at least twenty minutes in sinking. This is considered too great a length of time. Two other types of submarine vessels are approaching completion at Cherbourg. They are La Française and L'Algérien. They will undergo their official trials at an early date.

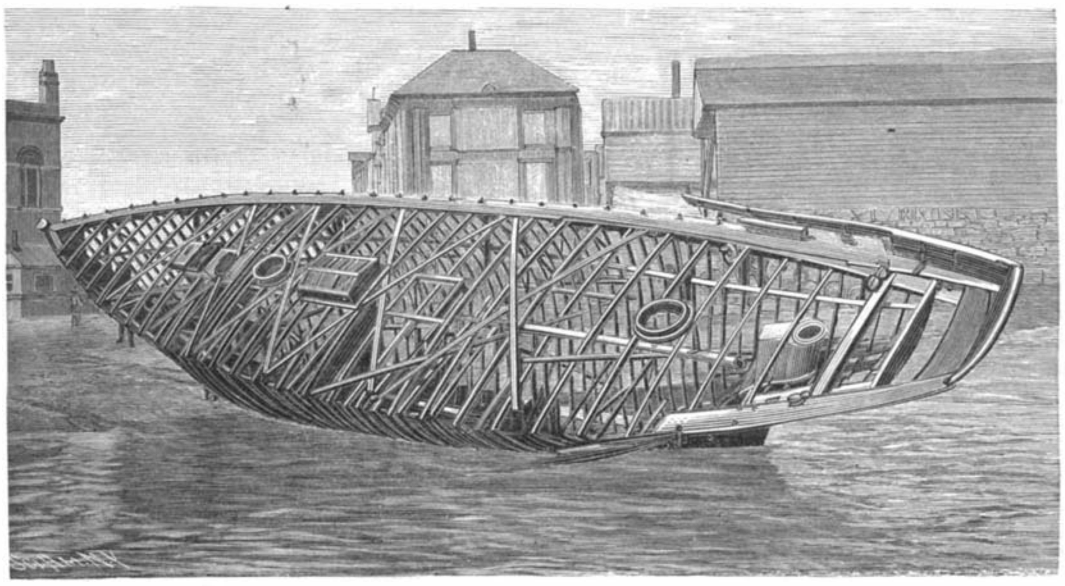
THE LAST OF A FAMOUS "AMERICA" CUP CHALLENGER.

Of all the English yachts which have come over to compete for the "America's Cup," there is probably none that has made such a good record for herself as the fine old English cutter "Genesta,"; certainly, she came nearer winning the cup than any yacht that preceded her or came after. The American yachting enthusiast who was so fortunate as to be present at that famous race in 1885 of twenty miles to leeward and return, will not soon forget the anxiety with which he saw Sir Richard Sutton's yacht slipping down the wind to the outer mark with an ever-widening distance between her and the centerboard "Puritan," nor the delight with which, when the boats hauled on the wind he saw the center board slowly, but steadily, out-weathering the cutter, and finally romping home the winner by the close but undeniable margin of 1 minute 38 seconds. In the light weather trial the shallow centerboard with her relatively large sail area proved to be a far faster boat than the "Genesta." Although she failed to take home the cup, "Genesta" was successful in winning both the Brenton Reef and Cape May cups.

The "Genesta" was a typical English deep-keel, outside-lead cutter of the so-called plank-on-edge type; though she was not so extreme in her relation of beam to draught as some cutters of her time, she was sent over here at a time when the "keel versus centerboard" controversy was at its height. In none of the races that have followed those of 1885 have the competing yachts of the two nations shown so strongly the distinguishing national characteristics as did "Puritan" and "Genesta," the one being distinguished by narrow beam, deep draught, outside ballast, large displacement and relatively small sail plan; the other by great beam, shallow draught, and both inside and outside ballast, the outside ballast being the first step toward the cutter type, just as the English "Thistle" in adopting a beam of 20 feet showed the first tendency toward the characteristic beam of the American sloop.

The "Genesta" was a composite built boat (elm planking on steel frames), and measured 96 feet on deck, 81 feet on the waterline, 15 feet beam, and 13 feet 6 inches draught. She had a displacement of 141 tons and a sail area of 7,141 square feet. The "Puritan" was 93 feet on deck, 81 feet 1½ inches on the waterline, 22 feet 7 inches beam, 8 feet 10 inches draught, with a displacement of only 105½ tons and a sail area of 7,370 square feet.

The accompanying illustration, for which we are indebted to The Yachtsman, shows the famous old cutter upon the beach in process of being broken up for old iron and junk, an inglorious end that overtakes all craft except a few favored warships like our own "Hartford," or Nelson's old ship, the "Victory."



PRESENT APPEARANCE OF THE FAMOUS CUP CHALLENGER "GENESTA."

THE FIRST-CLASS BATTLESHIP "ALABAMA"

The "Alabama," whose record of 17 knots an hour on her recent official trip, places her at the front rank of our battleships for speed, will always be a vessel of particular interest, from the fact that in her we see the introduction of a new type in the United States Navy. Comparing her with the "Oregon," the "Iowa," or the "Kearsarge," the most noticeable difference is the entire absence of the 8-inch gun. Hitherto our battleships have been distinguished from those of other navies largely by the fact that they carried a much heavier armament, due chiefly to the presence on board of a complete battery of guns which were intermediate in power between the main battery of 12-inch and 13-inch guns, and the secondary battery of rapid-fire guns of 5-inch and 6-inch caliber. The battleships of Great Britain, France, and Germany, and with a few exceptions, of Russia, have carried no guns of a caliber between the 12-inch and the 6-inch weapons, and in the "Alabama" we see the first disposition on the part of our naval constructors to follow the European practice. Although the absence of the 8-inch gun is very sincerely regretted by most of our officers of the line, it cannot be denied that in the "Alabama" the heavy secondary battery of 6-inch guns, on account of its rapidity of fire and the enormous weight of metal which can be thrown in a specified time, goes far to offset the removal of the very popular 8-inch breech-loading rifle.

The "Alabama" was authorized June 10, 1896; the contract for her construction by the William Cramp & Sons Ship and Engine Building Company was signed the following September; the keel was laid the December of the same year, and the vessel was launched on May 18, 1898, and has now been completed about eleven months later than the contract date, this delay being due to the failure of the builders, on account of the armor-plate controversy, to receive the necessary armor during the construction of the ship. The vessel is 360 feet long, 72 feet 2½ inches broad, and has a mean draught, when fully equipped for sea, and with 800 tons of coal on board, of 23 feet 6 inches. Her displacement on the draught given is 11.565 tons. She is driven by twin-screw, vertical, triple-expansion engines, and steam is supplied by boilers of the Scotch type. Her normal coal supply is 800 tons and her bunker capacity with nominal loose stowage is 1,200 tons, while with close stowage she can hold 1,440 tons in the bunkers. As compared with the "Kentucky" and "Kearsarge" she has about 8 feet more freeboard, due to a spar deck which extends from the bow about two-thirds of the way out. Her protection consists of a belt of Harveyized armor of a maximum thickness of 16½ inches, which tapers toward the bow and stern. Above the belt, amidships, side armor of 6 inches is carried up to inclose and protect the guns of the secondary battery. The main battery of four 13-inch guns is carried in elliptical balanced turrets which have 14 inches of armor protection. The secondary battery is extremely powerful and consists of fourteen 6-inch rapid-fire guns, twelve of which are carried on the main deck and two on the boat deck amidships. She is also armored with sixteen 6-pounders, six 1-pounders, four Colts, and two 3-inch field guns. She is fitted with four tubes for the discharge of Whitehead torpedoes.

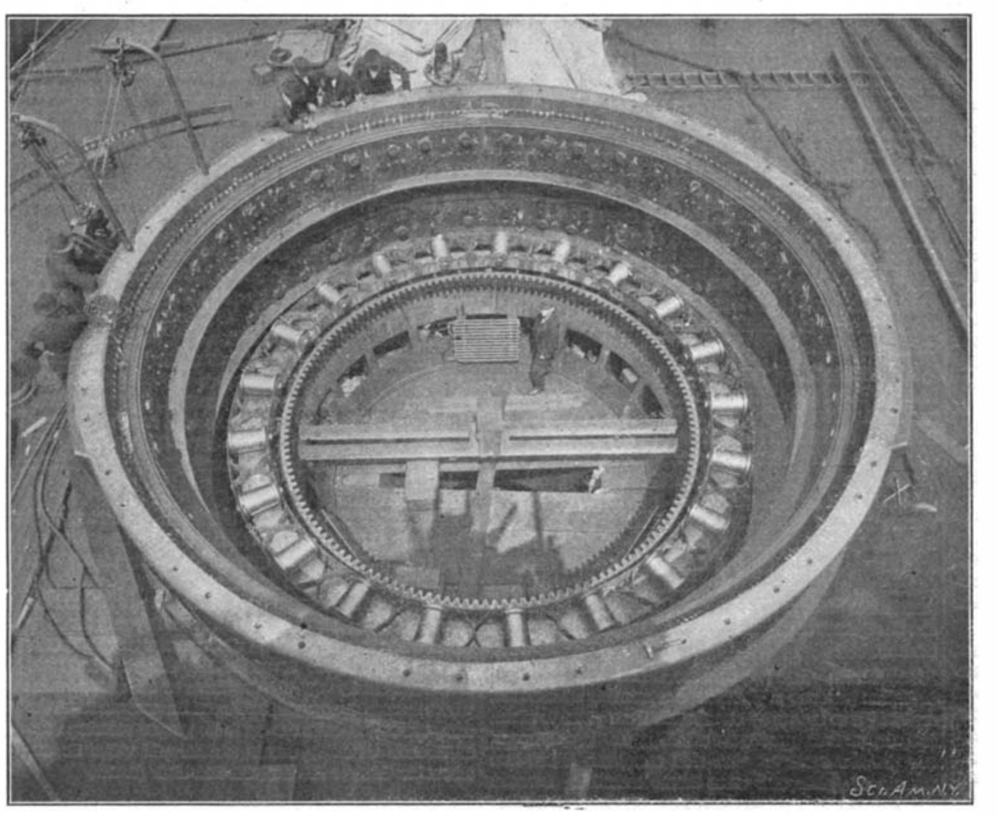
In various articles on naval matters which have appeared from time to time in the SCIENTIFIC AMERICAN we have described and illustrated, with sectional views, the structural features of the barbette of a modern warship; but we think that the most knowing of the naval "sharps" among our readers will be able to learn something from the accompanying illustration showing the interior of a barbette before the turret was installed. The photograph from which our plate was made is one of a series of progress photographs which were filed with the Chief Constructor of the Navy during the construction of the "Alabama." It was taken from the after end of the superstructure, the deck upon which the people around the edge of the barbette are standing being the main deck.

The barbette is a vertical, cylindrical, heavily armored redoubt, which extends from the protective deck to a height of 3 feet 8 inches above the main deck. The duty of this redoubt is to protect the unarmored base of the turret, the mechanism by which it is rotated, and the hoist by which the ammunition is brought up to the guns. Within this cylinder, which is about 12½ feet in depth, is located a circular track upon which is a circle of twenty-one conical rollers, which are held in their proper spacing and radial position by means of two concentric rings, firmly braced together, as clearly seen in the illustration. Upon these rollers is carried the whole weight of the turret, the guns and their mounts, a total of 277 tons. The lower half of the turret is in the form of a circular-inverted cone and is unarmored; the upper and armored portion of the turret is elliptical in plan, and the rear portion of it projects over the top edge of the barbette, enough space being left between the turret and barbette for easy clearance in turning.

The barbette is protected for two-thirds of its circumference with 14 inches of Harveyized armor, the remaining one-third, or the portion which is nearest to the point of view from which the photograph was taken, is protected with 10 inches of armor, less protection being needed on this portion of the barbette because it is screened by the 6-inch side armor on the hull of the vessel. The armor is bolted to a backing of teak, within which is 1 inch of steel plating attached to a heavy framing of steel beams, angles, and channel beams. The internal diameter of the barbette is 27 feet.

Immediately within and below the circle of rollers is seen the massive circular rack which forms part of the turning mechanism of the turret, rotation being effected by means of two electric motors carried in the base of the turret. The shafts of these motors are connected by suitable gearing with pinions which engage the circular rack; and the training of the great weight of the turret and guns is accomplished with a speed and accuracy which are impossible when hydraulic, compressed air, or steam motors are used.

The after barbette of the "Alabama" contains altogether 26 tons of armor. The total weight of the installment, including turrets and guns, is 783 tons. The forward barbette and turret, however, are much heavier, the total weight in this case being 978 tons. This increase is due to the fact that the "Alabama" carries her forward guns above the spar deck, and, therefore, some 7½ feet to 8 feet higher above the waterline than the after pair of guns, the increase in weight being due entirely to the increased height of the barbette.



INTERIOR OF THE BARBETTE OF THE FIRST-CLASS BATTLESHIP "ALABAMA."

PROF. HENRY F. OSBORN has been appointed to succeed the late Prof. O. C. Marsh as palæontologist of the United States Geological Survey. Prof. Osborn will have charge of the vertebrate palæontology of the survey especially with reference to the completion of the monograph for which illustrations were prepared under the direction of Prof. Marsh.

SILVER BRONZE.—Melt equal parts of bismuth and tin and add an equal part (by weight) of mercury. It is sprinkled, finely powdered, upon the freshly sized or varnished surface.—Pharmaceutische Post.

Science Notes.

The first-aid packages in South Africa have proved very valuable, and their use is recommended to railway employés, miners, and workers at other unusually perilous crafts.

By treatment with iodine and aniline pigments, H. Kraemer has determined that the alternate layers in a starch-grain are due to a substance rich in colloids but poor in crystalloids, alternating with a substance rich in crystalloids but poor in colloids. — Botanical Gazette.

Some specimens of the blind fish from the Mammoth Cave of Kentucky have recently been placed in the London Zoological Gardens. These fish have never before reached England alive, and it is supposed that only on one previous occasion have living specimens been exhibited in Europe, viz., in 1870. In that year five fishes were placed in a tank in the zoo at Dublin (Ireland), but they did not live very long, succumbing to a fungoid growth on their bodies.

A German syndicate has just made arrangements whereby it secures all the timber on a large strip of land in the mountains in eastern Kentucky. It is estimated that the strip contains about 800,000 of the finest specimens of oak trees. Foreign syndicates are investing heavily in eastern Kentucky, and especially in timber and mining interests. They own large tracts of the finest land, which will quadruple in value when railroads reach that section of the State.

The following abbreviations of metric units have been decided upon by the International Committee of Weights and Measures: Length: Kilometer, km.; meter, m.; decimeter, dm.; centimeter, cm.; millimeter, mm.; micron, μ. Surface: Square kilometer, km.^{2}; hectare, ha.; are, a.; square meter, m.^{2}; square decimeter, dm.^{2}; square centimeter, cm.^{2}; square millimeter, mm.^{2}. Volume: Cubic meter, m.^{3}; stere, s.; cubic decimeter, dm.^{3}; cubic centimeter, cm.^{3}; cubic millimeter, mm.^{3}. Capacity: Hectoliter, hl.; decaliter, dal.; liter, l.; deciliter, dl.; centiliter, cl.; milliliter, ml.; microliter, λ. Weight: Tonne, t.; quintal metrique, q.; kilogramme, kg.; gramme, g.; decigramme, dg.; centigramme, cg.; milligramme, mg.; microgramme, γ.

It was at one time believed that the oldest map was that known as the Peutingerian Table, which was supposed to be a product of the third century, says The Architect, but later inquiries show it to be no older than the twelfth century. It is now generally held that a still more ancient specimen of map-making is a mosaic in Madaba, Palestine. It formed a part of a Byzantine church, and was used as an adornment for the floor. Evidently the artist anticipated the pictorial cartographers of modern times, for an attempt has been made to suggest the character of some of the scenery in Palestine. Practically the greater part relates to that country, and the number of names which are given cannot fail to be useful to modern explorers.

Destruction by Dynamite.

It was reported from South Africa that the Boers recently attempted to destroy a railway tunnel by starting from the opposite ends two locomotives, heavily loaded with dynamite; but these locomotives collided at full speed midway in the tunnel, exploding the dynamite, and, of course, completely wrecking the engines; but (according to a later dispatch) the resultant injury to the tunnel itself was relatively small, and could be repaired easily and rapidly. According to another report, the official mining engineer of the Pretoria government, in charge of the Johannesburg gold mines, said that all the mines of the Witwatersrand could be destroyed in two days by the use of dynamite, if such a step should become necessary. The surrender of Johannesburg to the British, however, with the mines intact, disposed of all these reports of contemplated vandalism.

In view of the fact that a proposition to destroy the mines was made and actually discussed, I take occasion not to discuss the ethical aspects of this use of dynamite, as related to the laws of civilized warfare, but rather to point out that "destruction by dynamite" is not so easy as its projectors are accustomed to consider it. This statement, illustrated already by the experience of Anarchists, Fenians, strikers, and inexperienced miners, seems to have received its latest confirmation in the railroad tunnel mentioned above. The fact is, that when the impact of a dynamite explosion is communicated to a large body of air (as was the case in the great Johannesburg explosion five years ago), it may, through that medium, work widespread wreck; but when it is immediately received by solid masonry or rock, its energy is largely expended in the molecular work of local pulverization, being generated too instantaneously, and too simultaneously throughout the mass of the charge, to permit its seeking " lines of least resistance," or following such lines, once found, with the persistence due to a more gradual expansion, such as the slower, progressive explosion of black powder produces.

Thus, in one instance, when put under an obnoxious monument, dynamite dug a big hole in the ground, and pulverized the bottom stones of the monument, but did no further damage. In another case, exploded against the wall of a public edifice, it made a small opening in the immediate adjacent masonry—and that was all. In the recent railway road tunnel experiment of the Boers, the collision and the dynamite together doubtless made scrap iron of the two locomotives, and track ballast of a considerable amount of the rock in the immediate vicinity; but unless the locality of the explosion had been skillfully selected, with a view to collateral results, it is highly improbable that anything more than the clearing away of the rubbish (and, perhaps, some fresh support for walls and roof) would be required to make the tunnel commercially useful again.

The statement of the Transvaal engineer as to the practicability of the "destruction" of a large number of mines in two days may be taken with much allowance. Unless very elaborate and extensive preparations had been already made, and made with much skill, his threat indicated either cheek or ignorence only. Even if such preparations had been made, the rapid and general destruction which he describes as practicable would be so only if innumerable separate and widely-scattered bore-holes, already charged with dynamite, were waiting only for the electric spark to fire them simultaneously. But no sane engineer would dare to create and maintain such a situation as that for more than a day.

The probability, amounting almost to certainty, is that such attempted "destruction" would amount to nothing more than the partial or total wreckage of machinery and buildings, and the production, here and there, of local and limited caving of ground. This would have caused, no doubt, delay and expense in the resumption of mining operations; but it would not by any means have extinguished the Witwatersrand as a source of gold for the use of the world.—Science and Art of Mining.

THE English Admiralty have not yet concluded their experiments with the "Belleisle." The craft, which was riddled by the gun-fire of the "Majestic," is being patched up and will then be towed into Portsmouth Harbor and have her torpedoes exploded in her tubes. The Naval Department is desirous of ascertaining exactly what would be the result, if such an untoward accident as the premature explosion of the torpedo in its tube occurred during an actual engagement.

The Current Supplement.

The current SUPPLEMENT, No. 1288, is of unusual importance. "Germany's First Cable-Laying Steamer" is elaborately illustrated. "American Engineering Competition" deals with structural steel work. "Contemporary Electrical Science" is a series of short notes on electrical topics. "India Rubber at the Paris Exposition" is a valuable technical article. "The French Mission to Yunnan" is a profusely illustrated article. "Dairy Development in the United States" is a full article upon the subject.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

BAND-CUTTER AND FEEDER.—JOHN ERICKSON and JAMES McC. EDMONDSON, Gardner, N. D. In this apparatus the grain-bearing straw is delivered vertically to the cylinder, dropping from the carrier to the cylinder a predetermined distance. Retarding devices engage the straw before it reaches the cylinder, thus giving ample opportunity for all loose grain to drop out from the bundle and to be conducted to a suitable point without necessarily being passed between the cylinder and the concave. The machine is so constructed that the straw will spread before it strikes the cylinder, whereby the motion of the cylinder will distribute the straw more evenly and gradually than heretofore and will also prevent the slugging which invariably occurs when the straw is fed from directly in front of the cylinder.

HAY-RACK. — ALEXANDER FERGUSON, Odell, Ill. The purpose of the invention is to lessen the difficulty usually experienced in placing a hay-rack upon a wagon and running it therefrom, which is accomplished by making the rack in sections and providing fastening devices so constructed that the sections may be firmly locked together and readily separated, thus enabling the rack to be adjusted in sections upon the body or running-gear of a wagon in a convenient and expeditious way.

MOWING-MACHINE SEAT.—NATHAN BAUGHMAN, Hammersley Fork, Penn. In mowing-machines it is desirable that means be provided whereby the seat can be readily adjusted or rocked to secure the desired level position. The seat in this invention is pivotally supported so that it can be rocked from side to side and provided with a depending transverse rib or bearing extending on both sides of its pivot. A cam engages the rib on opposite sides of the pivot of the seat, so that it can rock the seat from side to side, but not tilt it from front to rear.

Mechanical Devices.

CENTRIFUGAL WATER-CLARIFIER. — FRANK H. RICHARDSON, Pueblo, Col. The device is designed to remove solid matter and impurities from water. The clarifier comprises a casing mounted to rotate relatively to a main or supply-pipe. Automatically-actuated valves permit the escape of separate material. The device is arranged in a well on the top of which are rollers engaged by the periphery of the casing to prevent vibration.

TOBACCO-SEPARATING MACHINE. — LUIS R. SCHOLTZ, Carácas, Venezuela. This machine is especially adapted to separate tobacco or piccadura from the wrappers of such cigarettes as are delivered from cigarette-making machines in a non-marketable condition, thus enabling the piccadura to be again utilized. When thus used over again, the piccadura is improved; for it is freed from dust. The machine is provided with means for collecting and retaining the tobacco-dust, which may be utilized in the manufacture of snuff.

FIRE-ESCAPE.—THOMAS T. BROWN, Euclid, Minn. In this fire-escape, a rope is used in connection with a friction device arranged to move relatively to the rope, so that a person attached to the friction device may descend gradually to the ground. The novel features of the invention are to be found in the construction of the friction-device so that it is rendered both durable and certain in action.

MARINE-DUMPING VESSEL. — FRANKLIN H. BULLIS, Brooklyn, New York city. The vessel is arranged to dump the load from the top instead of from the bottom and to insure a perfect discharge of all the mud, city refuse, or other matter forming the load. A single operator can manipulate and discharge the load with the greatest ease. On the deck of the vessel are two receptacles having their backs abutting and mounted to swing transversely in opposite directions from a loading to a dumping position and vice versa. By arranging the receptacles and their operating mechanism on the top of the hull, it is evident that they can be repaired at any time without requiring docking of the hull.

SAWMILL.—LEE W. DICKEY, Scottown, Ohio. The invention provides a peculiar construction of sawmill, enabling it to be readily transported from place to place, and a novel feed-gearing for effecting the proper movement of the carriage. The mill comprises a saw-box formed of joists and cross-beams extending between them at one end of the saw-box. Journals projecting inwardly from the joists at the other end of the saw-box are adapted to carry wheels on which to mount the rear portion of the saw-box. A reach is attached to the beams and projects forwardly to carry a wheeled axle to support the front of the saw-box so as to facilitate the transportation of the saw-box.

CHUCK. — ANDREW DINKEL, Auburn, N. Y. This chuck is particularly adapted for holding work, the center of which is to be bored—for example, for holding a gear while the hub is being bored. The inventor employs a number of radially-movable jaws which advance to grip the work and retract to release it, and which are acted upon by tangentially disposed links connected with a member which moves circularly with respect to the body of the chuck. The chuck is also fitted with a means of centering the drill, causing it properly to engage the work.

Railway Contrivances.

LOCOMOTIVE BUFFER-BEAM.—JAMES F. DUNN, Salt Lake City, Utah. The buffer-beam is cast in steel and so constructed that all its parts are comprised in an integral casting to which the proper parts of the engine may be directly attached. It is one of the purposes of the invention to protect the cylinder-heads, boiler-head, and adjacent vital parts of the locomotive in case of collision.

AUXILIARY CAR-MOVER.—PATRICK RYAN, Manhattan, New York city. The object of the device is to assist the motive power in propelling a car up grade when the tracks are slippery. On the inner side of each car-wheel an eccentric is fastened; and on the car-axle two eccentrics are secured. An eccentric strap is loosely mounted upon each eccentric on the car-wheels and on the axle. And upon each eccentric-strap a pusher-bar is secured. If the car-wheels slip, the pusher-bars, if resting with their free ends upon the road-bed, will successively push so as to coact with the regular motive power.

ELECTRIC RAILWAY SYSTEM. — GEORGE L. CAMPBELL, Manhattan, New York city. The invention is an improvement on a system previously patented by Mr. Campbell, in which a closed conduit is employed having a continuous main conductor and a sectional surface conductor. In the conduit a trolley is caused to travel with the car by the influence of a magnet on the car. In the present invention, Mr. Campbell has been concerned chiefly with the provision of an arrangement which insures the proper feeding of the current from the main conductor while the car is in proper running condition and instantly causes a dead rail when the car leaves the track or the magnets lose their power.

Miscellaneous Inventions.

APPAREL-COAT.—DANIEL MURPHY, 1307 E. Franklin Street, Richmond, Virginia. To avoid the dropping or the raising of the shirt-sleeve cuff from its proper position in the coat-sleeve, the inventor has designed a peculiar formation of the inner surface of the coat-sleeve and attached the cuff directly to it, instead of to the shirt-sleeve. This insures an invariable projection of the cuff below the coat-sleeve, and allows the cuffs to be put on or off with the coat. The coat-sleeve has buttons secured to the interior thereof, and fastened to the edges of the cuff. A flap fixed to the inner side of the sleeve above the buttons has buttonholes which register with the buttons, and are adapted to fold down over the upper edge of the cuff, and covering and retaining the cuff by being fastened to the buttons.

PROCESS OF TREATING GOLD AND SILVER ORES.—HENRY HIRSCHING, Salt Lake City, Utah. Mr. Hirsching's invention is a process for treating copper ores, principally to extract the cupric oxid, but also to obtain gold and silver from ores containing the oxid whether with or without copper. It consists in adding the small broken ore gradually under agitation to an ammoniated solution, diluting the solution, and separating it from the slimes. The slimes are washed separately and their residue heated to recover the ammonia therefrom. The process can be used to advantage and economy with refractory ores from which copper could not be profitably secured by melting and by other methods hitherto employed.

CURTAIN-POLE.—KATE R. BROADSTREET, Grenada, Miss. This curtain-pole consists of a tubular back-bar connected with a tubular front-bar. Each bar is provided with a guideway for curtain-hangers. When curtains are hung on this apparatus they can be shifted in various ways and reversed, crossing one another at the pole; or they can hang in the same horizontal plane, edge to edge, at the top or be bowed outwardly to produce a bow-window effect. The pole can be supported by ordinary brackets.

OIL-GAS LAMP.—ALBERT S. NEWBY, Kansas City, Mo. Two patents have been granted to Mr. Newby for lamps in which vaporized oil is used as the illuminant. In both lamps the burner is placed above the oil-reservoir, the oil being forced by air-pressure through a pipe leading above the burner, so that the flame can vaporize the oil. The feed of the oil is regulated by a needle-valve. In the one case a mantel is used; in the other an ordinary flame of high candle-power is produced. Both lamps are exceedingly efficient and are particularly serviceable for out-door use, since they cannot be blown out by any wind. The lamps are so constructed that they can be readily taken apart whenever it is desired to clean the parts.

Designs.

SKIRT-HANGER. — ARCHIA L. ROSS, Manhattan, New York city. This skirt-hanger is so designed that a number of skirts can be properly hung in a closet so that they will take up as little room as possible.

PIN.—JOSEPH COHEN, Brooklyn, New York city. The pin is intended for use in connection with campaign-buttons. Instead of the single point previously employed, two points are used, whereby the button is far more firmly held in place than heretofore.

NOTE.—Copies of any of these patents can 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.

NEW BOOKS, ETC.

SUBJECT LIST OF WORKS ON PHOTOGRAPHY AND THE ALLIED ARTS AND SCIENCES IN THE LIBRARY OF THE PATENT OFFICE. London: Patent Office Library Series, No. 2. Bibliographical Series, No. 1. 1900. 18mo. Pp. 62. Price 20 cents.

A most valuable little book worthy of a considerable sale, the arrangement is admirable.

THE AMATEUR'S PRACTICAL GARDEN BOOK. By C. E. Hunn and L. H. Bailey. New York: The Macmillan Company. London: Macmillan & Company, Limited. 1900. Pp. 250. Price $1.

A volume of the "Garden Craft Series." It is a capital book filled with exactly the information one is always wanting to know, and it will give valuable points even on such subjects as watering plants. Both fruit and flowers are considered.

MODERN HOUSE PLANS FOR EVERYBODY. For Village and Country Residences, costing from $250 to $8,000, including full descriptions and estimates in detail of materials, labor, cost, and many practical suggestions. By S. B. Reed, architect. New York: Orange Judd Company. 1900. Illustrated, 12mo. Pp. 243. Price $1.

To builders this work will be valuable as a handbook of reference, and to those who intend to build a home it will prove useful.

THE GAS ENGINE HANDBOOK. A Manual of Useful Information for the Designer and Engineer. By E. W. Roberts, M. E. Cincinnati, Ohio: The Gas Engine Publishing Company. 1900. 18mo. Pp. 220.

The book deals with American practice and is filled with valuable formulas and methods of determining mechanisms and propositions. It will prove of value to those who may have other books on the subject.

FIELD TESTING FOR GOLD AND SILVER. A Practical Manual for Prospectors and Miners. By W. Hamilton Merritt, F.G.S. London: Crosby Lockwood & Son. New York: D. Van Nostrand Company. 1900. 18mo. Pp. 144. Price $1.50.

The more intelligent is the prospector in his line of work the greater chance of success he will have. There is no business where exact science is of more value. Much of the literature upon the subject is worthless, but the present handy volume is one we can commend.

MODERN COMPOUNDING AND RECTIFYING. By Charles Norton. Chicago: Foote & Solomon. 1900. 18mo. Pp. 89. Price $2.50

There are many secrets in the distiller's business and many of them are given away in this book, which contains many practical formulas for producing all kinds of cordials, etc. It also deals with the blending and imitating of various liquors.

AN ELEMENTARY PHYSICS FOR SECONDARY SCHOOLS. By Charles Burton Thwing, Ph.D., (Bonn). Boston: Benjamin H. Sanborn & Company. 1900. Pp. 371.

Prof. Thwing has prepared a text-book which occupies a unique position. It is not too elementary, nor is it too advanced for the usual secondary school. The author tells us in his preface that he has endeavored to do away with those "limitations under which teachers work, both as to specific preparation for the work of teaching physics and still more as to material equipment." How well he has succeeded can be determined only by those who have practically used his work in the class-room. From the scientific standpoint, at least, the book certainly leaves nothing to be desired.

DYNAMOMETERS AND THE MEASUREMENT OF POWER. By John J. Flather, Ph.B., M.M.E. Second Edition. Revised and Enlarged. New York: John Wiley & Sons. London: Chapman & Hall, Limited. 1900. Pp. 394. 12mo. Price $3.

The author has presented in convenient form for the use of technical students and engineers a description of the construction and principles of action of the various types of dynamometer employed in the measurement of power.

THE WHY OF GRAVITY. By J. A. Allen. Alwington, Kingston, Canada. 1900. Pp. 34.

Mr. Allen's little treatise, running, as he himself admits, "counter to all ordinary habits of thought," will probably not meet with the approval of scientists. But nevertheless it deserves attention for its straightforwardness and intellectual independence of thought.

RESULTS OF RAIN, RIVER, AND EVAPORATION OBSERVATIONS MADE IN NEW SOUTH WALES DURING 1898. With Maps and Diagrams. By H. C. Russell, Government Astronomer. 1900. Published by authority of Her Majesty's Government in New South Wales. Octavo. Pp. 235.

UNIVERSALGELD. Auf Grundlage des metrischen Gewichtes und des Monometallismus, vorzüglich der Silber wahrung. Eine zwanglose Plauderie von Karl Pamperl. 1900. Ruckerlbergbei Graz (Oesterreich). Author's Edition.

Notes & Queries

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.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7951) DeF. H. asks: 1. Can a jar filled with water and covered on the outside with tin foil and having a large wire nail passed through the cork, be used in place of a Leyden jar? A. Yes, but not an efficient one. The leakage is too great, due to the moisture on the glass. This was the first form of Leyden jar ever used. It is described in many text-books and histories of electricity. 2. What per cent of the power of a steam engine would a hot air engine develop, both using the same amount of heat? A. With the same amount of fuel hot air engines develop from two to three times the power of steam engines for very small sizes. Large hot air engines have been found impracticable 3. What are the principal parts of the simplest toy hot air engine? A. The small toy hot air engine was illustrated and described in SCIENTIFIC AMERICAN, No. 20, vol. 76, 10 cents by mail. 4. What would be the voltage and internal resistance of a cell containing a solution of bichromate of potash and bisulphate of mercury? Two plates are suspended in this solution, one-half of an inch apart, one is zinc and one carbon; both are 6 inches long, 1¼ inches wide and ¼ inch thick. They are let into the solution to a depth of 5 inches. A. A bichromate cell has 118 volts. Its internal resistance is at the most a fraction of an ohm. This varies with the strength of solution and changes as the solution becomes exhausted. The bisulphate of mercury is used to amalgamate the zincs and does not affect the action of the cell directly.

(7952) W. T. C. writes: 1. I have a 75-watts dynamo and wish to run it with storage batteries; how many will it take? A. To run your dynamo as a motor with a storage battery, you will require half as many cells as the voltage of the current. 2. Which is the best adapted for the purpose? A. For so small a machine you can use any storage battery. Several good ones have been advertised in our columns. 3. Can I charge the same with the dynamo when belted to a power, and how long would it take? The dynamo is series wound. A. The little machine will charge the cells by allowing 2½ volts to a cell in charging. We do not know how long it will take.

(7953) W. G. asks: 1. Can the static motors described in the SCIENTIFIC AMERICAN of February 25, 1899, and August 11, 1900, be used with an induction coil? A. We think they may be. Try it and see. That is quicker than writing about it. 2. Is the voltmeter and ammeter described in SUPPLEMENT, No. 1215, to be used with alternating current? A. No. 3. In the description of the high frequency transformer in SUPPLEMENT, No. 1087, where it says the primary consists of 14 turns of 4 does it mean that there are four coils side by side with 14 turns each? Is it connected as shown in the drawing submitted? A. It will work if wound as you show in your diagram. But we should take the four wires and wind them side by side, turn for turn. Then wind the twine for separating the wires of different potential between the turns.

(7954) J. G. W. H. asks: Please state the theory and principles by which the electrical receiver of a radiophone is governed? Also please tell me whether ultra violet rays when thrown on two metallic joints or break in a circuit will close the circuit. A. The radiophone, called formerly the photophone, depends for its action upon the change in resistance of a cell of selenium under the action of heat or light. The theory of this action is not fully established. It appears that the action of a candle flame upon selenium causes its electrical resistance to drop to about one-fifth its former value. We do not know what relation ultra violet rays have to this effect. Lord Rayleigh has held that there is no reason to reject the theory that the effect is due to unequal heating of the selenium strips. The first photophone was invented by Prof. Graham Bell. Illustrated articles on this subject are to be found in the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 270, 271, 281, 283, ten cents each. Ganot's "Physics," last edition, price $6, treats this subject quite fully.

(7955) C. A. P. asks: What I want to know is this: What effect has the electro-magnet on the electric arc to cause it to be extinguished in the controller and to be deflected in the arc welding system? A. The action in these instances is the same as if the electric current were flowing through a wire and the wire was free to turn around the electro-magnet. It would move, being attracted or repelled according to the direction of the current. In this case the current flowing through the arc is repelled till it breaks and ceases to flow, if the magnet is strong; or blows the arc out into a long tongue of flame, if the magnet is weaker.

(7956) H. H. asks: Would you be so kind as to let me know what is the trouble with a dynamo I made like one described in SUPPLEMENT, No. 844. I made armature according to directions only I put 24 seq. in commutator and used slightly higher fields with 13 layers No. 24. It will only redden one 16 candle 52 volt lamp, at 2,500 revolutions. I have tested for short circuits, etc., but find it O. K. Please give me some information. A. Both of the changes you have made in the design of the dynamo cut down the output of the machine. We presume you have all the current it will give. The only information we can give is what you have already found out, that it is better to take a design well wrought out, and follow it without alteration than to alter that design, and find an inferior result. Our advice to all inquirers is not to attempt to design a dynamo unless after a thorough course of instruction in that line of work.

(7957) C. W. N. writes: I noticed in your issue of July 28, under Notes and Queries (7924), E. R. asks: Is the gage of iron and steel wire the same as copper? Your answer is, yes. Kindly permit me to correct you as to this impression. Iron and steel wire are gaged by the Washburn & Moen gage. Copper wire, as used for electrical purposes, is gaged by the Brown & Sharpe gage. A very small proportion of copper wire, known as copper market wire, is gaged by the Stubbs gage. A. When we answered the inquiry as to wire gages, we were aware that there are numerous gages in use by manufacturers for their products. We are not aware that these gages are limited to special metals. There are many more of these than you mention. It is an unfortunate state of affairs that it should be so. There ought to be but one gage for all purposes, and not a Washburn & Moen gage, a Trenton gage, an Edison gage, a Brown & Sharpe gage, a music wire gage, a twist drill gage, etc. If a congress could be assembled to unify practice in this direction, it would be worth all it would cost.

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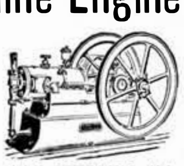

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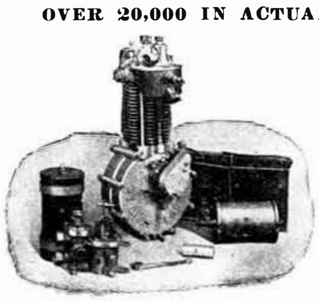

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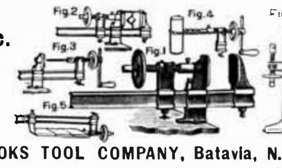

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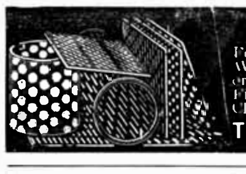

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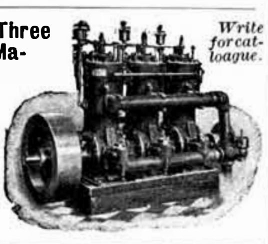

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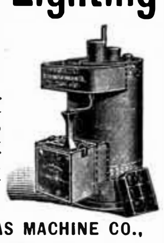

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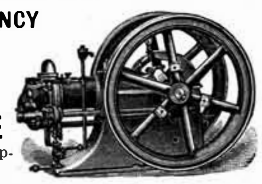

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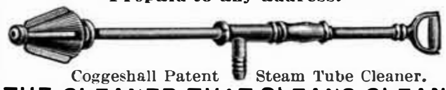

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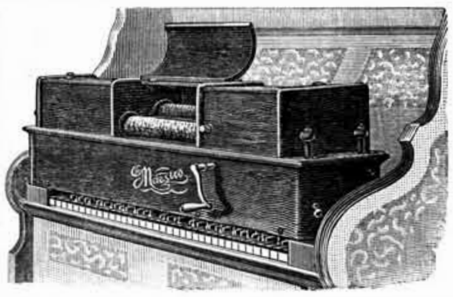

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