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## THE MONO-RAIL FOR HIGH-SPEED TRAVEL.

The mono-rail railway has achieved a sufficient measure of success to entitle it to rank as a standard system of construction, at least for certain classes of work. At present the system is restricted almost exclusively to railways designed for the hauling of freight by draught animals or by manual power on plantations, or to light railways which act as feeders to the main lines of traffic. It has found its most extensive field of operation in India and some parts of South America. Only of late years has it attracted more than occasional attention as a possible means of passenger traffic, although the mono-rail line between Listowell and Ballybunion, Ireland, nine and one-half miles in length, has been for some years in successful operation. In our issue of May 5, 1900, we gave illustrations of the Langen mono-rail railroad between Barmen and Elberfeld, Germany, which must be considered as the most important development yet made in this direction. This is a double-track, elevated line, carried upon steel posts and A-frames. The trains are made up of full sized cars, each with a seating capacity of fifty people, the average running speed of the trains being twenty miles an hour.

In both the Irish and the German lines above referred to, there is no attempt to obtain exceptional speeds, the operation of both systems conforming to the common practice of suburban and light railways. Rightly or wrongly, however, the advocates of the mono-rail construction claim to see in the system special qualifications for the running of abnormally fast express trains, and, as was to be expected, some highly absurd claims have been made and impossible methods of construction and operation suggested. The proposal which is just now attracting the most attention is the construction of an express railroad between the cities of Manchester and Liverpool upon what is known as the Behr system, in which the weight of the train is borne by a central elevated rail, and the cars are guarded against excessive oscillation by means of steadying rails placed below the level of the single rail, one on each side of the structure. The first application of the company for the necessary parliamentary powers met with refusal; but it seems that another effort is to be made to obtain the necessary powers, and as the project is backed by the powerful influence of Sir William Preece, so long identified with the British Post Office, it is considered probable that it will be carried through. The "trains," which are to be electrically operated, will consist each of a single coach weighing 45 tons and seating 64 passengers. These cars are to be started at ten minute intervals, and traveling at the rate of 110 miles an hour, they will cover the distance of 34½ miles in twenty minutes. There will be no intermediate stations, switches, or crossings. In a paper published recently upon the subject, Sir William Preece seems to be perfectly satisfied that this high speed can be maintained, and that, although the fares will be slightly lower than those charged upon the standard form of railway, the enterprise will prove to be profitable.

In the interests of high-speed transit it is to be hoped that parliamentary obstruction will be removed and that the possibilities of extremely fast travel may receive the thorough testing which would result from the completion of the proposed road. No one who considers the wonderfully rapid development of electrical traction since its inception can affirm that a proposal to raise the speed of inter-urban traffic to 100 miles an hour is chimerical either from the standpoint of the engineer or the capitalist. With a properly constructed track, transmission lines and motors, a mean speed of over 100 miles an hour could certainly be achieved; and if the company, as they state, can carry passengers between Manchester and Liverpool at about the same fare as is charged on the present railroads, and in half the time, it is certain that they will secure a sufficient volume of travel to render the undertaking profitable. We do not, however, for a moment believe that the mono-rail is indispensable to the realization of extremely high speeds, for it would be possible to run a train at equal speeds over a surface road, provided the proper superelevation of the outer rail were given. The advantages of the system seem to lie chiefly in the fact that by carrying the trains well above the surface, the risks that are incidental to all surface lines on account of crossings, open gates, broken fences, etc., are entirely removed.

## THE WATER-TUBE BOILER ON TRIAL.

It cannot be denied that the disappointing results that have followed the recent wholesale introduction of the water-tube boiler into the British navy shook, for the time being, the faith of engineers in water-tube boilers as such, and caused something of a revulsion of feeling in favor of the cylindrical boiler of the well-known Scotch type. The steam engineering world has awaited with considerable interest and anxiety the official report on the subject, and now that it has been some time before the public, and there has been an opportunity to weigh the evidence, it is generally conceded that the water-tube boiler, as a type, stands pretty much where it did before, and that its relative merits and demerits have not been affected one way or the other. All that was claimed for the water-tube boiler has been realized, and its failures in the British navy are not chargeable to the boiler, as such. In proportion to its power, it is considerably lighter than the Scotch boiler; it carries considerably less water; and it possesses the advantage (scarcely to be overestimated) of enabling a ship to raise steam and get under way in far less time than was possible with the older type.

According to the memorandum submitted by the British Admiralty, the failure of the Belleville boiler is to be attributed more to the inexperience of the boiler room staff than to any inherent defects in the boiler itself. There is no denying that it has proved to be an extravagant coal consumer; but it seems that after economizers were added, and the staff had become thoroughly familiar with the management of the boilers as thus equipped, the coal consumption per horse power compared favorably with that of the ordinary cylindrical boiler. It has been found that there is a strict relation between the economical results achieved and the degree of training of the crews. When in the course of this elaborate experiment (for it is nothing less) important defects occur in any part of the machinery of new ships, the best method of remedying the trouble is jointly considered by the builders, by the dock yard officials, and by the Admiralty engineers. It becomes necessary to determine whether the defect is to be remedied by a different method of handling the machinery, or whether it calls for some radical change in the plant itself. After a decision has been reached, it is frequently necessary to delay the changes until the ship can be laid off; and even when the alteration has been made, prudence dictates that it should be generally adopted only after it has been given a trial upon one or two ships selected for the purpose. All of this takes considerable time, and progress is necessarily slow.

That the Belleville boiler is not merely valuable for strategical and tactical reasons, but compares favorably with any other type in efficiency, is shown by the recent trials of the sloop "Vestal," which, on her full power trial, with 221 pounds boiler pressure, an air pressure of 0·27 inch, and a total indicated horse power of 1,451, showed a water consumption of 16·8 pounds, and a coal consumption of 1·52 pounds per indicated horse power per hour. At five-sevenths of full power, the water consumption was 15·6 pounds, and the coal consumption fell to the remarkably economical figure of 1·3 pounds per indicated horse power per hour. At half power, with a water consumption of 15·53, the coal consumption was 1·41 pounds per indicated horse power per hour. These results, it will be seen, compare favorably with those which are now obtained on the "Deutschland," whose equipment may be taken as representative of the latest merchant marine practice. This vessel, it will be remembered, showed a full power consumption of 1·45 pounds per horse power per hour.

## THE "WISCONSIN" AND THE "VARIAG."

The builders of the "Oregon" are to be congratulated upon the fact that the excellent work which they put into that fine vessel has evidently been duplicated in the second battleship which they have built for the United States navy, the "Wisconsin." At a time when naval men were complaining of the wide disparity which existed between the speeds achieved by naval vessels on government contract trials and their subsequent performance on actual duty, the memorable trip of the "Oregon" around Cape Horn proved that this ship, at least, was an exception to the rule; and as a fitting climax to her performance, in the long chase after Cervera's squadron she showed herself to be the fastest of the battleships, and at least a match for the cruisers. Dispatches from the Pacific coast state that on her trial trip in the Santa Barbara Channel, the "Wisconsin," a sister ship to the "Alabama," whose excellent record of 17·01 knots an hour was recently mentioned in this journal, covered the trial course at a speed of 17·1 knots an hour, thereby constituting herself the fastest battleship in the United States navy. The new battleship is a vessel of over 11,000 tons displacement, and was required to show a contract speed of 16 knots with an indicated horse power of 10,000. That she should have exceeded this speed by 1·1 knots is highly creditable, and suggests that in this vessel, as in a previous warship constructed at these works, the builders have voluntarily enlarged the capacity of the engines and boilers.

Only a few days prior to the trial of the "Wisconsin," the William Cramp & Sons Shipbuilding Company achieved a notable success with the Russian cruiser "Variag," which by the terms of the contract was required to maintain a speed of 23 knots an hour for twelve consecutive hours. It will be remembered that during the first trial, held some two or three months ago, the "Variag" maintained the required speed for several hours, or until the failure of one of the cylinders necessitated postponement. On the trial recently held, the "Variag" maintained a speed of 24·25 knots for twelve hours, a performance which, on account of the duration of the test, places this speedy cruiser among the very fastest of the vessels of her class. While it is true that the two Chinese cruisers, "Hai Tien" and "Hai Chi," of 4,300 tons displacement, achieved a mean speed of 24 knots during four separate runs over the measured mile, this is certainly not more creditable than the maintaining of 24·25 knots for twelve consecutive hours.

## THE LATEST DEVELOPMENTS OF WIRELESS TELEGRAPHY.

At the recent annual gathering of the British Association at Bradford, England, Sir William Preece, who, as electrician to the English Post Office, rendered valuable service to Marconi in the introduction of his system of wireless telegraphy into England, delivered a lecture upon his own experiments in the utilization of the Hertzian waves for transmission of articulate speech without the assistance of connecting wires. The first experiments were conducted across Loch Ness in the Highlands of Scotland, as long ago as February, 1894, and they had in view the transmission of Morse signals by means of his electro magnetic method of wireless telegraphy. Two parallel wires, well earthed, were arranged one on each side of the lake, and the apparatus was so arranged that the wire could be systematically shortened with a view to ascertaining the minimum length necessary to record satisfactory signals. During the experiments an attempt was made to compare telephonic and telegraphic signals, and determine whether it was possible to transmit vocal sounds in the same manner in which the Morse signaling was being conducted. It was found that when the length of the parallel wires was reduced to 4 miles on each side of the water, it was possible to exchange articulate speech across the loch at a distance of 1½ miles.

Shortly after this, however, Marconi's practical application of the Hertzian waves occupied the attention of the electrical world to the exclusion of Preece's experiments, but in 1899, after having identified himself conspicuously with Marconi's work, Preece returned to his former investigation. His new experiments were of a more elaborate character, and they conclusively proved the fact that the maximum effects are produced when the parallel wires are terminated by earth plates to the sea itself. The conventional telephonic transmitters and receivers were employed.

At this time a scheme was in contemplation for connecting the lighthouse of an isolated group of rocks known as the Skerries with the coast guard station at Cemlyn, which is equipped with a post office telephone system. It was found, however, that the rough nature of the bottom of the channel and the strong local currents were such as to prevent the laying of a cable, and it was decided to attempt communication by wireless telephony. A wire, 750 yards in length, was erected along the Skerries, and on the mainland another line was carried from a point opposite the Skerries to Cemlyn, a distance of 3½ miles. Each line terminated with an earth plate in the sea. The average distance between the two parallel wires was 2·8 miles, and with this installation telephonic communication was easily maintained between the two stations, and the service has proved to be practical and thoroughly satisfactory.

A similar system of wireless telephony is now in course of erection between Rathlin Island, on the north coast of Ireland, and the mainland. The excellent results which have thus far been obtained prove that under existing conditions wireless telephony is a success, and may be easily and cheaply adapted to commercial needs. Although the system has not been applied to ships, there is no doubt that telephonic communication from ship to ship or from ship to shore could be carried out, the circuit being formed by means of a copper wire terminated at each end of the ship in the sea.

Another development of wireless telegraphy is that of Rosenberg, which is just now in practical demonstration at the Crystal Palace, London. His system is similar to that of Marconi with the exception that it embodies a slight but very important alteration in the coherer. The inventor claims that he can communicate up to a distance of 2 miles without making use of the vertical wire, while with the vertical wire he can transmit messages to a distance of 40 miles. He announces that he has completed an automatic repeating device, which presumably will be installed at intervals of 40 miles. Mr. Rosenberg has also devised a modification of his system on a small scale, which should have an important commercial application. It consists of a small box containing the receiving apparatus as used in the system. When absent from his office one may receive notification of his desired attendance there by the tinkling of a small bell. The office or business house may not be aware of the wherabouts of the person whom it is desired to call up, but so long as he is no further distant from the transmitting apparatus than 2 miles, he can be notified. Mr. Rosenberg has given practical demonstration of this contrivance with distinct success.

A few weeks ago we drew attention to the application of the Hertzian waves to torpedo warfare, the invention being that of a young Englishman, who is at present successfully developing his system. The experiments described in the article referred to cousisted in the successful steering of a small launch by means of the Hertzian waves. As a result of the favorable report given by Admiral Colwell, of the British government, the Admiralty have offered the inventor a large sum provided he can successfully manipulate a torpedo while it is submerged. The German government have made him a similar offer under the same proviso. We are informed that the inventor has accomplished the desired result, and that in private preliminary trials he has steered the vessel with as much ease when it is submerged as when it is at the surface of the water. The gyroscope, which ceases to have any *raison d'etre* in an electrically controlled torpedo, is removed, and its place is taken by a wireless telegraphy receiving apparatus, which, acting upon a set of magnets, manipulates the rudder.

## CALCIUM CARBIDE AT THE CONGRESS OF APPLIED CHEMISTRY.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Among the papers read at the International Congress of Applied Chemistry, recently held at Paris, those relating to the carbide of calcium industry and the production of acetylene were of great interest. The present development of the carbide industry in Europe was shown by a series of papers read by different delegates, each of which described the carbide plants of one of the leading countries. M. Minet, in his opening paper, in which he treats electro-chemical processes from a historical and an industrial point of view, mentions the carbide industry in a general way, and gives a resumé of the installations in Europe. The paper read by M. Gin gives some interesting details as to the development of the carbide industry in Austria-Hungary, where the abundance of waterfalls has led to the establishment of a considerable number of carbide plants. At present, seven large plants are in operation, and the total water power used is about 24,000 horse power. A number of projects are shortly to be put in execution, which will bring the total up to nearly 80,000 horse power.

The largest of these works, from the point of view of capacity, is that of Jaïce, which has been erected by the Bosnian Electric Company; the large falls of the River Pliva are here utilized. The river widens into a lake which discharges into a lower lake in a series of cascades. The dam has been placed shortly below the mouth of the upper lake, where the water is taken off in a canal about two miles long; the canal passes through fifteen tunnels of 12 by 15 feet section and ends in a large reservior near the station. From this point the water is brought to the turbines by two iron conduits of 5 feet diameter. The capacity of the hydraulic plant is about 9,500 horse power. Eight turbines are installed in the station, of 1,000 horse power each, connected to Schuckert dynamos. The electric furnaces for this plant have been installed by the latter company. The plant situated at釐Paternion is of much smaller capacity, but presents many points of interest. It has been installed by the Venetian Electrochemical Society, and is located on the bank of the River Kreuznerbach. The lime is furnished by quarries of limestone which are found in the neighborhood. A head of water of 200 feet is obtained from a waterfall in this stream; the water is brought to the turbines by canals and iron conduits to the station, situated at 1,600 feet from the fall. Here are installed three turbines, of 400 horse power each, connected directly to a triphase alternator, working at 350 revolutions. The grinding machines will pulverize 8,000 pounds of lime and 5,000 pounds of coke per day. This material is transported to an automatic balance, and thence by a conveyor to a screw mixing tank; from here it falls to the doors of the electric furnaces by a series of conduits. The mechanical operations are carried out by two electric motors. Nine double electric furnaces are used, with space for three others to be installed later; the furnaces have a capacity of 125 horse power.

The Meran works is one of the most important plants; it is operated by the Gin and Leleux process. It utilizes the water power of the Etsche, one of the confluents of the River Adige. The fall has a height of about 280 feet. The canal is less than a mile long; it passes in a tunnel for a part of the way, and then two metallic conduits, 6 feet in diameter, bring the water to the turbines; there are five of these, of the Garry pattern, with horizontal shaft. To these are coupled five alternators of 1,200 horse power each. Of these, two are used for the carbide plant, to which the current is transmitted by two cables in subway and overhead line; these furnish 2,000 horse power to the plant. A deposit of crystalline marble, very pure, is found near the works. It is carried by an aerial transporter to the calcining furnace. The lime and coke are elevated by a bucket conveyor to the grinders, passing thence to the mixers and finally by a conveyor to the furnaces. The latter have a capacity of 260 kilowatts each; they are disposed in battery in a large room 35 by 130 feet. These furnaces are claimed to give, per kilowatt day, over 11 pounds of crystallized carbide.

Among the plants shortly to be erected is that of Petrozeny. The fall of the Szill River here situated belongs to the Acetylene Company of Vienna. It is about 75 feet high at a maximum, and a mean of 4,800 horse power may be obtained. Another projected plant is that of Almissa, on the Cetina River. This large fall belongs to a syndicate, including Ganz & Company, of Budapest, the Belgium Aluminium Syndicate, and others. The fall is to be obtained by a derivation from the Cetina, using for the purpose a tunnel five miles in length, and in this way 50,000 horse power could be realized. Another fall on the same river is to be utilized by Descovics & Gin, who have obtained the concession; a head of water of nearly 300 feet is assured, which will give 6,000 horse power. A central station is to be established below the fall, and the energy to be transmitted to the port of Olmissa by the high tension system at 12,000 volts; at the latter point will be located the carbide works.

The carbide industry in the United States was the subject of a paper read by Mr. John A. Matthews, who, after giving a historical resumé of the subject, describes the Niagara and Sault Sainte Marie plants, and brings out the fact that the former works turn out most of the carbide consumed in America. He gives the selling price of carbide as varying from $70 to $90 per ton, and estimates that it requires 300 horse power for twenty-four hours to produce a ton of carbide. The cost per ton he estimates at $38. The carbide produced at Niagara is guaranteed to give 5 cubic feet of acetylene per pound, but the production of gas is usually greater. Mr. Matthews says that acetylene lighting is being extensively introduced in the Western States.

Another interesting paper was that read by M. A. Rossel, upon the state of the industry in Switzerland. Up to the time of the discovery of carbide of calcium, hydraulic power was but little used in that country, and there were only two important electrochemical works, that of Neuhausen, which utilized a part of the fall of the Rhine for the production of aluminium, and the Vallorbes plant, making various electrochemical products. The first carbide was made in the latter works, and soon after the Neuhausen plant followed its example, as also the Luterbach works. From this point the carbide industry developed rapidly, and a large amount of capital was obtained for establishing hydraulic plants for this purpose. The Neuhausen Company greatly increased its plant, and erected that of Rheinfelden; Siemens & Halske, with the Wyman Company, installed a carbide works at Langenthal, etc. M. Rossel then gave a short account of some of the leading plants. The Neuhausen works use hydraulic power to the extent of 2,000 to 2,500 horse power, from the fall in the Rhine. A part of the energy is utilized to generate direct current and another part for alternating current on the two-phase system. Both aluminium and carbide are produced at these works, which are in active operation. The Veriner factory takes its energy from the large hydraulic plant at Chèvres; it utilizes about 7,000 horse power in the shape of two-phase alternating current. The primary tension is 2,000 volts and a series of transformers reduces this to 200 volts to operate the furnaces. There are thirteen of the latter, twelve using 500 horse power, and one of 1,000 horse power. The Langenthal works was destroyed by fire on June 5 last. It was erected in 1897 by Siemens & Halske and operated by them in conjunction with the Société Electrique de Wynan. The station at the fall produced triphase alternating current at high tension, which was brought by overhead line to the carbide plant, 4 miles distant; it was transformed here to 45 volts and 3,000 amperes by three transformers.

The three furnaces installed here produced about 500 tons of carbide per year. Another large plant is that established on the River Lonza, at Gampel, utilizing two of the falls of that river. The first fall has a head of 350 feet and operates five turbines of 500 horse power each, direct-connected to low-tension alternators, while the second fall, of 680 feet, drives ten similar turbines with high-tension dynamos; the two-phase system is used. The first fall gives 2,500 horse power, which is all utilized for the production of carbide; the second fall gives 5,000 horse power, and one-half of this energy is used for the same purpose. M. Rossel describes a number of other plants, including that of Vernoya, with turbines of 4,500 horse power, 900 of which is used for carbide; Thusis, using 3,000 horse power, with twelve furnaces of 250 horse power; the Nidau plant, disposing of 5,000 horse power, and using 1,800 for carbide, etc. In the second part of his paper M. Rossel speaks of the raw material used. Limestone of very good quality is found in Switzerland, which gives lime of 99 per cent purity and containing no trace of phosphoric acid. The carbide delivered to commerce is guaranteed to give 4·8 cubic feet per pound, but generally it exceeds this by 2 to 5 per cent. Acetylene lighting is being adopted for public systems as well as in some of the factories.

## THE CONGRESS OF APPLIED CHEMISTRY AT PARIS.

The Congress of Applied Chemistry has been one of the most interesting of the series held at Paris. It is the fourth international congress relating to this subject. The first was held at Brussels in 1894, with great success, and resulted in the formation of the second, held at Paris in 1896. The third was held at Vienna in 1898. The opening session of the present Congress was held in the amphitheater of the Sorbonne. M. Berthelot was honorary president of the committee, and M. Moissan, president. M. Moissan delivered the opening address; he gave a short resumé of the history of the previous congresses, and showed their great utility. In closing he thanked the delegates from the governments and various societies for the manner in which they had answered the invitation addressed to them. M. Berthelot, who was to have pronounced the main discourse of the session, was absent on account of indisposition, and the address was read by M. Moissan. M. Berthelot went over the general history of chemical methods, and shows the ancient origin of the science. In ancient Egypt the art of chemical transformations was practised, and this art was not merely experimental, as might be supposed, but was pursued with a well defined method, as is shown by the manuscripts. It is this ancient science, transmitted partly by traditional processes, and partly by the Syrians and Arabs, who have not contributed greatly to it, which became the alchemy of the middle ages.

M. Berthelot passes over the succeeding centuries to the great discoveries of the end of the last century, which laid the way for the modern science. He laid stress upon the important role filled by the new processes of electro-chemistry, and showed how rapidly these industries were developing and what a great future was in store for this branch of the science. After the address, the officers of the Congress were nominated, these being M. Berthelot, honorary president, and M. Moissan, president. The honorary vice-presidents included more than sixty of the delegates, and all of the leading countries were represented. A great number of papers were read at the succeeding sessions of the Congress; among the most interesting were those relating to acetylene, carbide of calcium, production of ozone, production of metals and alloys by the electric furnace, methods of analysis, some of which will be reproduced in full or in abstract at a later date. At the closing session the next Congress was fixed for 1902, to be held at Berlin.

## BORAX IN EUROPE.

The greater part of the borax which now enters into European commerce is extracted from borocalcite, a mineral which is formed principally of borate of lime. It is found in great quantities in certain parts of Asia Minor. The process of treatment depends upon the reaction of borate of calcium and caustic soda, which, when added, form borax and carbonate of lime. It has been found that the caustic soda may be replaced by bicarbonate of soda to obtain the same result, the best method being to use a mixture of the two. In the process which is now generally used, the native borocalcite is reduced to a fine powder in a mill. Of the powder, 15 parts by weight are taken, and 60 parts of water, and this is placed in a steam-heated vessel, adding 8 parts of bicarbonate of soda and 2 parts caustic soda, and the whole is boiled for about three hours. The mass resulting from this treatment is passed into large filter presses, and the hot solution which comes off is placed in crystallizing basins, and at the end of a few days the borax may be collected in crystals; these are put to dry in a steam oven. They are often in irregular masses of large size, and these must be broken into small pieces, after they have been well cleaned. The small crystals thus obtained are assorted and put in barrels whose weight is from 100 to 800 pounds. The cake of carbonate of lime which remains in the filter-press is washed with water until the borax is completely extracted, and is then sold to glass, paper or cement works. It is estimated that 100 pounds of borocalcite will yield 100 to 105 pounds of crystallized borax.