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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