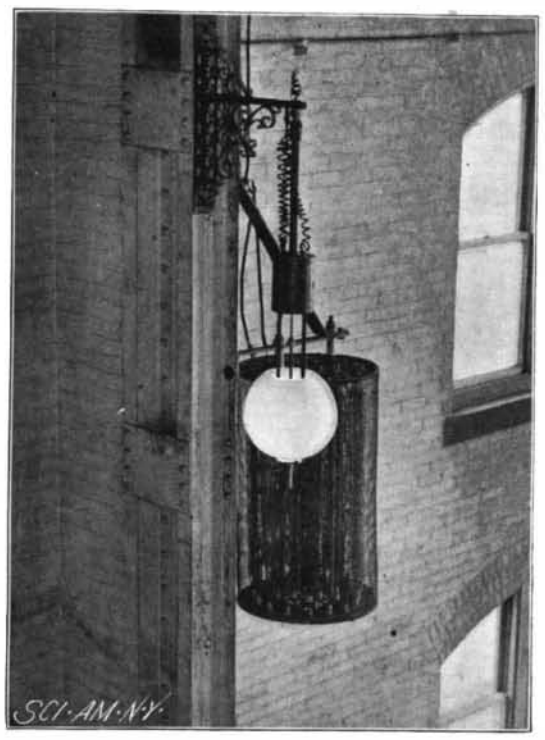
THE ELECTRIC HEATING OF THE GENERATING STATION OF THE NIAGARA FALLS POWER COMPANY.

BY ORRIN E. DUNLAP.

The Niagara Falls Power Company's big power station offers one of the most interesting studies on the subject of electrical heating to be found in the United States, if not in the world. The power station is a beautiful structure built of Queenston limestone. It is in the Moorish style of architecture. The fact that the roof of the great building is free from and unbroken by chimneys excites the attention of approaching visitors, and many are at a loss to know how to account for the unusual appearance of the structure on its exterior until they get inside and realize that the pleasing warmth is due to electrical heat, and that no other heat is employed about the building. The power house is divided into the dynamo room and the office quarters—a fact which makes necessary two series of heaters. The heaters in the offices are on a secondary 100 volt circuit, and this circuit is fed through converters which reduce the voltage from 2,000 to 100. In the office portion of the power house there is about 175 horse power in heaters of the American pattern, but they are seldom all on at the same time. Of course, it depends entirely upon the weather conditions as to the amount of heat required to make the rooms comfortable. The office occupied by the electrical superintendent, Mr. Paul M. Lincoln, is about 20 by 15, by 9 or 10 feet high. In this room are two heaters, each of 7 horse power, making a total in the room of 14 horse power, and in zero weather both are necessary to give comfort.

In the dynamo room there are fifteen heaters, three circuits of five each, and each circuit takes up about 200 horse power. However, it has never yet been found necessary to use all three circuits, two of them being found sufficient in the coldest weather. By consulting the illustration in connection with this article the heaters will be seen on the left on the walls of the dynamo room, about 15 feet above the floor. This method of placing them was adopted partly as a means of safety, but it serves nicely in distributing the heat midway between the roof and the floor. The current for heating the dynamo room is taken from the 'bus bars and carried on No. 4 rubber-covered wire, while that for heating the office portion of the building is taken from the primary of the circuit which feeds the street railways about Niagara Falls. As each heater takes up about 40 horse power, it will be seen that to put in converters to convert the power down to 100 volts would be quite expensive, and consequently the current is taken direct from the 2,200 volt circuit.

The heaters in the dynamo room are made of two circular rolled iron plates which are about ⅛ inch thick and twenty-four inches in diameter. Bolts hold these plates parallel, about 4 feet apart, one above the other. Each plate has about 28 holes in it, and the diameter of each hole is about ½ inch. In each of these holes is placed a porcelain insulator having a pretty large head, and through the insulators No. 6 iron wire is strung. There are 38 coils, and each coil is about 1½ inches in diameter, the distance between convolutions being about twice the diameter of the wire; at least, it is such that the resistance of the heaters will take about 65 amperes at 440 volts, so that all five heaters, in series, will consume 2,200 volts at 65 amperes. The heaters were designed by Mr. Paul M. Lincoln, and made by Dobbie, Stuart & Company, of Niagara Falls. Heaters of very similar pattern are in use in the power station of the Niagara Falls Park and River Railway Company, in Queen Victoria Park, on the Canada side



ELECTRIC HEATERS USED AT NIAGARA

of the river, the voltage on these latter heaters being 500.

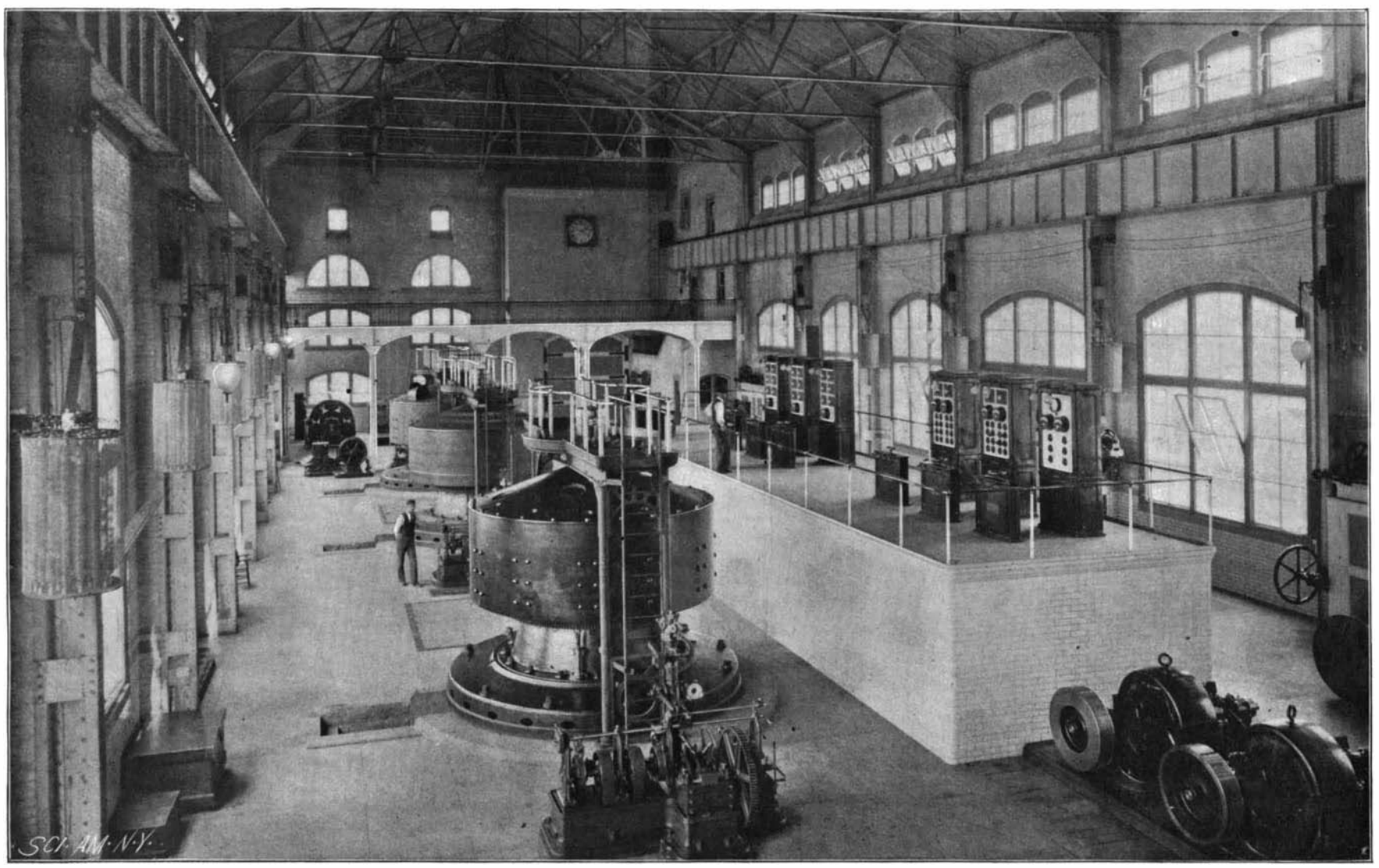
The maximum amount of power used in heating the dynamo room and office portion of the central station of the Niagara Falls Power Company is about 420 or 430 horse power, but it must be understood that this is not counting the heat from the dynamos, which is, indeed, an important factor so far as the dynamo room is concerned. At the present time there are three dynamos in the station, each of 5,000 horse power capacity. As a general thing, two of these machines are running at the same time. Now if each machine was being run so as to give 4,000 horse power, instead of at its full capacity, and three per cent of this power was lost in heat, each of the dynamos would contribute no less than 120 horse power to heating the dynamo room, or from the two machines generally in use 240 horse power would be obtained. This estimate of the power from the dynamos lost in heat is not any too large, a fair average being from 2½ to 4½ per cent. Add the 240 horse power from the dynamos to the amount of power consumed by the heaters when all are in service, and it will be seen that nearly 700 horse power is consumed in heat in the entire building. It is fair, however, to state that when two dynamos are in operation the additional heat thrown off makes unnecessary the use of all the heaters.

Internal Rays.

Prof. S. P. Thompson, in a letter to L'Eclairage Electrique, explains the distinctive properties of a new kind of rays, which he has discovered inside the X ray tube, and which he calls "internal rays." These rays, which we have already shortly described in our report of the British Association meeting at Liverpool, says the English Electrical Review, differ from the Roentgen rays in being deflectable by a magnet, and from the cathode rays in being given off in every direction from the surface of the anti-cathode. Prof. Thompson's attention was first drawn to these rays by observing that the boundary line of the fluorescence in a focus tube was displaced by a magnet, while no displacement of the corresponding line on a fluorescent screen held outside the tube was observed. Evidently, then, there were some deflectable rays flowing along with the Roentgen rays inside the tube, but unable to pass with the latter through the glass. These rays do not appear to us to be so different in kind from the Roentgen rays as to require to be characterized by a special name. If Lenard's theory of the difference between the cathode and the Roentgen rays be correct, the two kinds of rays regarded from the point of view of magnetic deflectability pass into each other by insensible gradations. Though Prof. Thompson says internal rays do not pass through glass, they may be able to pass through the sides of an aluminum tube, in which case they would merely be a variety of our old friends the Lenard rays. There appears to have been a great tendency lately among X radiationists to mistake mere varieties for new species.

A CONTEMPORARY is responsible for the following paragraph; the SCIENTIFIC AMERICAN disclaims any responsibility for its accuracy:

In China the hen is kept constantly busy. When not engaged in hatching her own brood, she is compelled to hatch fish eggs. The spawn of fish are placed in an eggshell, which is hermetically sealed and placed under the unsuspecting hen. After some days the eggshell is removed and carefully broken, and the spawn, which has been warmed into life, is emptied into a shallow pool, well warmed by the sun. Here the minnows that soon develop are nursed until strong enough to be turned into a lake or stream.



GENERATING STATION OF THE NIAGARA FALLS POWER COMPANY, SHOWING THE ELECTRIC HEATERS.

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Science Notes.

Great interest has been created in astronomical circles by some of the results reached by Prof. Simon Newcomb in his more recent investigations. One of these is that astronomers have been overestimating the distances of the stars; and the other, that our universe has after all a fairly well defined limit. The first of these conclusions Prof. Newcomb bases on an idea that the stars which are called the smaller ones, because they are less bright, may not be large stars at a very great distance, but perhaps smaller or dimmer ones nearer at hand. The old idea is familiar to all, namely, that all the stars are of the same brightness, and that the fainter ones are at a very much greater distance from us than the bright ones; this theory, however, has been weakened by later discoveries, such as, for example, that Sirius has a companion whose light, if equal surfaces be considered, is but a fraction of that of its principal; and astronomers have come to recognize dim stars, or even dark ones, like the companions of Algol, about which so much has lately been written, to be quite as common, perhaps, in the universe as the bright ones. Prof. Newcomb's proposition as to the limits of the universe is regarded as even more novel and striking, suggesting, as it does, the possibility that some day all the stars will be seen.

Quite recently a considerable number of additions to our knowledge of the Roentgen rays and their applications have been published, says Nature. From Prof. Hobday we have just received a reprint of his and Mr. V. E. Johnson's joint paper in the Veterinarian for September, dealing with the use of these rays in veterinary practice, illustrated by several excellent radiographs of the hoof and hock of horses, both normal and abnormal. In the Bulletin of the Belgian Royal Academy, M. L. N. Vandevyver enunciates the empirical law that the length of exposure for radiographs through limbs of different dimensions varies as the cube of their thickness, and the illustrations which accompany the paper afford ample corroboration of the law from a practical point of view. The journal of the Camera Club for December contains the account of a lecture, by Prof. Rüker, on the transparency of glass and porcelain to these rays, from which it appears that the presence of phosphates in china is indicated by their greater opacity, a result which might naturally be expected to follow from the considerable opacity of bone to Roentgen rays. M. Bouchard, in a communication to the Paris Academie des Sciences, states that Roentgen rays can be successfully employed in diagnosing pleurisy and similar complaints.

In the current number of the American Journal of Science Prof. R. S. Tarr, of Cornell University, has a paper giving the results of observations of climate and geological changes in Greenland and the American sides of Baffin's Bay. The observations were made during a voyage last summer. On the American shore were found great floes of ice, the coast bleak, and heavy snow banks on the land in July. On the Greenland coast, hundreds of miles northward, flowers were in blossom, insects abundant, and the air balmy, storms bringing rain and not snow. This difference, which has heretofore been noted and attributed to difference in the temperature of ocean currents, Prof. Tarr partly assigns to warm winds, including that from the Greenland ice cap, which was found warmer than that from the sea, the explanation being the same as that for the chinook wind. Prof. Tarr found in Baffin Land and Labrador evidences of former glaciation which came when the land was higher than now, but the American land is now in a reverse movement of uplift, while on the Greenland coast there is submergence of land at present in progress. In conclusion Prof. Tarr raises these queries: "Is Greenland now passing through the stage of ice withdrawal from which the American, Labrador, and Baffin Lands have so recently escaped? And is there any relation between the downsinking of Greenland and the uprising of Labrador and Baffin Land? Is the ice withdrawal directly due to the land movement, and is the load of ice really the cause for the sinking which allows its withdrawal? That is, does the ice increase in area and extent with no other result than its own destruction by depressing the land, and hence removing the cause of supply?"

Value of "Useless" Research.

The report of the British Association's committee on the establishment of a national physical laboratory, after referring to what is done and what can be done for promoting research by the universities and schools and other existing institutions, specifies particular types of investigation which are outside the range of effort possible for such institutions or for an individual—such as observations of natural phenomena, the study of which must be protracted through periods longer than the average duration of human life; testing and verification of physical instruments and preservation of standards; and the systematic and accurate determination of physical constants and numerical data which may be useful for scientific or industrial purposes. In the discussion of this report, Prof. Fitzgerald opposed divorcing the universities from research, but hoped they would teach the usefulness of "useless" research, while investigations of commercial importance should be relegated to a national laboratory. Prof. Kohlrausch, of the Physical Training Institute (the Reichsanstalt) at Berlin, showed how completely that institution was answering the purposes for which it was founded, illustrated in the great development of the technical glass industry, particularly of thermometer making; the improvement of photometers and standards for measuring light; and researches in apparatus for measuring furnace temperatures. Scientific discovery, he declared, whether costly or cheap, is, in its results, beyond price, for you never know whether the abstract discovery will not lead to inventions of great industrial importance. He could point to quite small physical discoveries which later received great technical applications, says the Popular Science Monthly. When Huygens investigated the singular double refraction of calcareous spar, no one supposed that so small a point in physics would have a commercial value over the whole world in the sugar industry and in brewing.

A THILL SUPPORT AND ANTI-RATTLER.

The simple and effective device shown in the accompanying illustration has been patented by Granville Bartlett, of No. 360 South Broadway, Lexington, Ky. It is preferably made of heavy wire or rod bent upon itself at the middle to form a curved hook or tongue-like portion, as shown in the small figure, this portion in use engaging the thill eye, below which extend coils from which side wings extend upward and forward,

BARTLETT'S THILL SUPPORT.

adapted to bear against and lock the bolt head and nut from turning. There are upper coils above the nut and bolt head, and forwardly extending arms for connection with or on which the seat of the thill is formed. By arranging the lower coils to carry only a small portion of the weight of the thills, the wear on the hook, thill eye and bolt is much less than if the entire weight of the thills was borne by the lower coils.

Discovery of the Eggs of the Pearly Nautilus.

In a communication to the Times, Prof. E. Ray Lankester says: The pearly nautilus is the only living representative of the great group of extinct animals whose shells are known as ammonites. So rare were specimens of the animal itself that twenty years ago I paid £18 for two preserved in spirit. Yet they are trapped in baskets like lobster traps by the natives of some of the Melanesian Islands and used as food. The structure of the animal is extremely curious, and an admirable account of it formed the first and in many respects the ablest scientific memoir produced by Sir Richard Owen. The nautilus is allied to the cuttle-fishes, but differs from them in most interesting ways. To fully understand its structure and the mode of building up of its chambered shell, it is necessary to know its young stages while it is growing and forming within the egg. To gain this knowledge will be a great triumph; it has been one of the few important embryonic histories not yet ascertained by the enterprise of latter day naturalists. Dr. Arthur Willey proceeded first to Ralum, in New Britain, where he spent a year trapping the nautilus in 70 fathoms of water and dredging in vain for its eggs. He then tried a station on the coast of New Guinea, where he was nearly drowned by the capsizing of his small craft. After passing through New Caledonia, he arrived last summer in Lifu, one of the Loyalty Islands, where nautilus can be captured in three fathoms depth only. Here he constructed a large submarine cage in which he kept specimens of nautilus, feeding them daily. On December 5 last his patient endeavors were rewarded. Some of the nautili had spawned in the cage, and thenceforward he was able to obtain abundant samples of the eggs. Each egg is as large as a grape, and is deposited separately by the mother nautilus. At present we have received but few further details from Dr. Willey, but he has doubtless by this time obtained the young in all stages of growth, and will return to England with the materials for a most important memoir. Dr. Willey's success was announced (on February 3) from the chair of the Royal Society by Lord Lister. Dr. Willey was enabled to undertake this quest by his appointment to the Balfour studentship, founded by general subscription in memory of Frank Balfour, whose heart would have been rejoiced by the work thus carried out in his name. He was also assisted by the government grant fund of the Royal Society. It is a legitimate source of gratification to British men of science that a successful result has followed from the application of these funds. By aid of the same funds Mr. Caldwell twelve years ago discovered the eggs of the Australian duck mole and echidna, and the larval stages of the remarkable fish ceratodus of Queensland—an animal which, like the nautilus, is a survival of most ancient extinct forms.

The Canal of Joseph.

How many of the engineering works of the nineteenth century will there be in existence in the year 6000? Very few, we fear, and still less those that will continue in that far-off age to serve a useful purpose. Yet there is, at least, one great undertaking conceived and executed by an engineer which during the space of four thousand years has never ceased its office, on which the life of a fertile province absolutely depends to-day. We refer to the Bahr Joussuf—the canal of Joseph—built, according to tradition, by the son of Jacob, and which constitutes not the least of the many blessings he conferred on Egypt during the years of his prosperous rule. This canal took its rise from the Nile at Asiut, and ran almost parallel with it for nearly two hundred and fifty miles, creeping along under the western cliffs of the Nile valley, with many a bend and winding, until at length it gained an eminence, as compared with the river bed, which enabled it to turn westward through a narrow pass and enter a district which was otherwise shut off from the fertilizing floods on which all vegetation in Egypt depends. The northern end stood seventeen feet above low Nile, while at the southern end it was at an equal elevation with the river. Though this cut ran a perennial stream, which watered a province named the Fayoum, endowing it with fertility and supporting a large population. In the time of the annual flood a great part of the canal was under water, and then the river's current would rush in a more direct course into the pass, carrying with it the rich silt which takes the place of manure and keeps the soil in a constant state of productiveness. All this, with the exception of the tradition that Joseph built it, can be verified to-day, and it is not mere supposition or rumor. Until eight years ago it was firmly believed that the design has always been limited to an irrigation scheme, larger, no doubt, than that now in operation, as shown by the traces of abandoned canals, and by the slow aggregation of waste water which had accumulated in the Birket el Querum, but still essentially the same in character. Many accounts have been written by Greek and Roman historians, such as Herodotus, Strabo, Mutianus and Pliny, and repeated in monkish legends, or portrayed in the maps of the middle ages, which agreed with the folk lore of the district. These tales explained that the canal dug by the ancient Israelite served to carry the surplus waters of the Nile into an extensive lake lying south of the Fayoum, and so large that it not only modified the climate, tempering the arid winds of the desert and converting them into the balmy airs which nourished the vines and the olives into a fullness and fragrance unknown in any part of the country, but also added to the food supply of the land such immense quantities of fish that the royal prerogative of the right of piscary at the great weir was valued at £250,000 annually. This lake was said to be 450 miles round, and to be navigated by a fleet of vessels, and the whole circumference was the scene of industry and prosperity.—Engineering.

Aluminum Coated Sheets.

A new departure in the field of sheet metals has just been undertaken by a St. Louis, Mo., firm. This firm have sent us, says the Metal Worker, samples of steel sheets coated with aluminum, which, it is claimed, are superior to and more durable than galvanized iron, tin plate or planished iron for many purposes for which those materials are now generally used. The special advantages of the aluminum coated sheets are stated to be that they can be worked and seamed without peeling, the coating adhering absolutely to the sheet, can be easily soldered, will resist the action of sulphurous gases and can be heated to a red heat without destroying the coating. Moreover, they can, when desired, be polished to a luster equal to burnished silver or nickel. The samples in our possession show that the work of coating is very completely done, the sheets presenting an absolutely smooth and evenly covered surface, free from imperfections of any kind. In their unpolished state the sheets have a dull, silvery appearance, and when polished look exactly like nickel plate. The firm are also producing aluminum coated sheets plated with copper, which are designed for use in most cases in which pure copper sheets are now employed. These also take a high polish.

The feasibility of coating iron with aluminum was demonstrated some years ago at the works of the Tacony Iron and Metal Company, Tacony, Pa., where all the iron plating for the dome of the tower of the Philadelphia Public Buildings was given a coating of aluminum by the electrolytic process. In this case, however, a coating of copper was deposited on the iron before the aluminum was applied. In the sheets furnished us by the St. Louis company the aluminum appears to be deposited directly on the steel.

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