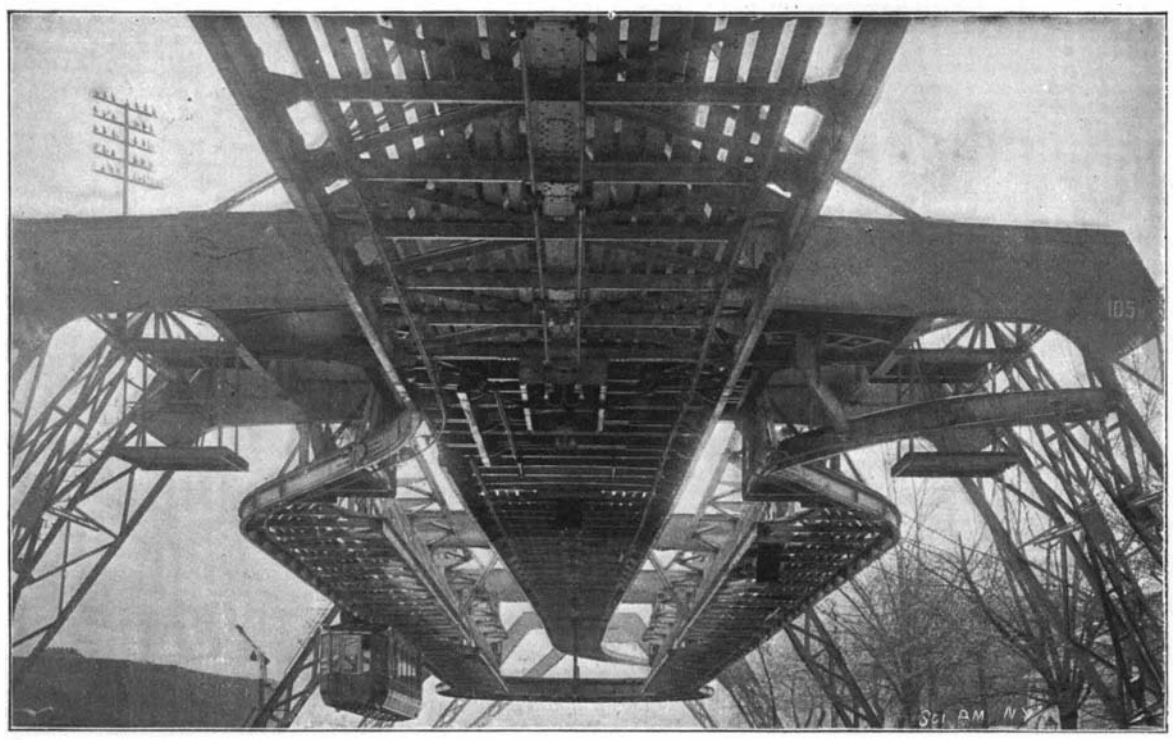
THE LANGEN SUSPENDED RAILWAY OF BARMEN-VOHWINKEL-ELBERFELD.

BY PROF. DOLEZALEK.

On March 1, 1901, the suspended railway connecting the three German manufacturing towns of Vohwinkel, Eberfeld, Barmen, some 13.3 kilometers in length, was partially opened to the public.

The road is built on a system of latticed longitudinal girders, one vertical and two horizontal, assembled into the form of an I-section. The main girders form the web of the I; and the lateral girders, which give the requisite lateral stiffness, serve as the top and bottom flanges of the I. Diagonal tie-rods extend from the upper panel points of the central girder to a connection with the chords of the bottom lateral girder. The last-mentioned chords consist of steel I-beams, and upon their upper flanges is laid the single T-rail, from which the cars depend and on which they run. The girders, which vary in span from 21 to 33 meters (68.88 feet to 108.24 feet), are carried upon supports varying in structure with the locality where they are used. Where the railway is carried immediately above the Wupper River, the A-frame style of pier is used; while in the towns through which the line passes, the trusses are carried upon substantial U-frames. The A-frame consists of two rectangular latticed struts, which are united at the top by a rectangular plate yoke.



The Return Loop at the Zoologischer Garten Station.

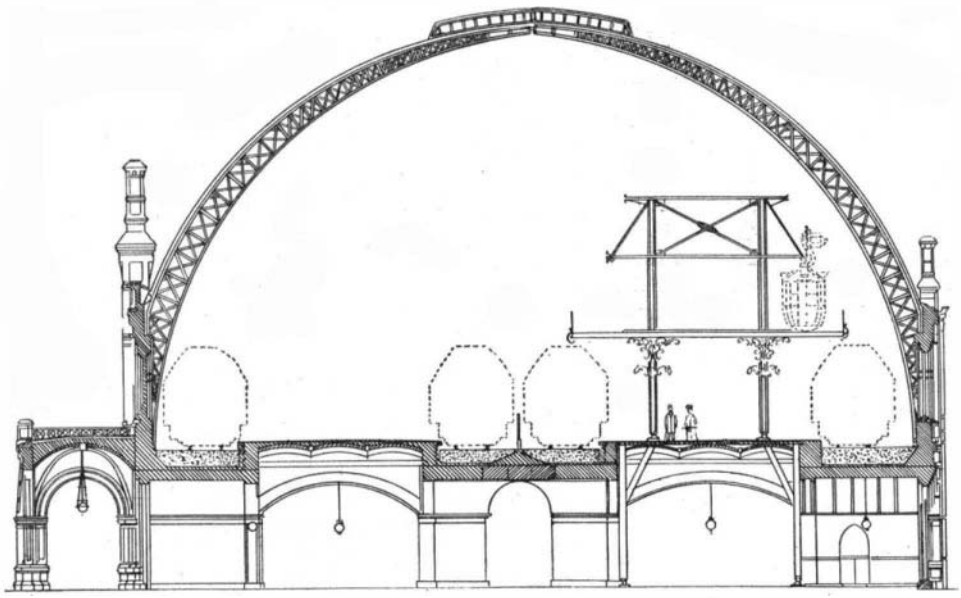
The supporting structure of the road, including trusses and piers, has an average weight of 1,100 kilogrammes per meter, which is due primarily to the great length of the girders and unusual height of the supports at Elberfeld. Under more favorable conditions this weight could be reduced.

The cars are 11.5 meters (37.7 feet) long, 2.6 meters (8.5 feet) high, and 2.1 meters (6.88 feet) wide; are therefore fairly long and narrow, and are slightly tapered at the ends. They have a seating capacity of 50, and are built with two side doors opening inwardly, and two auxiliary doors at the ends. The total weight of each car is twelve tons. The cars are freely suspended from two trucks spaced 8 meters apart and equipped each with two wheels, double-flanged and having a diameter of 0.9 meter. The wheels are mounted in tandem to run on a single rail, and are driven by two electric motors of 36 horse power each, through the medium of transmission gearing. The motor-trucks receive current by means of a slip-shoe and a contact rail, which is carried on the bottom of the lateral girder, somewhat to the inside of the main supporting I-beam.

The truck-frames embrace the rail-girders and the rails so closely that a play of only 7 millimeters is allowed, and that derailment is impossible. If a wheel or axle should break, the cars would be held up by the frames.

Oscillation of the car is limited by two projections on the lower part of the hook-shaped frame, as shown in one of our diagrams.

The cars swing around the curve in a slightly inclined position and spontaneously reassume their normal vertical position when a straight part of the rail is reached. To the passengers the change in equilibrium is imperceptible. Since a sudden change of equilibrium causes an oscillation proportionate to the velocity and the angle determined by the radius of the curve, which oscillation lies within twice the value of this angle, comparatively long transitional bends have been provided, by reason of which the equilibrium is gradually changed, with the result that almost inappreciable oscillations are produced.



Station at Friedrichstrasse, Showing Intermediate Station.

On the supporting structure at Elberfeld the maximum oscillation is 15 deg., corresponding to a speed of 55 kilometers per hour on a curve having a radius of 90 meters. On an experimental line in Deutz the axis of suspension swung 26 deg., so that curves having a radius of 90 meters can be rounded at a speed of 75 kilometers per hour, and curves of 350 meters at a speed of 150 kilometers per hour.

The actual speed of the Barmen-Elberfeld-Vohwinkel line has been temporarily fixed at 40 kilometers per hour, but will soon be increased to 50 kilometers per hour, so that the average speed, including stops, will be 30 to 36 kilometers per hour, and so that entire length of the road, 13.3 kilometers, can be covered in 25 minutes.

In the experiments which have been made an acceleration of 0.6 meter and even 0.8 meter per second was obtained at the start. Even with an acceleration of only 0.5 meter per second, the prescribed speed of 40 kilometers per hour will easily be attained.

During the experiments, the brake retardation could be considerably increased to more than 0.5 meter per second. With a brake retardation of 0.75 meter per second, it would be possible to brake the cars within about 80 meters.

The cars are fitted with a Westinghouse air-brake, a hand brake connected up with the air-brake, and an electrical brake, while an emergency stop can be made by reversing the motors.

There are eighteen stations on the line, which are built on structures at about 4.5 meters above the ground. This elevation was necessary in order not to interfere with street traffic in the towns. The rails run straight through the stations. Covered staircases lead from the ground to the station platforms.

Within the station and extending through its entire length a wire-netting is stretched between the tracks for safety. Rocking of the cars, as passengers are received and discharged, is prevented by means of springs mounted beneath the cars and arranged to slide on wooden longitudinal beams of the station platform. The return-loop at the Zoologischer Garten is so constructed that, by means of a lifting-switch, and a sharply-descending rail, the cars are switched beneath the main track, around to the opposite side, and finally by means of a lifting switch and an ascending guide-rail, to the track leading in the opposite direction.

The system is fitted with an automatic block system, in which the signals are regulated by the car itself, and, consequently, the headway between the trains may be reduced, if de-

The Station at Doppersberg.

THE LANGEN SUSPENDED RAILWAY.

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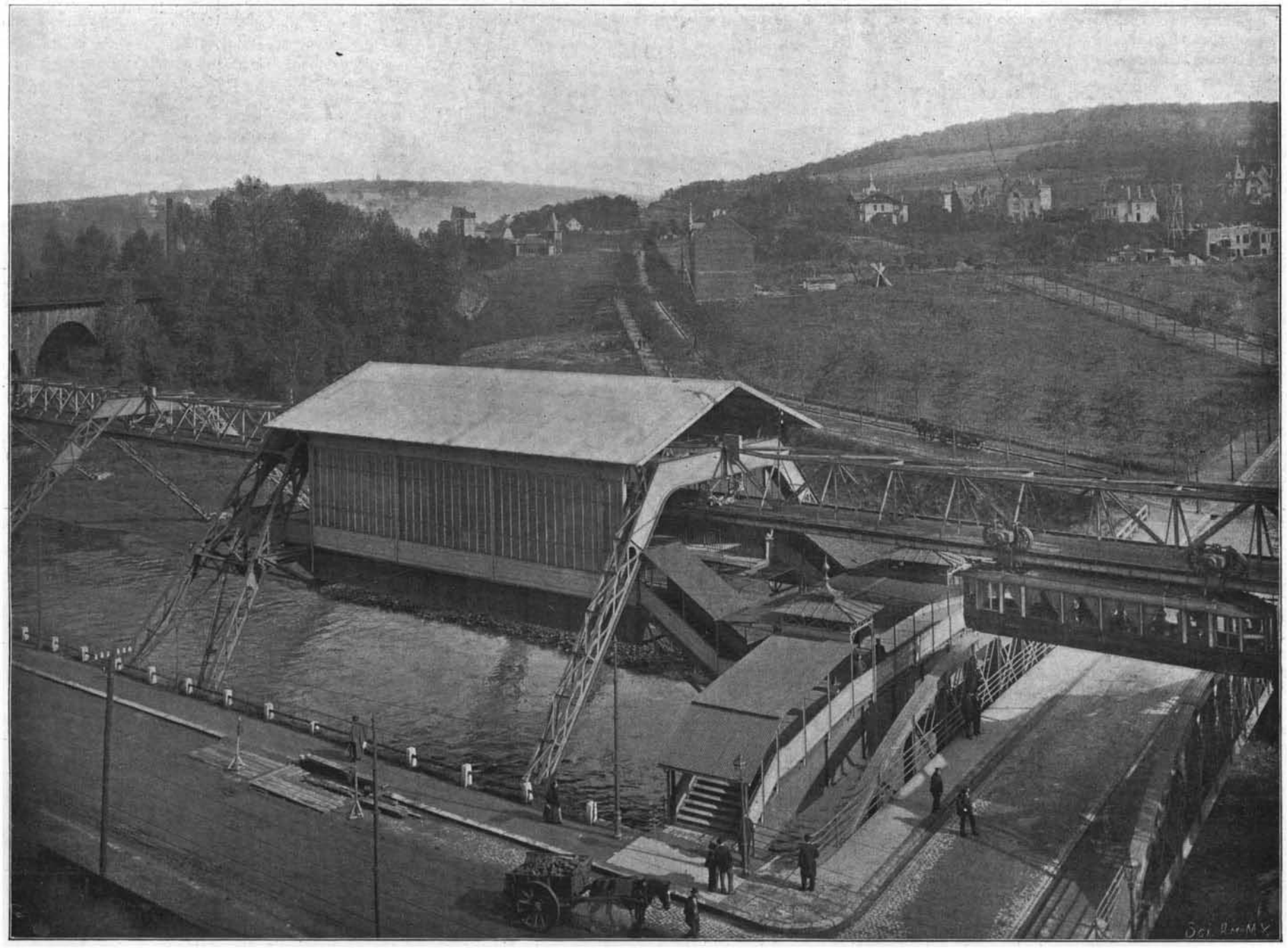
Interior of Doppersberg Station.

The Highway in Elberfeld Sonnborn, Showing the Inverted U-Frames.



General View of the Zoologischer Garten Station, Showing the Construction Over the Wupper River.

THE LANGEN SUSPENDED RAILWAY OF BARMEN-ELBERFELD-VOHWINKEL.—[See page 53.]

sired, to two minutes. The electrical equipment has been duplicated, so that in case of accident or necessary repairs traffic will not be blocked.

In order to give the whole structure of the road longitudinal stability, rigid double A-frames, with a broad fixed base, are introduced at intervals of about 900 feet, the intermediate A-frames being provided with ball-and-socket joints. By reason of this arrangement, the intermediate posts, or A-frames, as the case may be, are free to move in a longitudinal direction, and accommodate themselves to the expansion and contraction of the supported spans.

In that portion of the line which is built above the river, the total weight of the structure, including the supporting struts or piers, is less than 850 pounds to the foot, while the weight of the portion above the roadways, where inverted U-posts are used, is 785 pounds. When it is considered that the length of the spans average about 100 feet it will be seen that the structure has been designed with a due regard for economy of material. The road cost between $200,000 and $225,000 per mile, including the foundations and the stations. If the equipment be included, the cost may be placed at about $265,000 per mile.

The Charleston Exposition.

BY GEORGE E. WALSH.

The Winter Exposition is something unique and novel even in this age of exposition-making, and probably few cities can offer the climate favorable enough to make such an enterprise successful. Charleston has the peculiar geographical location which makes it accessible to Northern and Southern cities, and with a winter climate that can be described neither as hot nor cold. It approximates that "happy medium" between our extremes of temperature which most people desire.

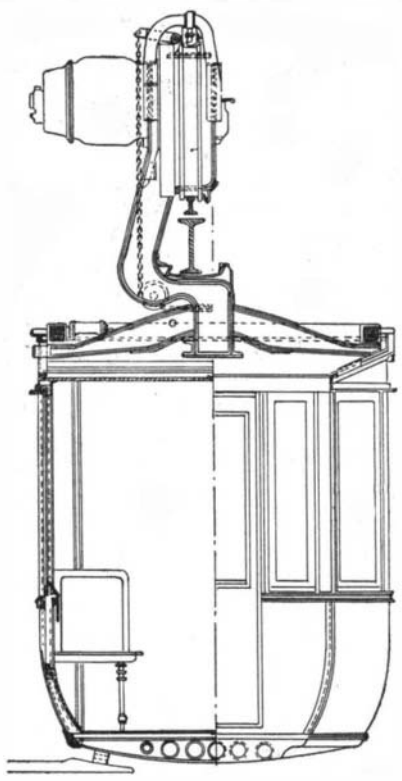
Situated not far distant from the temperate and tropic zones, the historical city by the sea which appeals this winter to those who love expositions, furnishes an opportunity to learn about the products and habits of life of a tropical and semi-tropical part of our western hemisphere that is rarely accorded to any people. The city is practically a key to the great commercial life which pulsates among the islands of the tropics off our South Atlantic coast, and which each year is becoming more important to us. Charleston is a seaport that has no superior for stimulating the growth and development of the trade with the West Indies and this country; and while our Southern States produce many of the articles of a tropical and semi-tropical nature, there is less rivalry than mutual advantages obtained through exchanging of products with the islands of our coast. Only in an accidental way do we appreciate the importance of this West India trade; yet we sell more merchandise to the West Indies than to all the fifteen republics of South and Central America. Our Pan-American Exposition and Pan-American Congresses are all intended to stimulate a future trade with South America; but here with the West Indies is a trade already in our possession, and yet not half developed. The islands to-day are looking to us to supply them with most of their manufactured goods, and in exchange they offer to send to us the tropical products of their fields and orchards.

In the year 1900 we sold to the West Indies goods to the amount of $47,436,677. Compared with the value of our products sold to some other countries which have received far more advertising one may find food for interesting study. In the same year our trade with the South American republics reached a total valuation of $42,373,255; with China, Japan and Asiatic Russia combined, $47,396,744; and with the combined countries of Greece, Turkey, Switzerland, Norway and Sweden, Spain, Portugal, Russia and Austria-Hungary, only $45,089,368. Our trade with the comparatively little-talked-about West Indies suddenly looms up in true proportions when such comparisons are made, and we manage to find more enthusiasm on the subject. Charleston in holding its Winter Exposition for the purpose of exhibiting the products of these islands, as well as those of the South, intends to draw into closer union the interests of the West Indies and those of this country. As a factor in the American expansion of our commerce these islands of the Atlantic must prove of the greatest importance to the South.

The display of the products of the West Indies at the Winter Exposition is of the finest, and the visitor there is enabled to get a very comprehensive idea of the resources of the island. Likewise the exhibits of the American products which the average West Indian will need are made with singular simplicity of aim and desire. The West Indian trader can study what he needs and find suggestions for his own improvement.

Naturally in such an exposition the chief exhibits are of products which the group of South Atlantic States are most interested in. These include cotton, sugar, tea, rice and tobacco. These products, from one of the oldest and richest of our agricultural sections, are in constant demand in the West Indies in one form or another. Most of the cotton raised in this country comes from a group of the States on the southern Atlantic seaboard most interested in this exposition; and since cotton mills have become almost as numerous there as in New England, manufactured goods of this product will figure as important factors in the future development of that section. It is not without good reason, therefore, that the Charleston Exposition endeavors to draw the West Indian traders to a seaport which aspires to control a trade that is bound to expand as time goes on.

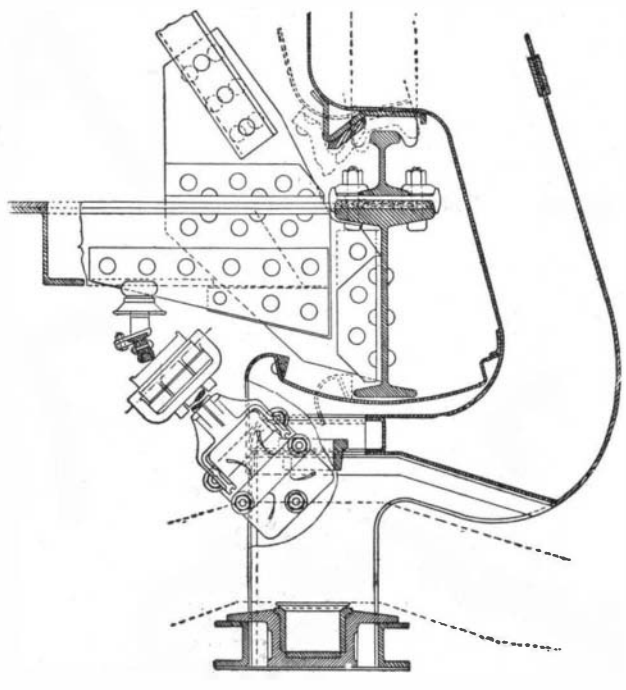
The fact that most of these islands off our coast



PARTIAL CROSS-SECTION AND REAR-END ELEVATION OF CAR.

are owned by European nations, who merely use and exploit them as colonies, makes the trade relations between them and this country all the more interesting and valuable. Great Britain's flag waves over fifty-six of the islands, the Netherland's over five, France's over three, and Denmark's over three. By their geographical position and natural trade conditions they should either belong to this country or be independent and commercially bound to us; but political rulings have arbitrarily changed their destinies, though not their actual trade development.

Trade conditions between this country and the West Indies are further emphasized by a comparison of the consumption of our goods according to the population of the islands. Thus during the year 1900 the people



METHOD OF SUSPENDING THE TRUCKS.

of the islands imported from this country our surplus goods, per capita, to the extent of $7.90. The imports, per capita, in China of our goods amounted to 3 cents. The same proportion existed between the people of the Philippines and our exports to the islands, while the South American republics imported goods, per capita, from us to the extent of $1.13. Considered from any point of view the trade with the West Indies is one of the most important we have, and anything to encourage and stimulate it must be of general benefit to the whole country.

An egg of the great auk was recently sold in London for 240 guineas.

Correspondence.

Power from Rivers.

To the Editor of the SCIENTIFIC AMERICAN:

How to utilize the water power in navigable rivers is a problem which has received but little attention from engineers. In these days of big accomplishments, when capital seeks investments in the largest enterprises, it is strange that an attempt has not been made to wrest power from the big, sluggish rivers which have played so important a part in the development of our country.

To stimulate thought on this subject I submit a plan for using this wasted power.

Supposing it is decided to take power from the Missouri River at Omaha, Neb., the power to be used for traction and lighting purposes. We will say that the average fall of the river for ten miles is seven feet to the mile, or seventy feet to the ten miles. We lay a dozen lines of pipes, each two feet in diameter, on the river bed from Omaha to a point ten miles up the river.

By having the upper ends of the lines of pipes terminate at a foot below the surface and near the bank, so as to leave the river clear, we would have a power at the lower end which would raise twelve columns of water, in pipes, sixty-nine feet above the surface of the river. The power which could be thus utilized would be limited by the number and strength of the lines of pipes, which could extend any distance up the river.

The first cost of a plant constructed on this plan would be large, while the maintenance and operating expenses would be comparatively small.

EDWARD P. SHARP.

Lincoln, Neb., December 31, 1901.

[There are plants erected on this system in various parts of the country.—ED.]

An Esquimau Arrow.

To the Editor of the SCIENTIFIC AMERICAN:

A few days ago a very large wild goose, weighing 16 pounds, was shot and killed by a hunter on the shores of Lake Liberty. This body of water is located in the Spokane Valley, about 12 miles from the city of Spokane, Wash.

The hunter was standing near the lake, when a flock of geese came winging their way from the north and settled in the tall hedge. He shot and brought one down.

As he picked up the big honker, he was surprised to see a piece of polished ivory protruding from the breast of the goose. The ivory projected about two inches. With great difficulty the man pulled the stick out, for the flesh had grown tightly around it, and the wound had entirely healed.

He then saw that it was the long, sharp point of an arrow, which was made of ivory, about eight inches long, and as large as an ordinary lead pencil.

There are some queer, delicate carvings on the ivory where it had been attached to the arrow-stick. No such arrow has ever been seen in this part of the country, and it could not have belonged to any of the Indian tribes. The Indians in all these regions have, for many years, discarded the use of bows and arrows.

Evidently, the bird has borne the arrowpoint for thousands upon thousands of miles from the far Arctic regions where it had been shot by some Esquimau hunter. The point was deeply embedded in the flesh of the breast, and had touched no vital spot. In the bird's long flight, the arrowstick had doubtless been broken off. The goose was a full-grown male, and had probably received the wound a long time ago.

Some returned Cape Nome miners pronounce the arrowhead of Esquimau manufacture. It will be preserved in the State Museum.

J. MAYNE BALTIMORE.

Bossburg, Wash., December 30, 1901.

The Current Supplement.

The current SUPPLEMENT, No. 1360, has for its first page engraving a portrait of Mr. Marconi, and in the article his recent address before the American Institute of Electrical Engineers is given. "The Need of Direct Steamship Service to Africa" describes conditions which warrant the opening of an American line. "Locomobile Steam Carriage" gives a detailed drawing showing a full section of the carriage. The Meeting of the Geological Society of America is specially reported for the SUPPLEMENT by E. O. Hovey. The Annual Report of the Secretary of Agriculture is continued.

In the course of two years, a thriving town, known as Deferiet, and a gigantic paper mill have been built and put into operation on the Black River, New York. The mill is that of the St. Regis Company and it has a capacity of one hundred tons per day. An investment of two millions is represented in the company's holdings at this point.