

### A CURIOUS ELLIPTICAL BRIDGE.

A clever and peculiar example of bridge construction and erection has recently been carried out upon the seacoast of County Antrim in the North of Ireland. At this point the shore drops precipitously into the sea, the cliffs known as "Gobans' Cliffs," which tower to a height of 200 or 300 feet, being of the basaltic origin seen in this part of the country.

This seacoast scenery is of the wildest and withal most beautiful in its solemn grandeur in the North of Ireland; and to enable visitors and tourists to view the spectacle from its most advantageous points, and also to gain access to the many remarkable caves in the vicinity, a walk has been cut out and built in the face of the cliffs, which in itself constitutes a commendable engineering achievement. This pathway is only from two to three feet in width, and winds along the face and climbs the cliffs in a most extraordinary manner, which from a short distance always imparts to the promenade a most perilous appearance, since immediately below, the waves thunder among the rocks. But the walk has been most skillfully and cleverly designed and constructed. Steps are cut roughly and broadly into the solid rock, but to insure perfect safety to climbers a handrail has been provided. The intervals between the rocks are spanned by delicate and spider-looking bridges of iron. The length of the walk so far constructed is nearly three miles, and it is to be continued for another two miles, which it is anticipated will be completed within a few months. The work is being carried out by the Belfast and Northern Counties Railroad under the supervision of Mr. Berkeley Wise, the chief engineer to the railroad.

The most notable triumph of engineering in connection with this work is the erection of what is known as Gobans' Bridge. This structure is distinctive owing to its curious design, being elliptical in shape. This piece of work was rendered necessary to span a gap 65 feet in width, giving access from the mainland to an isolated rock known as "The Man-of-War."

The general shape of the ellipses of the bridge and its method of construction may be comprehensively gathered from our illustrations. The bridge has a clear span of 65 feet, but is 70 feet in length from end to end. The main structure of the bridge consists of twelve ellipses made of steel placed equidistant. The major axis of each elliptical section is 7 feet inside, with a minor inside axis of 4 feet 8 inches. As will be seen from our illustrations, each of the ellipses is made in two segments of 3-inch by 3-inch by  $\frac{3}{8}$ -inch angles. They are spaced 7 feet 3 inches centers, except the end ones, which are 2 feet 4½ inches centers. The ellipses are held firmly in position by means of longitudinal iron bars, attached to the ellipses by means of stiffening plates 10 inches by 10 inches by  $\frac{3}{8}$ -inch. The longitudinal members are angles 3 inches by 3 inches by  $\frac{3}{8}$ -inch, and the flat bars are 3 inches by ½ inch. The ellipses are additionally strengthened by means of diagonal stays or bracings extending from the points where the half sections of the ellipses are joined.

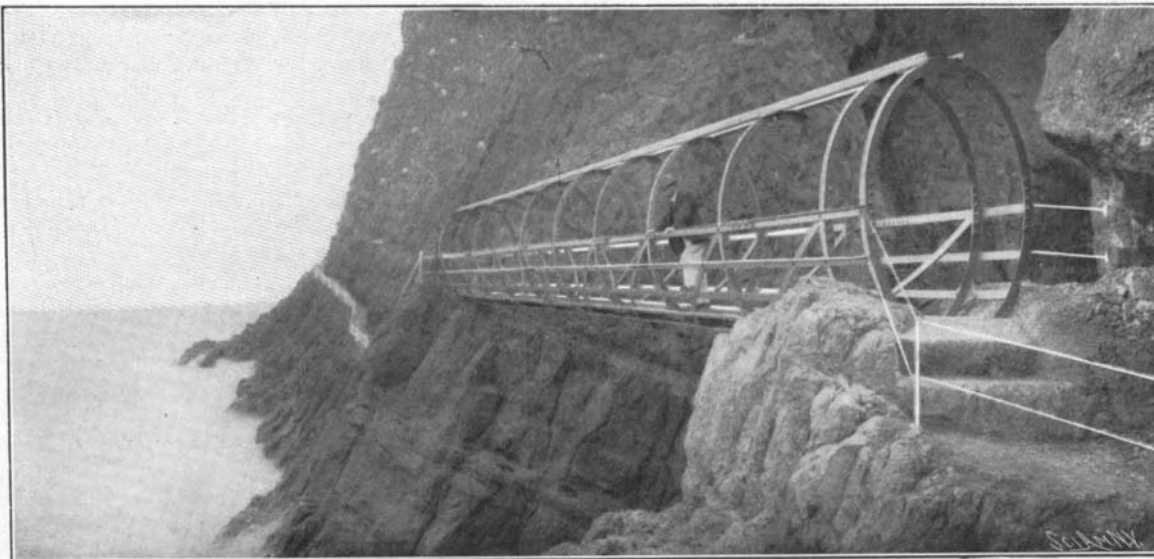
This arrangement yields a stronger foundation to that portion of the ellipse which is to carry the greatest weight, i. e., the floor. The diagonal lattice steel girders are 3 inches by ½ inch, and carriers for floor angles 3 inches by 3 inches by  $\frac{3}{8}$  inch. The flooring of the bridge comprises two pieces of pitch pine 12 inches in width by 3 inches in thickness, laid upon the interior bottom surface of the ellipse and raised sufficiently therefrom to afford a perfectly flat surface upon which to walk. In the cross section therefore the internal major axis from the floor to the crown of the ellipse is sufficient to afford a clear

walking space to accommodate the tallest persons.

Owing to the exposed position of the site of the bridge, the turbulency of the surf playing upon the rocks immediately below, and the strength of the tides, it was found impossible to erect the bridge on the spot. Under these circumstances the structure was erected at Belfast and transferred intact to a scow. The latter was then towed to "The Man-of-War" rock and carefully brought to, as far as possible, immediately below the spot where it was to be installed. Lifting tackle was then placed in position upon each side of the gap to be spanned at the roadway level, and the lifting cables attached to each end of the bridge. The hoisting operation had to be carried out with extreme care, owing to the cramped space in which the lifting tackle was operated, and to prevent the structure being thrown by its own swinging motion when suspended in the air against the face of



PECULIAR BRIDGE CONSTRUCTION ON THE NORTH COAST OF IRELAND.



GENERAL VIEW SHOWING THE POSITION OF THE BRIDGE ON THE CLIFFS.

the rocks, which would have seriously damaged it. The structure was, however, lifted to its position without mishap. It was originally intended to stay the bridge when in position with guys, but when the bridge was erected it was found to be sufficiently rigid to dispense with these additional supports. The bridge was designed by Mr. Berkeley Wise, the chief engineer to the Belfast and Northern Counties Railroad of Ireland.

Railroad building by electric light is the experiment about to be tried by the Santa Fe Railroad Company, when it begins the construction of its cut-off line which will connect the Pecos Valley line with its main line in New Mexico. A large electrical plant will be installed at the mouth of the Abo Pass Canyon, and six hundred laborers will be kept at work all the time.

### Profits of Irrigation in the Eastern Part of the United States.

The rise in prices of agricultural lands in the last few years has made it necessary that farmers should get the largest possible return from their lands, and has created a general interest in whatever will help to that end. One of the aids now being considered is irrigation. In the East it is not, as in the West, absolutely necessary for the raising of any crops, but, like fertilizing or thorough cultivation, is a means of increasing the returns from land. The whole question is whether it will pay. The report of the irrigation investigations of the Department of Agriculture for the year 1901, carried on under the direction of Elwood Mead, gives some valuable data on this question. The report covers experiments in Missouri, Wisconsin, and New Jersey.

A series of experiments extending over several years at the Wisconsin Experiment Station at Madison shows a marked increase in the yields of farm crops. The average increase in the yield of clover hay on irrigated land over that from unirrigated land has been 2.5 tons per acre; the average increase in yield of corn has been 26.95 bushels per acre; and potatoes show a gain of 83.9 bushels per acre. The annual cost of irrigation at Madison has been \$6.68 per acre, not including any interest on the investment, but including all extra labor. At current prices, this leaves a net profit from irrigation of about \$20 per acre on hay, \$11 per acre on corn, and \$73 per acre on potatoes. The conditions of soil and climate at Madison do not differ from those of the Middle West generally, and the results given above show that where water can be obtained without too large an outlay irrigation as a part of intensive farming is very profitable.

Another series of experiments was begun for testing the effect of irrigation and fertilization on sandy soils, such as are common in large sections of Michigan, Wisconsin, and Minnesota. These lands are poor in plant food, and retain so little moisture that all attempts to farm them have failed. The experiments included the supplying of both manure and water. Manure alone was of little use, as there was not water enough to make the plant food available. Water alone produced good results, but the application of both gave the best results. The cost of irrigation was \$6.70 per acre, and the net gain from irrigation was as follows: Potatoes, \$30 per acre; corn, \$1 per acre; watermelons, \$58 per acre; muskmelons, \$45 per acre. From these experiments it seems that with special crops irrigation of the sandy lands is profitable, but the increase in yield of corn is not enough to justify the expense of securing a water supply.

In New Jersey water has been used on small fruits and vegetables, and the added returns due to irrigation vary a great deal with the seasons. Some years no irrigation is

needed, in others all crops need it, but in most years some crops are helped by it. Prof. Voorhees, who has charge of this work, reports that in his opinion, irrigation where tried has paid well. Pumping from streams or wells is the most common way of getting water for fruit and garden irrigation. Small plants furnishing water enough for from five to ten acres, including pump and engine, cost from \$200 to \$500.

Farmers around Butte, Mont., have organized to make a fight against the owners of the ore smelters in that vicinity, which, it is claimed, have ruined the agricultural industry of that section. The statement is made by the farmers that no less than five tons of sulphuric acid and half that amount of arsenic are discharged into the air daily, and that the crops for a great many miles around are affected.