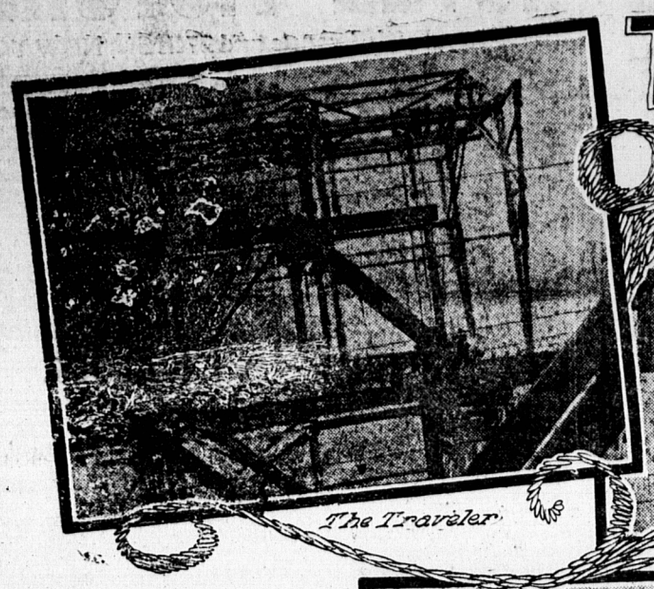
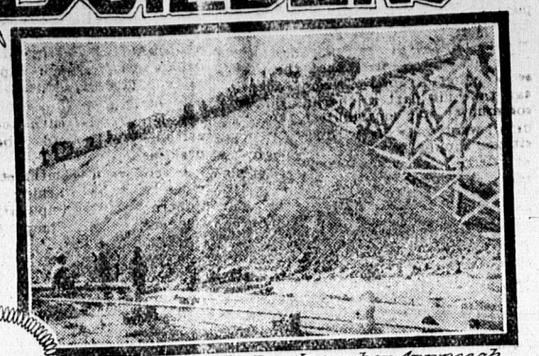
THE BRIDGE BUILDERS

BY THOM... VON

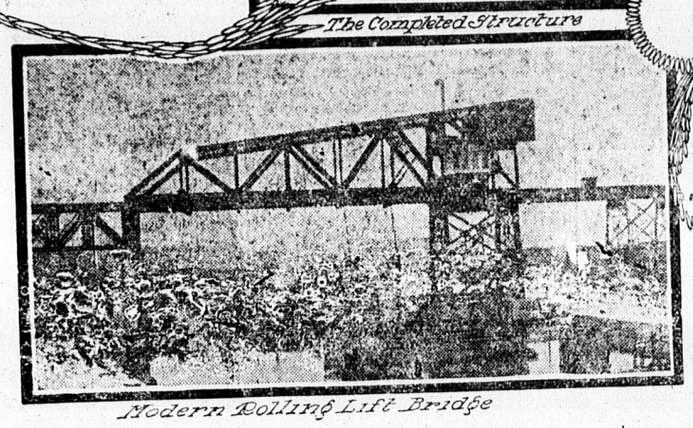


The Traveler

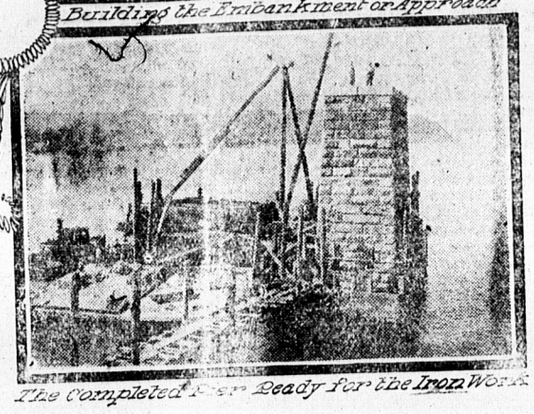
The Completed Structure



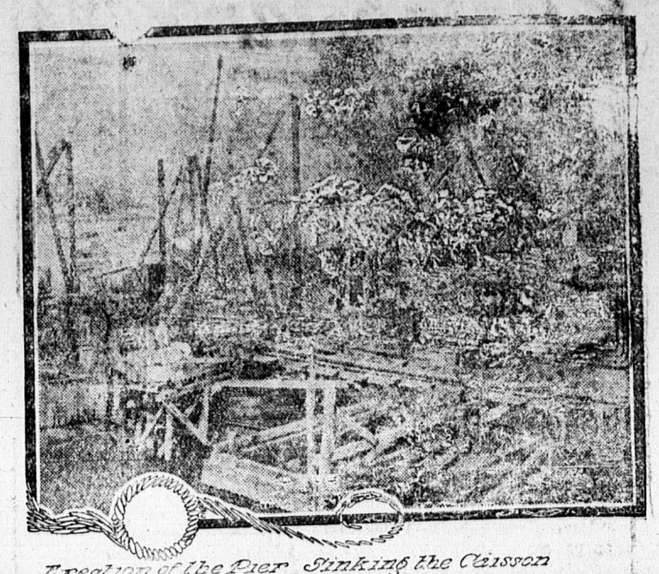
Building the Embankment or Approach



Modern Rolling Lift Bridge



The Completed Pier Ready for the Iron Work



Erection of the Pier Sinking the Caisson

IN the great advance made in mechanical arts and construction there is probably no thing that has reached such high degree of perfection as the bridge. When one speaks of a bridge it does not convey to the mind anything definite, as one knows that a bridge may mean any kind of structure from a pair of logs thrown across a gully to those masterpieces that span great rivers and across which thunder heavy trains.

Bridge building is probably one of the oldest of the arts of man. Even the primitive gentleman who wished to shorten his route either felled a tree or else constructed a crude but effective suspension bridge of wild vine. Perhaps the idea of a suspension bridge was gleaned from watching the monkeys as they held on to each other and swung from tree to tree, thus making the first living bridge which has, in the "human bridge," been adopted into modern melodrama.

To speak of the origin of the bridge is merely to speculate, but it highly probable that the Japanese were the first to apply anything like scientific treatment to the structures by the adoption of the cantilever system, crude, though effective.

For spanning a stream of considerable width they laid two balks of timber, one in each side of the bank, and connected them with a third balk. A structure of this character still stands in Nikko and, though built more than 200 years ago, is in good condition.

ROMAN BRIDGE BUILDERS.

It was the Romans, however, who demonstrated to the world the art of building bridges that would not only answer the needs of the day, but would withstand the wear of centuries. They were the first people to utilize stone, and, with the application of the arch, gave to the world the first instance of a structure of that character about 127 B. C., when the Ponte de Rotto, or Senators' Bridge, was built.

Trajan built the most remarkable bridge of antiquity in the stone structure across the Danube, near Warkel, Hungary, it being 4,500 feet long and 60 feet wide. There were 20 arches having 170-foot spans, and the roadway was 150 feet high. This structure, however, was destroyed by Adrian on the pretext that it would afford a passageway for barbarians from the North.

For several centuries the Roman types of bridges were looked upon as being the only proper kind, hence most thoroughfares in Europe have stone bridges, though brick also plays an important part in construction.

Wrought and cast iron did not make its appearance in bridgework until toward the close of the eighteenth century, but since then there have been great strides in the use of this material, almost to the entire exclusion of stone, owing to the cost of the latter.

Stone, however, in the form of concrete, is once more claiming attention, and for short spans re-enforced concrete will, no doubt, be the material of the future.

Throughout the world the advance agent of the bridge is the railroad, and what improvements have been made in bridgework have been largely made by railroad engineers, and have been paid for by the railroad companies.

In the early days wood was largely used for constructing bridges, but with its increasing cost, its structural weakness and its cost of keeping up, iron and stone became the material. For culverts, stone and concrete are used, but for the great reaches across wide waters and gullies stone foundations are surmounted by steel latticed work.

These structures while light are strong. Kept well painted iron work lasts for years and may be readily replaced without interfering with traffic, the worn parts being replaced with new in a very short time; indeed, these bridges are not infrequently entirely rebuilt from the first to the last bit of iron without making the slightest change in the regular schedule of the road.

INTERESTING CONSTRUCTION.

The building of one of these great highways of the air is most interesting. The approach is the first consideration, and is made to the bank on either side. Sometimes it is necessary to make a deep cut and sometimes a deep fill. In the latter case the earth is brought to the site in small cars and dumped until the embankment is completed.

In the meantime work on the piers between the banks is started, and it is in laying the foundations for these piers that the greatest amount of labor is involved. In the beds of rivers quicksands are often encountered, necessitating the sinking of caissons to great depths. In such cases compressed air is used, and huge steel bottomless boxes are forced down from 50 to 75 feet to solid ground and filled with concrete. On the caisson is placed the layers of stone and thus the shafts arise to the desired level.

Then begins the work of the ironmonders. The iron [illegible] having been carefully set up [illegible] art at the foundry and each [illegible] is shipped to the site. [illegible] the engineers build from each toward the centre, thus effecting a saving of time, but often it is impossible to do this and all has to be done from one end.

Beginning on the very edge of the spot to be bridged there is erected on rails a traveller, a curious framework on which are two or more derricks with long booms. With the derricks the long iron beams are swung into position and held until squads of men can bolt them together. Then follows the [illegible] of rivets with pneumatic [illegible] and presently there is a portion [illegible] solidly put up.

As the bits of iron are put together the traveller moves forward, stopping only when the last rod has been set and its portion of the work completed.

American engineers have erected some of the finest specimens of stone and iron bridges in the world; in fact, so high do our engineers stand in the estimation of foreigners and so rapidly do our mills turn out the necessary iron work that American firms have captured scores of contracts in South America, Africa, Russia, Asia and other countries where new railroads are being built.

Of suspension bridges the most notable examples in the world are to be found in New York across the East River and Hell Gate, but one of the most interesting suspension bridges is in a Colorado canyon. It became necessary to devise some sort of a structure to enable a railroad to skirt the edge of a cliff but above the flood mark of the stream.

After considering the location it was decided that the only kind of a bridge adaptable would be a hanging structure, and thus it was built, tied to the cliff at the platform but hung by rods by the outer edges.

MOVABLE BRIDGES.

Following the bridge as a means of crossing streams came the evolution of bridges into a means of defence for castles and even towns. These bridges were the first of the movable type and were used chiefly as bascules or drawbridges to span the moats surrounding the point of defence. Being of short span but little iron was used in their construction. They revolved or lifted about a single pivot, or [illegible] in a vertical direction, and were sometimes counterbalanced similar to a [illegible] were very effective, but upon the [illegible] gunpowder and [illegible] became obsolete as did the various other forms of defence of the period.

With the advance of civilization and the spanning of wider and deep water courses it became necessary to provide for the interests of shipping which had advanced proportionately. Thus came the introduction of the drawbridge at the channel.

The mediaeval pivot or trunion bridge was early applied to the purpose, but it was not until the nineteenth century that there was much development in the movable bridge, when iron was largely substituted for wood.

For more than half a century the most distinguished engineers of Great Britain wrestled with the problem of erecting a bridge across the Thames River in the vicinity of the Tower of London. Owing to lowness of the banks it was not feasible to build a subway on account of the great grades necessitated nor was it feasible to build a high level bridge for the same reason. The desire to have the channel as wide as possible precluded the use of the swing bridge with its central pier, so there was but one type left—the bascule—and it was adopted.

This structure ranks as the finest of its kind in the world. It required eight years to build and represents an outlay of $4,000,000, of which $500,000 was expended for the artistic embellishment of the towers. In view of the bridge having a span of waterway 200 feet in width it stands for the highest development of that type. At the same time, owing to its slowness of operation and expense of maintenance, it also marks the culmination of the bascule, for since it was completed, in 1894, no large bridge of that character has been built.

In this country, however, the bascule received but little attention, every effort being directed toward the swing, suspension and high level types, and there are many remarkable structures that will stand as monuments to their builders.

In water-front cities where navigable waters thread their way into the very heart of the business district, the problem of bridges is all the greater. The swing bridge is highly objectionable on account of its central pier; indeed, the conditions confronting the engineers were identical with those that perplexed the Britishers.

About 1893 William Scherzer, now deceased, invented a new type of bridge which bears his name, and which is known as a "rolling lift," a modern adaptation of the bascule, with the advantages of cheaper construction and higher efficiency. It is capable of a greater span than a swing bridge and when open it forms a positive barrier on either side.

This bridge has opened a new era in the spanning of narrow waterways and not only is it coming into general use in this country but a structure of the type has been erected across the great Neva River leading to the Winter Palace of the Czar of Russia at St. Petersburg.