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THE BRIDGE BUILDERS

BY THOMAS WILSON



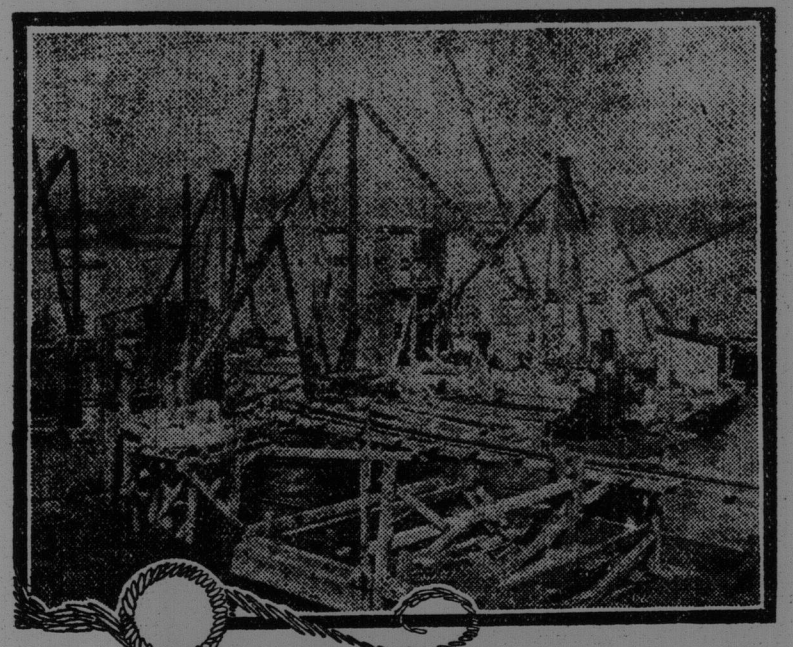
The Traveler



The Completed Structure



Building the Embankment or Approach



Direction 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 is highly probable that the Japanese were the first to apply anything like scientific treatment to the structure by the adoption of the cantilever system, crude, though effective. For spanning a stream of considerable width they laid two piles of timber, one in each side of the bank, and connected them with a third pile. 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 Pont de Rotté, 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 reinforced 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 bridge

work 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 surrounded by steel lattice 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 highway bridges is the most interesting. The approach is the first consideration, and is made to the bank on either side. Some

times 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 iron-molders. The iron work, having been carefully set up and taken apart at the foundry and each part marked, is shipped to the site. Wherever possible, the structures are built from each toward the center, 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 a gang of riveters with portable furnaces and presently there is a portion of the bridge 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 that 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 conversion 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 hinge pivot, or trunion in a vertical direction, and were sometimes counterbalanced similar to a see-saw. They were very effective, but upon the introduction of gunpowder and cannon they became obsolete, as did the most and other forms of defence of the period.

With the advance of civilization and the spanning of wide 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 mediæval 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 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.

WHERE BIRD MEETS MAN UNAFRAID

BY W. A. DU PUY

Bird Life is plentiful on the Reservations of the Bull at Harco

A Sooty Tern New to the World

THE Game Preservation Bureau of the national government has created a common ground where the hunter and the hunted may meet in fellowship with no threat for gore on the part of the one nor fear of death on the part of the other. Moreover, the two are taking advantage of the opportunity offered, and the wild things of the air are seen to partake of the bounty from the hand of man in the open or to brazenly parade their young for his inspection.

BIRDS KNOW SAFE SPOTS. This condition of affairs comes about through the establishment of bird preserves of small areas in various parts of the country, the number of these having now increased to 15, ranging from Florida to Alaska. The word has gone forth in bird-kind of the nature, location and extent of these preserves and naturalists are assigned to the evidence that is given by the birds of their understanding of their rights when within the prescribed limits.

In the District of Columbia, for instance, there is a regulation to the effect that quail may be shot in that section which lies below a given railroad bridge. Hunters complain that no sooner is a gun discharged in the fields outside of the preserve than every bird soars away beyond the bridge and that in the protected section they are as careless of the presence of a man with a gun as of a cow grazing in the meadows.

COVERED WITH BIRDS.

Pelican Island, on the east coast of Florida, is the nesting place of thousands of the birds from which it takes its name, and these are practically the pets of hundreds of tourists that visit this congested bird metropolis every year. The preserve is but a sandbank of four acres, but is the seat of the only colony of pelicans on the east coast of Florida. Before it became a preserve in 1931 there seemed danger of the complete extermination of these birds. Collectors of quail for hat adornment would often visit the island and kill the pelicans by the score. For collectors would hear down upon it and carry away hundreds of specimens in a single day. Finally the state passed a law protecting the non-game birds and, in conjunction with the Audubon Society, the island was given protection. In 1903

the president, by executive order, set aside the island as a bird preserve, and a warden was appointed as a federal officer, as well as a representative of the Audubon Society.

In the past few years the pelicans have increased prodigiously upon the island, its surface is a mass of them and immediately upon the island and immediately assume the air of landed proprietors.

WILD BIRDS EAT OUT OF THE HAND. Dr. A. K. Fisher, of the Game Preservation Bureau, reports that he recently personally witnessed Canadian geese and various specimens of ducks feeding from the hands of the keepers of Golden Gate Park, in San Francisco. These were not birds that were regularly kept in the park, but untamed ones that had stopped for a few days in the course of their migrations.

Similar conditions have been reported from the various preserves, the demonstrations of the development of friendship being the more marked the longer the preserve has been guarded from the sportsman, thereby giving the birds an opportunity to develop confidence in man. The evident tendency is to return to the conditions of Robinson Crusoe's island, where the animals and birds were reputed to be so unacquainted with man that they had not learned to fear him. Such conditions are further reported to the bureau to now exist in the Sandwich Islands by scientists who have visited them in recent years. The peculiar incident cited in this connection is the amusing dancing albatross, which indulges in quadrille-like festivities, embracing much balancing to partners, hewing and swinging on the corner. These birds are not afraid of man, and if when he approaches he bows the bird will respond to his salute in kind.

To the preserves that had been previously established have been added during the past year Tern Island reservation, the home of laughing gulls, at the mouth of the Mississippi; the Shell Key reservation and the East Timbalier Island reservation, the latter formerly a military post, both off the coast of Louisiana, and frequented by pelicans, ducks and man-of-war birds; the recently beautiful Three Arch Rocks reservation, on the Oregon coast, frequented by California murres, the tufted puffin or sea parrot, cormorants, petrels and many other varieties, and finally the three reservations on the coast of Washington, inhabited by various birds and colonies of sealions.

100,000 DUCKS A YEAR.

Breston Island reservation, at the mouth of the Mississippi, when taken in connection with the Audubon reservation, which adjoins it, is the greatest hatchery for ducks in the world. These islands were set aside as a game preserve by the president in October, 1904. The action was taken upon receipt of reliable information showing that there was a definite plan on the part of certain hunters to devastate the island of its game. Plans had been made for the slaughter of 100,000 ducks during the winter that was beginning when the executive order was issued. On these islands it is now estimated that 100,000 terns are bred each year in addition to many other kinds of ducks and other birds. All of these, including swarms of mallard ducks that come down from the north, seem to recognize their safety on the islands and instinctively take refuge there.

DUCKS GETTING WISE.

Another example of the conduct of feathered things upon a preserve where they are safe from hunters was recently observed at one of the tourists' hotels on the Indian River in Florida. For a mile around the hotel the shooting of game is prohibited. The wild ducks coming from the South seem to soon become aware of the fact that while it is the part of wisdom to take flight at the remotest approach of man outside of the protected area, they may swim freely all about the hotel. One enthusiastic hunter even induced a wild canvasback to swim up to the dock and eat bread from his hands.

In Central Park, New York, similar action has been observed on the part of the usually shy duck. A number of these are kept in the lake at the park, being prevented from flying away by having their wings clipped. Flocks that are passing overhead often light in the lake after seeing these decoys. They never stay longer than three or four days, but during that time become remarkably unafraid of man. A flock of them one day lighted on the pavement at the Fifty-ninth street entrance of the park in the midst of hurrying crowds of people and many of these were forced to take care that they did not step upon the ducks. Henry Olby, of the Game Preservation Bureau, who is an eminent bird authority, witnessed this happening. The Stump Lake reservation, in North

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UNKNOWN MARVEL IN DUTCH NEW GUINEA

It was reported years ago that a snow-crowned mountain, more than 20,000 feet high, had been seen in the far interior of New Guinea. As the description of the mountain was vague and corroborated by the report was lacking the story came to be regarded as mythical.

Perhaps, however, it was founded on fact. The fine snow mountain just discovered in the eastern part of Dutch New Guinea may be the summit that was reported, though the peak which H. A. Lorents has seen is not so high by a mile as that was said to be, for its culminating point is only 14,700 feet above sea level. Its estimated elevation, however, is subject to correction because its height was only computed at a long distance. Mr. Lorents has named the mountain Wilhelm Peak in honor of the Queen of the Netherlands.

A picture of it, taken at a distance of 50 miles, shows a grand summit, the upper part of which, or all that could be seen of it above the ridges intervening between the explorer and the mountain, was entirely covered with snow. This is the latest discovery of the Dutch in the vast eastern part of their colony, which, except along the coasts, has until recently been a blank on the maps.

For two years, however, while exploration has been at a standstill in British and German New Guinea, the Dutch have been busily studying the eastern part of their domain. The region is so vast that they have made only a good beginning in the work of revealing it, but they have found the Digul, Noord and other large rivers and have proved that the Charles Louis range of lofty mountains extends far to the east.

Lorents had hardly begun the ascent of the Noord River, when Wilhelm Peak came in view. For weeks the dazzling white picture that seemed to hang in the clouds was always before him. His progress was slow, for new tribes were being discovered and the advance had to be cautiously made. He could buy no supplies from them and they deserted their little villages when his vessel came in sight and shot arrows at his party from the high grass. The Dutch explorers are all instructed not to shed blood if self-defense does not require it. Though Lorents scarcely saw the natives, he found abundant evidence that they had not emerged from the stone

WHERE THE PEACOCK REIGNS

The little native State of Mourhaji, known as the "Peacock Kingdom," is the most northerly of the tributary states of Orissa, and native chronicles relate that the principality was founded more than 2,000 years ago. The chief emblem of signature is a peacock, which is held as sacred, and hence the killing of this heraldic bird is strictly forbidden throughout the state. The state has an area of 4,242 square miles, and the country is varied in soil and scenery. It abounds in rich valleys, but a vast extent is clothed in primeval forest. The Maharajah of Mourhaji is an enlightened prince and administers his state on modern British lines. The government is divided into separate departments, as in British territory, and each department is under an officer, who is responsible for its administration.

Sericulture is being encouraged and mulberry groves have been planted. The culture of Tassar silkworms is an important industry, and visitors to the recent industrial exhibition at Calcutta, India, had a good opportunity of seeing the "Tassar" manufacturers of the state. The country is very rich in minerals and forests, but while the latter are being exploited, the former still awaits the attention of the mining experts.