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specifications and detailed directions of Col. Walter Katte, chief engineer of the North River Construction Company, and E. L. Corthell, chief engineer, and A. Lucius, engineer in charge of bridges of the New York, West Shore, and Buffalo Railway.

The bridge is 29 feet wide from center to center of trusses, the viaduct being the same from center to center of column caps. The first span has a height of 32 feet, and the other two a height of 45 feet. It is a pin connected, wrought iron bridge, the iron having a minimum ultimate tensile strength of 50,000 pounds per square inch of original sectional area before fracture. The end and intermediate posts and top chords, as well as the columns in the piers, are of the pattern known as Phœnix columns. The wooden floor consists of transverse floor timbers, extending the full width of the bridge, supporting rails and guard beams. According to the specifications for bridges of this size, they must carry the dead load consisting of the iron in the structure and a floor weighing 400 pounds per lineal foot of track, consisting of rails, ties, and guard timbers only, and a moving load for each track--supposed ing of two consolidation engines, coupled,

followed by a train weighing 2,240 pounds per running foot. In order to provide for vibrations and wind pressure, the bottom lateral bracing in through bridges is proportioned to resist a lateral strain of 450 pounds for each foot of span.
The viaduct is composed of lattice girders supported upon six iron piers, the distance between facing columns of the piers being 50 feet in all except that next the bridge, which is 60 feet. Much trouble was experienced in obtaining a suitable material upon which to build the piers, and in some instances excavations to the depth of 60 and 80 feet had to be made before finding a good foundation. The bridge piers rest on masonry, built on piles driven to refusal.
The placing in position of a structure of this magnitude at so great a height involves great care and much labor, and its rapid and successful completion makes it a subject well worth studying. No false work was used in erecting the viaduct. The piers consist, practically, of four iron columns resting on beds of masonry, and firmly held in position by struts aud ties. After the foundations had beeu completed the columns were raised in place, when a gin pole (a wooden mast having a pulley at its upper end, through which a hoisting rope passes) is fastened to them by iron bands. A rope passes from a hoisting engine through a block at the base, thence through the pulley in the gin pole. By this means the several parts were raised into position and secured. The work was completed, section by section, to the full height and the track laid. As soon as the first section had been finished a traveler, operating on top, assisted in the work of raising the balance.
Very different and much more difficult was the task of erecting the spans. In this case it was necessary, in order to support the great weight of irou, to build a framework of heavy timber of strength sufficient to bear the load and resist the wind which sometimes sweeps through the gorge with great violence. Our drawings show a side and transverse elevation with details of the top, bottom, and splice. All bolts were three-quarter inch, all diagonal transverse braces were 3 inches by 8 inches, all horizontal transverse braces were 4 by 8 inches, all longitudinal braces 3 by 8 inches, with X bracing between outside and center legs. This framework was supported on piles; the distance from the top of the piles to the caps was 142 feet. Three hundred thousand feet of timber was used and 416 piles. Putting the span together after this had been finished was comparatively easy. About two-thirds of the total cost of erection was for the false work, engines, blocks, tackle, and other appliances. The total cost of erection was about $11 / 2$ cents per pound. The cost was from one-thirl to one-half a cent per pound greater than it would have been in summer, owing to last winter being an unusually inclement one. Much of the time the ropes, stagings, etc., were covered with ice.

## Consideration for Employes.

Referring to an article published in the Scientific AmerCan in its issue of June 2d, on " Consideration for old Em ployes," the proprietors of the Morgan Crucible Company, London, England, send a plan of a scheme for the encouragement and relief of faithful, disabled, and aged employes, which is in practical operation with them with good results. In brief, the plan gives to each employe at weekly wages: to all who have been employed six months, a bonus of six peuce on the pound, or $21 / 2$ per cent; to a one year's worker, $33 / 4$ per cent; to a five years' employe, 5 per cent.
These bonuses must be placed in the Post Office Savings Bank, and every twenty pounds thus deposited will draw yearly $21 / 2$ per cent given by the company. The company give pensions also to incapacitated workmen at a rate of six shillings per week for a workman of ten years' continuous service, eight shillings per week for one of fifteen years' service, ten shillings per week for twenty years, and when a workman has performed twenty years of continuous service and has heen retired, he receives 30 per cent of his salary thereafter.

## Tar and Ammonia from Coke Ovens.

In the course of his inaugural address as President of the Iron and Steel Institute, Mr. B. Samuelson, M.P., F.R.S., said, with reference to the recent improvements in the manufacture of coke, that the yield of this product per ton of coal had been increased from about sixty per cent-the average of the ordinary beehive oven-to seventy-five and seventy-seven per cent. These were the figures realized by certain oblong ovens erected at the president's own collieries in Durham, and by the new ovens on the Corves system erected by Messrs. Pease. Atthe same time that the yield of coke had been increased, the by products were utilized to the extent of seven gallons of tar and thirty gallons of ammoniacal liquor per ton of coal. The value of these byproducts at present is 4 s . 3 d . per ton; but against this must lee set the charge of 1 s . 4 d . per ton for additional labor, and the interest on the capital cost of the plant, which is considerable. Viewed from the standpoint of the iron manu facturer, this advance in the utilization of by-products simply means a reduction in tbe cost of the production of iron. It does not appear, however, that Mr. Samuelson gave any further details of the profit and loss of the process referred to in his own case; and therefore his bearers were left unenlightened as to the extent to which the develonment of the system may be looked for.

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## THE TOTAL SOLAR ECLIPSE OF THE GTH OF MAY

Not a word was heard from the astronomers who traveled and miles to observe the solar eclipse, until the 12 th of June. The glad news then flashed over the wires from San Francisco that the weather on the momentous day was excelient, and that the results attained were a great success. Somewhat fuller accounts of the expedition have since found their way eastward, but the full results of the observations can only be obtained from the official reports of the observers, which will be fortbcoming as speedily as possible.
It will be remembered that the American expedition was sent out by the National Academy of Sciences to observe the total eclipse of the sun on the 6th of May at Caroline Island, in the South Pacific Ocean. It consisted of six members, and was in charge of Professor Holden, of the Washington Observatory, of Madison, Wis. The observers started for their destination on the 1st of March. From Callao, Peru, they were conveyed by the United States steamer Hartford to Caroline Island, which they reached on the 20th of April. Two observers joined them at Callao, sent out by the Royal Astronomical Society of Great Britain, and four officers from the Hartford increased the number of observers to twelve. On the 22d of April, a party of French astronomers arrived in the L'Eclaireur, and took up their quarters on the island. Among the members of the French expedition were several astronomers of world-wide fame, including M. Jannsen, to whom total eclipses and their aweinspiring phenomena are as familiar as the letters of the alphabet to ordinary men; M. Tacchini, of the Roman Observatory, famous for his power of handling the spectroscope; M. Trouvelot, whose wondrous drawings of the sun and the planets gained for him great fame during his residence in Cambridge, Mass.; M. Palisa, distinguished for his skill in picking up asteroids ; and M. Pasteur, of the Meudon Observatory, well known as an accomplished photographer.
Caroline Island was found to consist of a cbain of small coral islands encircling a lagoon. The vegetation is good, and cocoanuts and a small quantity of guano form articles of export for a London firm which has leased the island from the British government. At the time of the astronomical invasion the seven inhabitants consisted of four men, oue of whom was accompanied by a wife and two childreu. Caroline Island was not their permanent abode, but they had been brought from Tahiti to take care of the young cocoauut trees and the property left on the island.
The men of science landed on the coral rocks, not without difficulty, and encountered still greater difficulty in getting their precious instruments on shore. But the unloading was finished at last, ard the Hartford; leaving ten men be liind to give needed assistance, steamed away to Tahiti, to find a barbor where she might safely lie till the eclipse was over.
The intervening time was spent in mounting the instruments and making every possible preparation for the coming of the great event. At length, the day of the eclipse dawned, and American, English, and French astronomers were at their posts, determined to do what men can do to wrest important secrets from the grasp of the sun, while his face was veiled by the dark shadow of the moon. Serious doubts as to the weather disheartened the observers on the morning of the eclipse. But the clouds scattered, and the sky cleared before the grand event, and remained nearly clear till after the eclipse was over. A slight haze and a few passing clouds alone interfered with the perfection of the conditions under which the phenomenon was observed. The period of totality was five minutes and twenty-five seconds, and the practiced observers made the most of the precious minutes as they passed, each observer devoting himself to the part assigned to him.

The most glorious sight ever witnessed by human eyes The most glorious sight ever witnessed by human eyes
was displayed in all its grandeur and sublimity to the band of observers on this lone island of the ocean. The four con6249 tacts were noted, and, as the moon covered the sun's face, the corona beamed brightly forth, with five well defined streamers. The rosy protuberances were, however, very few, and the chromosphere was in a state of unusual qui6.50 escence. Photographs were secured of the corona and its spectrum, and of the sky in the vicinity of the eclipsed sun. Some very interesting spectroscopic observations of the 6253 corona were made, whose result seems to upset prevailing theories; for Professor Hastings, of Baltimore, one of the observers, asserts that the corona is not an appendage of the servers, asserts that the corona is not an appendage of the
sun, but an optical phenomenon. There was a time when this was the general view, but astronomers of late years have not only considered the corona as belonging to the sun, but photograpds of the solar disk have been recently made showing the silvery streamers when there was no eclipse. Professor Hastings will have to support his observations by proofs strong as Holy Writ before his theory will be accepted, now that a different one has been long considered valid by the astronomical mind.
Not a trace of that mythical member of the solar brotherhood, the planet Vulcan. was obtained, though careful search was made. Perhaps there is no such planet, and perbaps he was safely hidden behind the sun's vast mass, and may beam forth at some future total eclipse to prove conclusively that Mercury's unexplained perturbations have a tangible cause. Much more valuable work was done. Trouvelot made a sketch of the corona; Dr. Dixon sketclied its five well defined streamers; Tachini observed a spectrum resembling that of comets in one of the coronal stream ers; Jannsen noted dark liues in the spectrum of the corona.

