the previous operation, and the upper horizontal conveyor carries it to the furnace. In this manner it will be seen that the coal is taken, by an entirely automatic process, from the cars to the retorts, or to the magazine, or from the latter to the retorts.

In order to feed the retorts, a coal reservoir is placed above and back of the furnaces, to which the coal comes from the conveyor. The reservoir feeds a number of carriers which roll upon a suspended track for charging the retorts ; the carriers are filled by a system of traps at the bottom of the main reservoir, operated by levers. The retorts are arranged in three horizontal rows, and there is one carrier to feed each row ; when a carrier has received its contents, it is drawn in front of the retort-mouth and the coal discharged into it by working a hand lever; in this way only one workman is needed to load a battery of forty-five retorts.

Two of the retorts in the model have been made of glass, in order to show the coal in the interior. The retorts are inclined toward the front, the gas being taken from the lower end; the arrangement is known as the Coze system. This inclined arrangement allows the automatic filling and discharging of the retorts to be easily carried out. The arrangement of the furnace is such that the retorts are accessible and may be cleaned without difficulty ; besides, the makers claim a complete utilization of the heat produced in the furnace and a great economy of combustible. A very high temperature is obtained in the interior of the furnace by mixing carbon monoxide with the heated air before it is sent into the furnace.

The transportation of the gas-carbon or coke from the retorts is also well provided for. After opening the upper and lower heads of the retorts, the incandescent coke falls into an automatic extinguisher and transporter called Brouwer's chain, placed in front of the furnace. This arrangement will be observed in the front view. The conveying chain moves along in front in a water-canal, and the coke, automatically extinguished, is carried to a conveyor which passes back to the coke-crusher ; after being broken in the crusher the coke is raised by an elevator to a shaking-sieve, which distributes it in a series of large reservoirs placed above and back of the furnaces ; the reservoirs have a trap below by which the coke is dropped into the cars ; if desired, however, the elevator may take it to a horizontal conveyor which runs back to the coke-bins in the rear, and which have about the same size and arrangement as the coal-bins above mentioned ; like the latter, they have a car running above them on rails, which receives the coke from the conveyor and discharges it into the bins. From these magazines the coke may be again taken to the loading-reservoir by an arrangement below similar to that used for the coal; it is discharged from the funnels into a wagon which takes it to an elevator, and it is thus lifted to the reservoir. It will be seen that the coke may be thus automatically carried from the furnace to the cars or to the magazine, or from the latter to the cars. For the motive power of the plant any of the well-known types of motors may be used ; the model is driven by a small electric motor, and all the conveyors, wagons, etc., are shown in operation.

THE RECONSTRUCTION OF THE KINZUA VIADUCT.

The Kinzua viaduct on the line of the Erie Railroad has long been one of the "show" features of that picturesque route. This bridge serves to carry the railroad across a deep and comparatively narrow valley, which lies high up in the Alleghanies in the State of Pennsylvania, the floor of the bridge being approximately 2,000 feet above the level of the sea. The Kinzua viaduct is claimed to be the fourth highest bridge in the world, the loftiest being the Garabit viaduct over the Truyère, in Southern France, on which the rail level is 401 feet above the river. The new viaduct is 301 feet 6 inches above the normal level of Kinzua Creek, the measurement being taken to the base of the rails. The total length of the viaduct over all is 2,100 feet.

The new structure takes the place of an iron bridge which was erected in 1882 by Clarke, Reeves & Company, now the Phœnix Bridge Company. The old bridge was erected upon skeleton towers, and the superstructure consisted of trusses which were 38 feet 6 inches long over the towers, and 60 feet in length between the towers. The foundations consisted of masonry piers, which in every case were carried down to solid rock foundation. In the old structure were 2,500 tons of iron. Each tower consisted of two bents, the columns of which were given a batter transversely of the bridge of 1 to 6, the columns consisting of sectional, riveted, circular sections, with external longitudinal flanges, a type which has been largely used, particularly in early years, by the Phœnix Bridge Company. The towers were stiffened by means of horizontal, latticed struts, with diagonal tie-rods, and in this respect conformed to the standard practice of that day. The superstructure trusses were riveted, lattice, plate iron structures, built of plates and angle iron.

The reconstruction of the viaduct is due, not to any defects or decay in the old structure, but to the great increase which has taken place of late years in the weight of engines and rolling stock. The greater strength of the new viaduct results from the greater weight of the material used, 3,500 tons as against 2,500, from the improved materials of construction (mild steel taking the place of iron), and from the more scientific distribution of the material. The only portion of the old structure that remains is the foundations, which proved sufficient to carry the greater load imposed by the new bridge.

The principal dimensions of the old and new bridges are practically identical. The viaduct is carried upon twenty towers, each tower consisting of a pair of two-column bents. Each column consists of two built-up channel beams, the webs of which are $\frac{7}{16}$ of an inch thick and 2 feet and $\frac{1}{2}$ inch in width. The channel beams are spaced 3 feet apart, and they are connected by stout latticework of steel plates and angles. Each bent is stiffened laterally by means of deep latticed struts, and the columns are further stiffened at the point of their connection to the struts by means of massive, plate-steel knee-braces, one of which is shown in the accompanying view of one of the footings of the towers. The towers are braced longitudinally by means of latticed struts and ties. All the connections are riveted, an arrangement which, as compared with the pin-and-link connection of the old structure, insures much greater rigidity. The transverse batter of 1 to 6 gives to the towers at the center of the bridge, where it is loftiest, a maximum spread of 102 feet $10\frac{3}{4}$ inches, measured from center to center at the piers. The superstructure consists of two lines of plate-girder spans, which are spaced 9 feet apart between the centers. The bents in the towers are spaced 38 feet 6 inches apart, and the spans between the twenty towers are 60 feet in length. Provision is made for expansion due to changes of temperature by interposing between one column of each bent and the foundations expansion rollers, there being a nest of these rollers, which are 3 inches in diameter and 43 inches long beneath each bent.

From a popular point of view, the most interesting feature in connection with the reconstruction of the bridge is the method adopted in removing the old bridge and building up the new structure in its place. For this purpose two "travelers," each consisting of a complete Howe truss timber bridge, 180 feet in length, were constructed and run out over the old bridge. They were built long enough to reach over three towers, say from tower one to tower three. The method of operating them was as follows : The traveler was run out over the particular tower which was to be removed, and the three spans, that is, those between the three towers and over the tower itself, were removed, and then the material of the tower was cut loose, section by section, drawn up by hoisting cables to the traveler, and run out on to the permanent structure and removed to either shore. After the old tower had been taken away, the material for the new tower was run out over the bridge to the traveler, lowered into place and riveted up. The two travelers worked from opposite ends of the bridge, and finally met in the center, as shown in one of our illustrations. The new bridge has been constructed by the Elmira Bridge Company, from plans made by Chief Engineer Buckholz, of the Erie Railroad Company. Traffic over the bridge was suspended on May 14 last. The work of reconstruction commenced May 20, and this important work has been successfully carried out in the interim by a force of from 140 to 150 men employed by the contractors, Messrs. Grattan & Jennings, of Buffalo.

Compounds of Osmium.

In a communication recently made to the Académie des Sciences, M. L. Wintrebert describes a series of experiments in which he has produced several new compounds of the metal osmium. The metal here plays the part of an acid, in combination with oxalic acid forming a series of salts, which the experimenter calls osmyloxalates ; he has succeeded in producing several of these salts. The first experiment in this direction was made last year by M. Vèzes, who found that by adding an excess of oxalic acid to a potassic solution of peroxide of osmium, OsO_4, fine needle-like crystals were obtained, of a brown color, acting strongly upon polarized light. M. Wintrebert, in taking up the experiment, formed the same salt in a different manner, using the osmiate of potassium, K_2OsO_4, as a starting point. Oxalic acid is added to an alkaline and concentrated solution of the osmiate until an acid reaction is obtained and the liquid is slowly heated ; it passes from a dark red to a light yellow-brown, and after cooling deposits the brown needle-like crystals previously mentioned. The conditions of the experiment indicated that the osmium is at the same degree of oxidation as in the osmiate, which is derived from the trioxide, OsO_3; this was confirmed by direct analysis of the compound, which gave the formula $OsO_2\ (C_2O_4)_2\text{-}K_2,2H_2O$, it being thus an osmyloxalate of potassium hydrate.

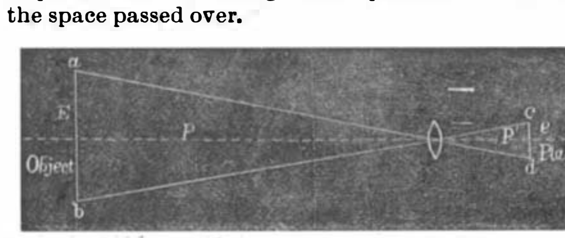
It is evident that the potassium may be replaced by other metals, and a series of salts obtained ; two of these salts have been prepared, those of sodium and of mercury. The osmyloxalate of sodium is prepared by heating to the boiling point a solution of peroxide of osmium in caustic soda and adding an excess of crystallized oxalic acid, so that after this is dissolved the solution is quite acid. The boiling solution changes after a time from a dark red-brown to a light yellow-brown ; it is then concentrated by evaporation. It deposits first the binoxalate of sodium, then the osmyloxalate appears in the form of brown crystals, which are much more soluble cold than those of the potassium salt. These two alkaline salts are but little stable in the presence of water ; their solution soon becomes turbid, and a black precipitate of osmic acid is formed ; this decomposition may be prevented by adding a small quantity of oxalic acid or alkaline oxalate to the solution. To prepare the silver salt, one of these solutions is poured into a solution of nitrate of silver ; the brown liquid changes color, passing to a greenish brown, and deposits small greenish-brown crystals, which appear yellow by transparence, and act upon polarized light. The silver salt is rather unstable ; the liquid in which it is formed often becomes turbid, and deposits osmic acid and oxalate of silver. In the crystalline state the salt undergoes a slow decomposition.

PHOTOGRAPHIC METHOD OF DETERMINING SPEED OF AUTOMOBILES.

Owing to the number of arrests which have been recently made in Paris for the fast driving of automobiles, attention has been called to a method which will determine the speed exactly, and not leave this to the judgment of the police officer. Several photographic methods have been proposed, but the only method which is entirely automatic is that proposed by M. Delamarre. The determination of the speed of a moving object depends upon the measure of the space passed over in one second ; if V is this speed and E the space passed in T seconds,

$$V = \frac{E}{T}$$

Suppose an apparatus provided with a shutter and an arrangement for obtaining upon the same plate two successive images at the interval of one second, the displacement of the image would permit of measuring the space passed over.



The fundamental formula for lenses would then give, according to the diagram,

$$\frac{E}{e} = \frac{P}{p'} = \frac{p-f}{f}$$

where f is the focal length of the lens used ; whence

$$E = e\frac{p-f}{f}$$

If E is known, the value of V will be at once obtained. The problem then consists in measuring E. M. Delamarre has already shown that if in operating from the same position two lenses of different focus are used, f and f_1, giving for the measure of E the values e and e_1, then

$$E = (f - f_1)\frac{e\,e_1}{e_1 f = e f_1}$$

This formula being independent of the distance at which the operation is made. It suffices then to construct a hand apparatus of the detective form with coupled shutters, whose two lenses will have different focal lengths. The operator will then make the exposure, and the plate when developed will be measured and the above formula applied, thus indicating at once the speed of the vehicle in question. An apparatus of this kind would fulfill the conditions required ; it is necessary, however, before reducing the idea to practice, to overcome a number of difficulties, and the originator of the device is at present working in this direction. The difficulties, which are inherent in any apparatus of the kind, are that it is necessary to operate upon a portion of the path of the automobile which is perpendicular to the axis of the lens, and besides a lens with fixed focus must be used. It is, however, quite possible to construct an instrument of this kind of an entirely practical nature.

Sneeze-Wood.

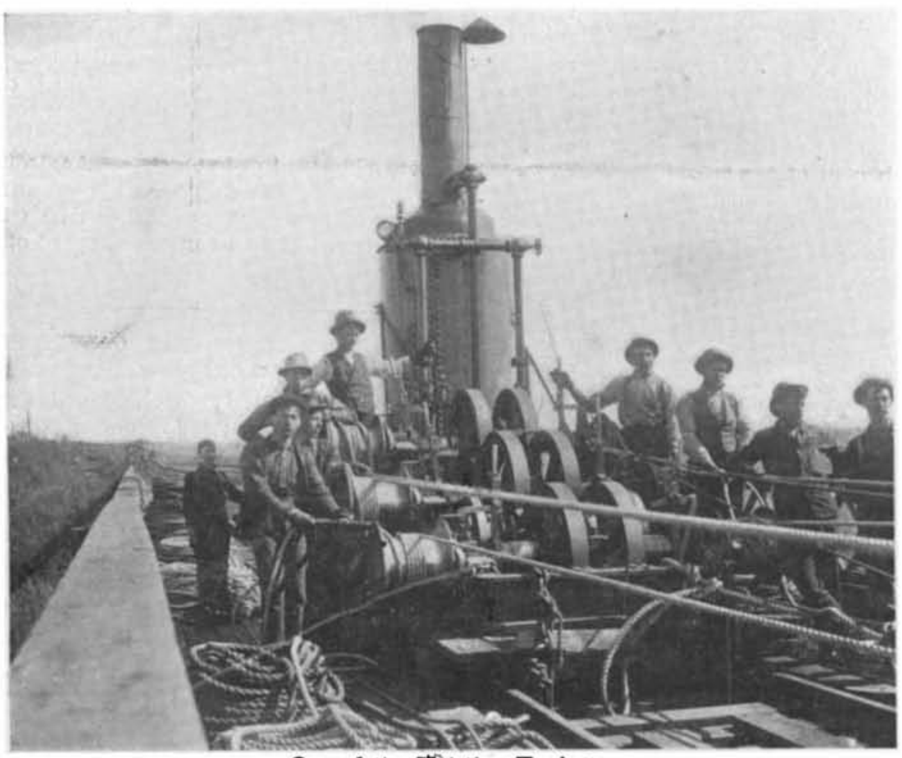
Among its many peculiarities, South Africa includes the "sneeze-wood" tree, which takes its name from the fact that one cannot cut it with a saw without sneezing, as the fine dust has exactly the effect of snuff. Even in planing the wood it will sometimes cause sneezing. No insect, worm, or barnacle will touch it. It is very bitter to the taste, and its specific gravity is heavier than water. The color is light-brown, the grain very close and hard. It is a nice-looking wood, and takes a good polish. For dock work, piers, or jetties it is a useful timber, lasting a long while under water.—The Building News.

SCIENTIFIC AMERICAN

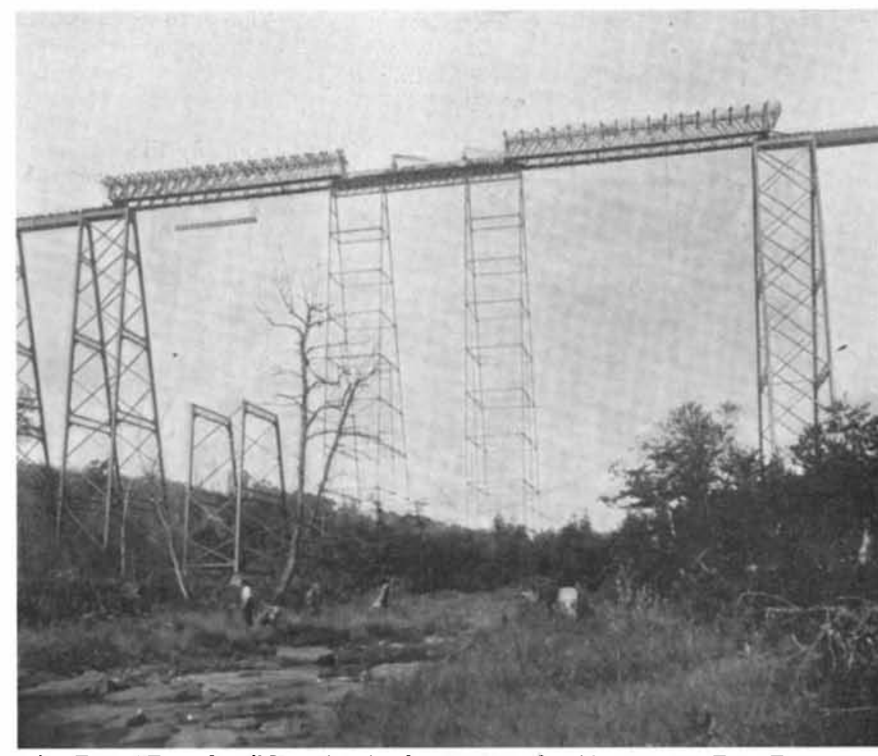
[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1900, by Munn & Co.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXXXIII.—No. 17.] ESTABLISHED 1845. NEW YORK, OCTOBER 27, 1900. [$3.00 A YEAR. 8 CENTS A COPY.



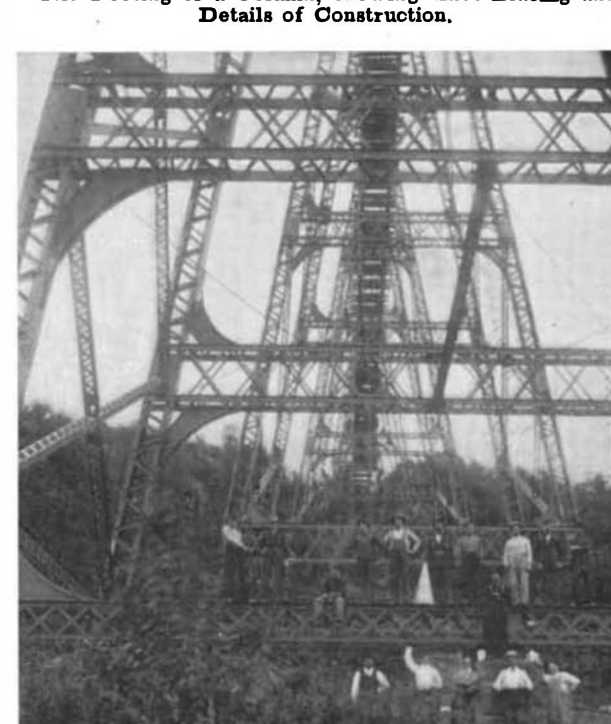
One of the Hoisting Engines.



The Two "Travelers" Meeting in the Center of Bridge. Only Two Towers and Three Spans of the Old Structure Remaining.

Lowering a Column Section into Position.

The Footing of a Column, Showing Knee-Bracing and Details of Construction.



View Looking through the Towers of New Bridge.

THE RECONSTRUCTION OF THE KINZUA VIADUCT.—[See page 262.]