SIMPLE EXPERIMENTS IN PHYSICS.

BY GEO. M. HOPKINS.

The engravings represent a few examples of the projection of simple physical experiments upon the screen. Besides a lantern, a few glass tanks with parallel sides will be required. These are preferably, but not necessarily, made of three pieces of plate glass, one a thick piece, having the shape of the cavity cut out of it, the

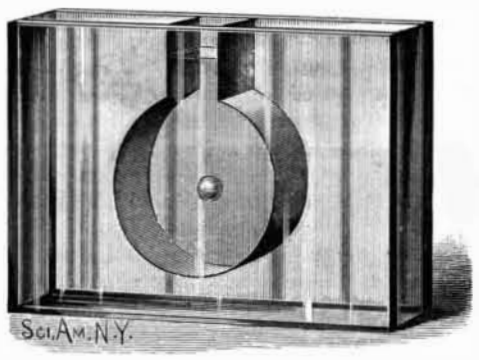


Fig. 1.—COHESION.

others simply flat pieces, attached to opposite sides of the first by means of marine glue or other suitable cement.

A cell made of plates of glass clamped on opposite sides of a bent rubber strip serves a good purpose. It is a great convenience to have several of each kind, so that preparations for projection may be made at leisure.

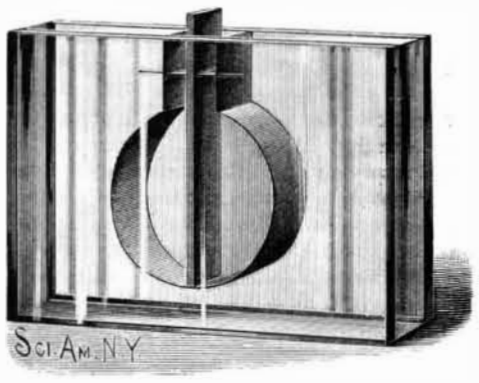


Fig. 2.—REDUCTION OF VOLUME BY MIXTURE.

In Fig. 1 is shown the well known experiment illustrating cohesion. In the tank is placed a mixture of alcohol and water, having the same specific gravity as olive oil. Into the mixture is very carefully introduced a globule of olive oil, which may be colored or not. The oil assumes a perfectly spherical form, and produces a very interesting image on the screen.

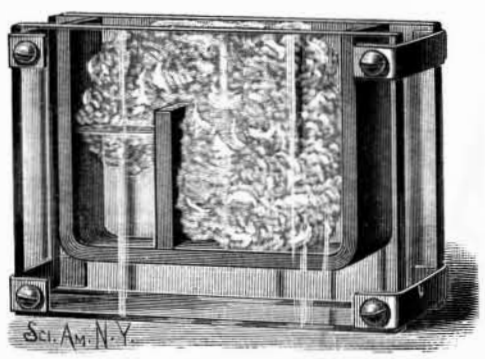


Fig. 3.—COTTON AND ALCOHOL EXPERIMENT.

In Fig. 2 is shown the method of projecting the experiment in which the volume of equal parts of alcohol and water is less when they are combined than it is when they are separate. The tank has a large chamber with a narrow neck. The chamber is divided in the center by a removable partition having soft rubber

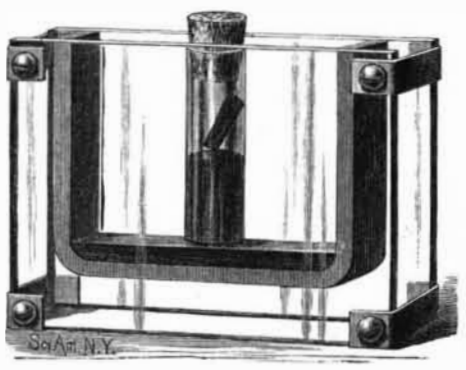


Fig. 4.—ABSORPTION OF GAS BY CHARCOAL.

edges. Water is introduced into one division of the chamber, and slightly colored alcohol is placed in the other division. The water and the alcohol are level with a mark on the glass. On turning the partition, the water and alcohol mix, and the level of the mixture immediately falls some distance below the mark on the glass. After a thorough mixture of the liquids, the partition may be replaced in its first position.

By arranging a tank with a partition near one end, as shown in Fig. 3, the experiment in which a large amount of cotton is introduced into a vessel filled with alcohol, without causing it to overflow, may be repeated so as to show it on the screen. The smaller compartment of the tank is filled with alcohol, and in

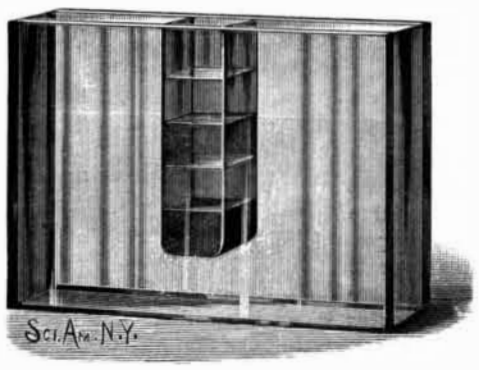


Fig. 5.—EQUILIBRIUM OF LIQUIDS.

the larger compartment is placed a quantity of loose cotton. This is gradually transferred from the larger to the smaller compartment, by means of a pair of fine tweezers, without causing the alcohol to overflow.

The absorption of gases by charcoal is readily shown in the manner illustrated in Fig. 4. A glass tube, open at both ends, is dipped in mercury contained in the bottom of the tank. A cork is fitted to the upper end of the tube. Carbonic acid is poured into the tube, then a piece of freshly heated charcoal is dropped in, and the cork is instantly replaced. The charcoal absorbs the gas rapidly, creating a partial vacuum, which causes the mercury to rise in the tube to a considerable height.

In Fig. 5 is shown a tank containing four liquids of different densities, the densities decreasing from the bottom upward. This is simply the well known experiment of the "vial of four elements." The liquids are mercury, a saturated solution of carbonate of potash in water, colored alcohol, and kerosene oil. This simple experiment is very interesting when performed in the usual way; but when it is projected upon the screen, the struggle of the different liquids to regain equilibrium, after having been thoroughly stirred up, is striking.

A Large Organ.

A correspondent of *La Science en Famille* states that in the Protestant church at Libau (Russia) there is an organ which occupies the whole width of the church, about 60 feet, and which has 131 registers, 8,000 pipes, and 14 bellows of large size. It has 4 harpischords and one pedal. The largest pipe is formed of planks 3 inches thick and 31 feet in length, and has a section of 7 square inches, and weighs 1,540 pounds. Besides the 131 registers, there are 21 accessory stops that permit of combining various parts of the instrument without having direct recourse to the registers. By a special pneumatic combination, the organist can couple the four harpischords and obtain surprising results. For the sake of comparison, the following large instruments of this kind may be cited: Organ of the Cathedral of Riga, 125 registers; Garden City Cathedral 120; St. Albert Hall, London, 100; Cathedral of Ulm 100; St. George's Hall, Liverpool, 100; Notre Dame, Paris, 90; Boston Cathedral 86; Cathedral of Schwerin 85; St. Nicholas Church, Leipzig, 85; Cologne Cathedral 42.

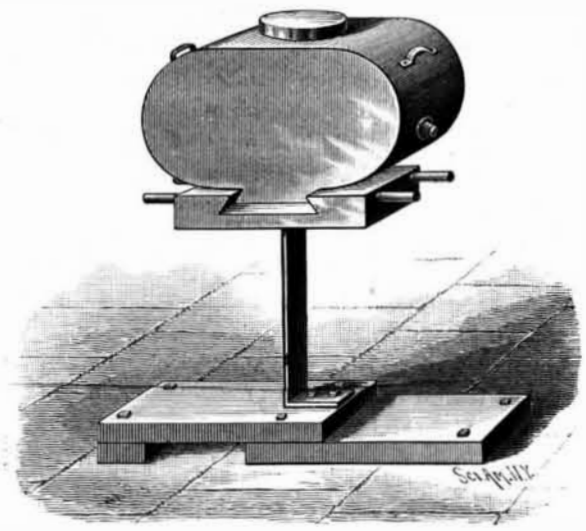
The New St. Clair Tunnel.

The St. Clair tunnel from Port Huron to Sarnia is making fair progress. Instead of driving from intermediate shafts, work has been started at the portals, which are now just being dug out. The total length from portal to portal is about 4,620 feet, of which 2,400 feet is under the river, which is here 42 feet deep. The distance of the roof of the tunnel below the bed of the river averages about 25 feet. The material is blue tenacious clay throughout, plastic and putty-like in consistency. About 150 men are now at work. It does not appear likely that any considerable trouble will arise from water, although there may from gas, which at points is encountered under high pressure, but small volume, so that it soon exhausts itself. The adopted section is a circle of 20 feet 4 inches outside, 19 feet 10 inches inside the clear, the lining being cast iron segments 2 inches thick, 6 inch flanges, 18 inches wide; 14 segments and a key-piece about 10 × 18 inches completing the circle. A cast steel shield, 15 feet × 21 feet 4 inches, is driven in front by a hydraulic pressure of 3,000 tons from twenty-four jacks, 10 in. × 26 in. Two 30 H. P. Roots blowers are to supply air, two 50 H. P. Lidgerwood engines do the hoisting, two 100-light incandescent light plants supply illumination, and the plant generally is on a very liberal and adequate scale.

The grades into and out of the tunnel are 2 per cent for about 3,000 feet at each end. The cost of the tunnel is likely to be high, say $2,250,000, the metal lining being very expensive; 800 tons of bolts alone will be required. The material is so fluid that it is practically impossible to make an open cut even 60 feet deep for the approaches.—*Engineering News.*

AN IMPROVED CHURN.

The accompanying illustration represents a light and simple form of churn, designed to be very effective in operation, for the invention of which a caveat has recently been filed in the Patent Office, by Mr. Robert

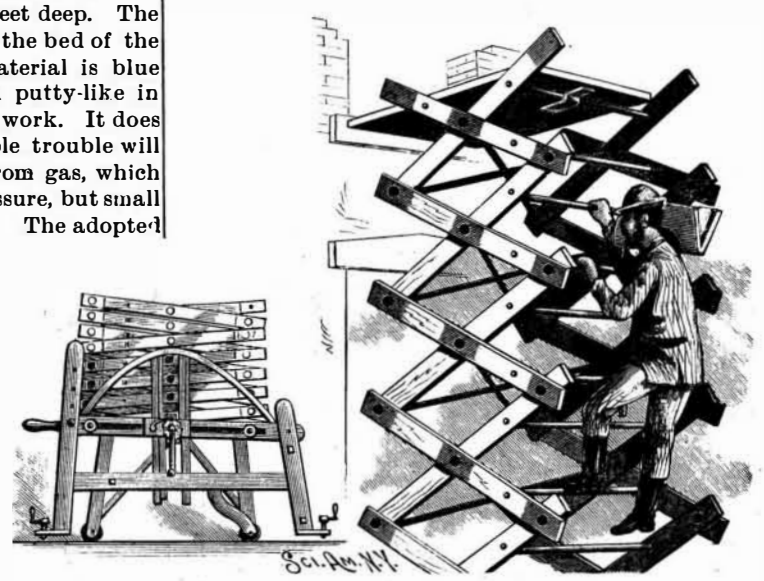


CAMPBELL'S CHURN.

Campbell, of Mancelona, Mich. The base is made in two parts for convenience in shipping, and on the base is secured an arm carrying at right angles a vertical spring plate, to the upper end of which is attached a support for the cream-holding vessel. This support has handles at each end, and has a central dovetailed groove in which fits a dovetail formed on the under side of the cream-holding vessel, the latter being preferably made in the shape of a boiler placed on one side, a cap screwing on the top opening, for filling the vessel and removing the butter, while there is an opening near the bottom for drawing off the buttermilk. The churning is performed by pulling either of the handles in one direction to bend the spring plate, on letting go of which the plate rebounds and the cream in the vessel receives a concussion, this operation being repeated as often as necessary until the butter is made.

AN IMPROVED EXTENSION LADDER.

An extension ladder which may be quickly and conveniently elevated and inclined toward a given object, and which can be readily transported from place to place, has been patented by Mr. Simeon Piche, of 305 West Superior Street, Duluth, Minn., and is illustrated herewith, the small view being a side elevation of the ladder when folded down for transportation. The device has two stationary sides, consisting of inclined uprights united by a crossbar, the longer upright having on its inner face a longitudinal bracket provided with a series of apertures. Near the upper end of the other upright is pivoted a lever arm, the handle end of which rests in the bracket on the longer upright, and is adapted to reciprocate, or to be held at any desired point. Upon the upper edge of each of the lever arms a curved beam is secured, the ends of the beam being attached to the lever arms within the standards, and from these curved beams, at each side of their center, a standard is downwardly projected, plates being secured upon these standards to constitute ways upon which rack-bars are adapted to slide. A transverse shaft through



PICHE'S PORTABLE EXTENSION LADDER.

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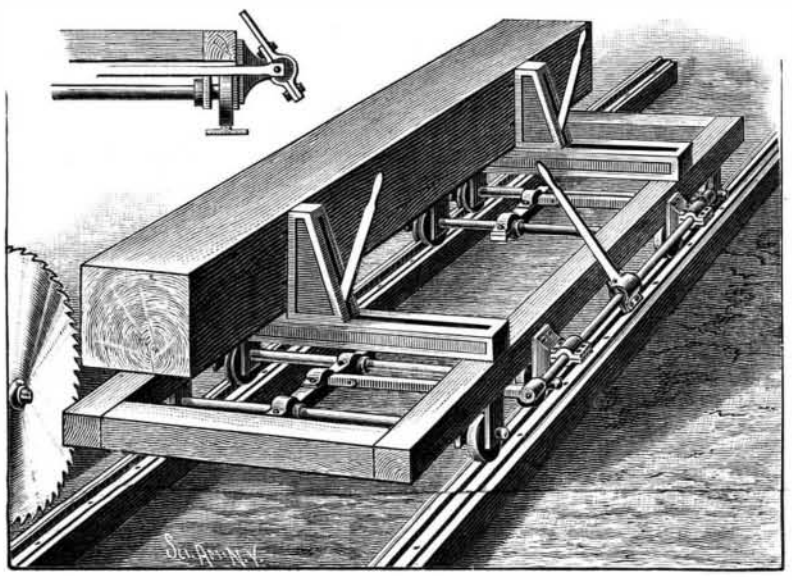
the center of the lever arms has a crank arm at each end for rotating the shaft, upon which are pinions, one pinion adapted to engage and reciprocate the approaching racks on each side of the ladder frame, while upon one extremity of the shaft a ratchet wheel is secured, adapted to be engaged by a pawl pivoted to the outer face of one of the lever arms. The ladder proper is made up of a series of rectangular frames arranged to form lazy-tongs, each frame having near its



ROSENBERG'S OFFSET FOR SAWMILL CARRIAGES.

forward ends a round, the rounds being in vertical alignment when the ladder is extended or elevated. The ladder is elevated by means of the crank handles on the transverse shaft, when the sliding rack operates to extend the several sets of lazy-tongs, the lever arms affording the means of inclining the entire ladder to the rear as far as desired. A platform is usually provided for the top of the ladder, the platform having hooks adapted to encircle one of the upper rounds. From the lower set of lazy-tongs are projected legs, provided with wheels, these legs being drawn from the ground when the ladder is elevated, and the ladder then resting upon its fixed frame, but when the ladder is folded down these legs assume an essentially perpendicular position, and form supports whereby the ladder may be guided on its wheels in any direction.

Eels that Scale Precipices.

One of the most novel sights in the spring of the year, at the rocks of the Willamette Falls, is the swarms of gyrating eels. They are friskiness itself, and show a low order of intelligence. If you put your hand in the water over the eels, or spit on it, instantly they are gone. But poke a stick down among the snaky things, and they do not notice it. The sense of smell seems to be their main guard against danger. Like salmon, they do their level best to dart up the rocks in order to ascend the river, and with good success. Says a fisherman:

"I have seen as many as a hundred bushels of eels hanging on the rocks at one time by the suckers of the mouth. They would wiggle and flutter their tails, and by the momentum thus obtained, letting go with their suckers, jump up about six inches higher. I caught about forty barrels last season that I salted and sold to the Columbia fishermen for bait. I picked them off the rocks with a fish hook tied to a pole. I started at the bottom row of hanging eels, and would silently pick off barrel after barrel. The upper rows hadn't sense enough to perceive the enemy. I have caught eels in the headwaters of the Santiam, in the Cascade Mountains. Suppose they had swum up from the Willamette."—*Oregon City Courier.*

MANY a man has ruined his eyesight by sitting in the bar room looking for work.

OFFSET MECHANISM FOR SAWMILL CARRIAGES.

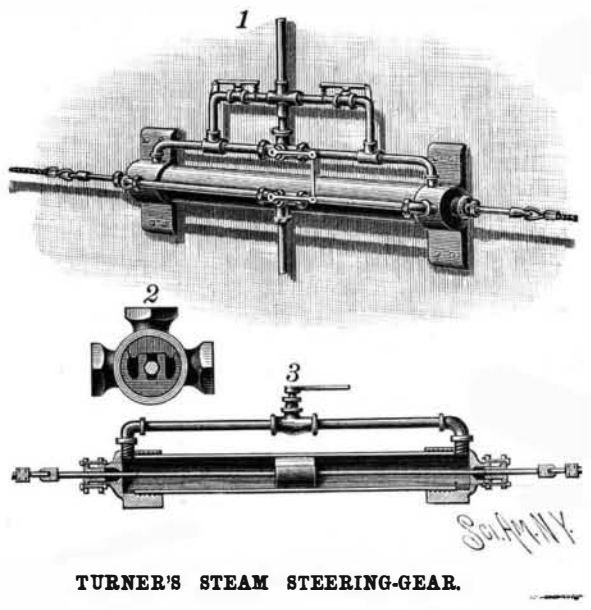
A simple and conveniently manipulated device, whereby the log frame and mechanism carried thereby on sawmill carriages may be shifted bodily in a line at right angles to the line of travel by the carriage, preparatory to "jigging back," is illustrated herewith, and has been patented by Mr. George Rosenberg, of Muskegon, Mich. The carriage is supported upon axles journaled in hangers, and upon the axles are keyed collars, each pair of axles being connected by a cross bar, the ends of the bars encircling the axles between the collars. Upon the side of the longitudinal beam of the carriage farthest from the saw a rock shaft is journaled, an eccentric or short crank being formed on each end of the rock shaft, the eccentric faces being turned down when the carriage is carried back for a cut. The rock shaft is manipulated by a lever secured thereto at or near its center. A short rod is passed centrally through the cross bars, uniting each pair of axles, the rod being provided at each side of the cross bars with a lock nut, and having a slot in the end facing the rock shaft, with which the rod is united by a link pivoted in the slotted end of the rod, the outer end having an integral sleeve in which the eccentric surface of the rock shaft is held to revolve. When the carriage is to be jigged back, the lever manipulating the rock shaft is moved from the saw, causing a tension to be exerted on the cross bar held between the central collars on the axles, so that the frame and its appurtenances are drawn away from the saw, while to throw the log into contact with the saw, the lever on the rock shaft is turned toward the saw, as shown in the illustration. The rock shaft may, if desired, be journaled inside the carriage frame, either above or below the axle.

A Great Steel Plant.

The steel plant of the Phœnix Iron Company, of Philadelphia, which has been in course of erection for the last four months, is now reported as completed. The engines weigh 370,000 pounds, and the roll train weighs 400,000 pounds. This is the largest plant in the country, not excepting that at Pottsville. The engines have a capacity of 2,000 pounds pressure, and the plant is expected to turn out steel suitable for armoring cruisers for the government and for making steel guns of any caliber.

AN IMPROVED STEAM STEERING-GEAR.

The steam steering-gear herewith illustrated, which has been patented by Mr. Frank B. Turner, of Portland, Oregon, consists in a long steam cylinder, with a piston whose rods reach through opposite ends of the cylinder, and are connected with the tiller ropes, Fig. 1 showing a side elevation, Fig. 2 a transverse section of one of the valves, and Fig. 3 a longitudinal section. The pipes entering opposite ends of the cylinder, as shown in Fig. 3, communicate with a central three-way valve, one of whose openings receives the steam

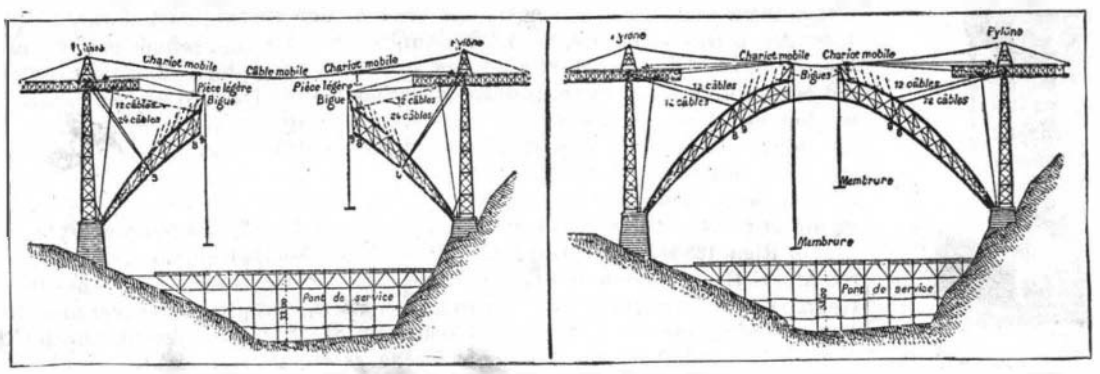


TURNER'S STEAM STEERING-GEAR.

supply-pipe. Similar pipes, also entering opposite ends of the cylinder, are likewise connected with a similar three-way valve, which receives the exhaust pipe, T's in the latter pipes communicating with safety valves arranged to resist the highest pressure the cylinder is obliged to bear in the regular working of the apparatus. The arms of the exhaust and live steam valves are connected by a link, so that the two valves will be moved simultaneously, and when steam is admitted into either end of the cylinder by the live steam valve, it is exhausted from the other end. By admitting steam to both ends of the cylinder at the same time, and closing it in, the piston will be held in any desired position along the length of the cylinder, the exhaust closing before the feed-valve, which may be left open just enough to give the required pressure on both ends.

THE GARABIT VIADUCT.

We have already spoken several times of the Garabit viaduct—that colossal work which does so much honor to French engineers—and we have given the dimensions and principal arrangements of it, and have described the placing of a part of the superstructure. We shall now complete what we have already published by a description of the placing in position of the large central arch and the process employed for mounting this huge mass. We shall give a few details in regard to this point, as well as to the tests that have been made this year, and which are borrowed from the interesting book in which the lamented Beyer has given all the calculations relating to the viaduct.



Figs. 1 and 2.—ANCHORAGE OF THE ARCH AND SUPERSTRUCTURE OF THE GARABIT VIADUCT.

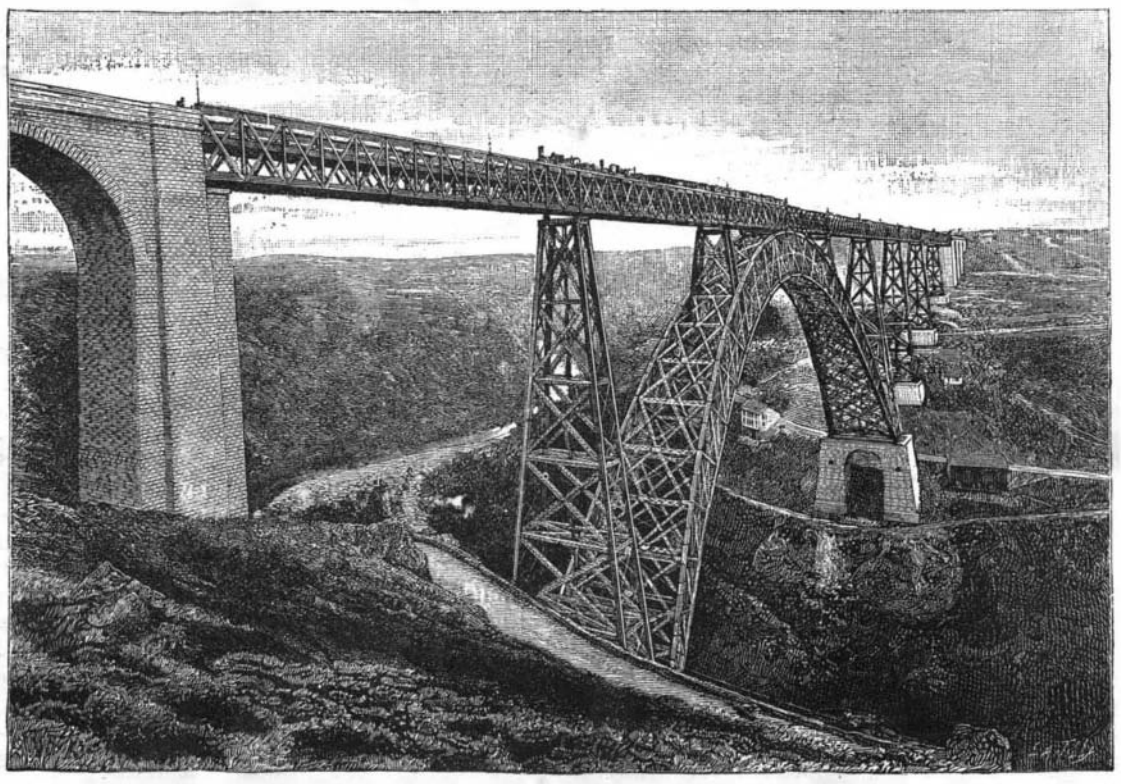


Fig. 3.—TESTING THE VIADUCT UNDER THE WEIGHT OF A 405 TON TRAIN.

The central arch of the viaduct, constructed by Mr. Eiffel, is, as is well known, of 540 feet span and rests upon two large piers, the metallic part of which is 195 feet in height. The total weight of this arch is 2,608,540 pounds.

The piers were first constructed, and then the two lateral parts of the superstructure were set up upon mounds of earth arranged as platforms. Next, these parts were swung into position on the large piers, and were made to project about 70 feet on the side toward the arch. Each, thus placed, was held very firmly by means of 28 steel wire cables fixed to the rear end and anchored to the abutments of the approaches.

This done, two scaffolds were erected in front of the

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