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## THE BRIDGE OVER CATSKILL CREEK.

The accompanying engraving represents one of the most picturesquely located bridges on the New York, West Shore, and Buffalo Railway; it spans Catskill Creek, a small stream flowing from the mountains and emptying into the Hudson River.

The bridge consists of eight double deck spans, six of which measure 167 feet each from center to center of end piers, are 26 feet deep, center to center of chords, 20 feet wide, center to center of trusses, 13 feet, center to center of tracks; the two end panels are 16 feet 10 inches, and the eight intermediate panels are each 16 feet 8 inches. There is one span of 103 feet 6 inches between centers of end piers, and 20 feet 11 inches deep; each of the six panels measures 17 feet 3 inches. The remaining span is 97 feet 6 inches long and 20 feet 11 inches deep; the end panels are 17 feet 3 inches; and the four intermediate ones each 15 feet 9 inches. The actual weight of the six 167-foot spans is 2,340,000 pounds, or 390,000 pounds per span; the next span weighs 180,000 pounds, and the third 173,500 pounds; the total weight of the eight spans being 2,693,500 pounds.

The bridge is proportioned to carry (1) the weight of iron in the structure; (2) a floor weighing 400 pounds per lineal foot of track, consisting of rails, ties, and guards only; and (3) a moving load for each track, consisting of two "consolidation" engines coupled, each weighing 80 tons, followed by a train weighing 2,240 pounds per running foot. The maximum strains due to all positions of this live load, and

of the dead load, are taken to proportion all the parts of the structure.

To provide for wind strains and vibrations the top lateral bracing is proportioned to resist a lateral force of 450 pounds per foot of span; 300 pounds of this being treated as a moving load. The bottom lateral bracing is proportioned to resist a lateral force of 150 pounds per foot. Variations in temperature to the extent of 150 degrees are provided for.

The bridge was built by Clarke, Reeves & Co., Phoenixville (Pa.) Bridge Works.

## Preparation of Collodion Cotton.

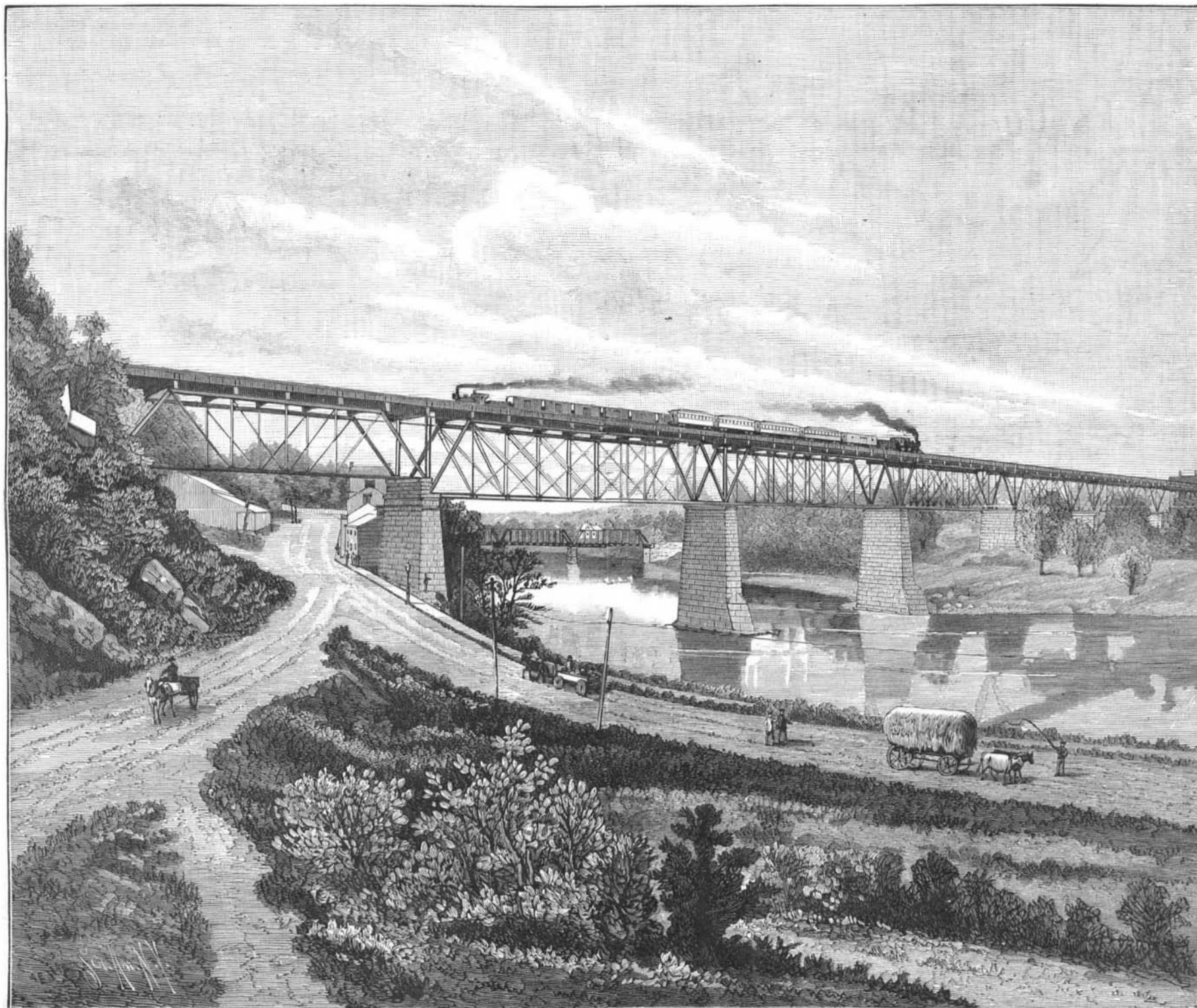
In the preparation of pyroxylené for making collodion, F. A. Katschursky recommends the following process: Three parts of chemically pure sulphuric acid, specific gravity 1.84, are mixed with one part of distilled water and poured (slowly) into three parts of fuming nitric acid, specific gravity 1.48. When the mixture is cold he introduces one part of the purest cotton, from which all traces of grease have been removed. The method of introducing the cotton is peculiar, in that it is twisted loosely around the end of a glass rod, and left in the acids *three days*. The effect of the acid is at first to barden the cotton; when it begins to lose this quality it is taken out of the acid, carefully dried, and washed in water acidified with fuming nitric acid, afterward with distilled water. It is advisable not to put more than 35 grammes (1¼ oz.) of cotton in one vessel, as the heat is so great with larger quantities that it may take fire.

According to *Bundschar*, still better results are obtained by the following: Two parts of purified cotton are wound about a glass rod and dipped into a mixture of twenty-seven parts of sulphuric acid, specific gravity 1.49, with 13 parts of purified nitric acid, specific gravity 1.40. It is left there 1½ hours, then taken out and dried, washed in acidified water, and afterward in distilled water.—*Polytechnisches Notizblatt*.

## Professor Hughes on Magnetism.

In his recent paper to the Royal Society, Professor Hughes dealt with the discovery he has made of the presence, in the interior of a magnet, of waves of opposite magnetic polarity, which balance each other when there is neutrality. In a magnet the polarity at the poles is of one name across the bar, but when the iron is neutral the poles run N S N S . . . across the bar. He also deduces the practical result that very thin magnets have greater residual magnetism than thick ones; thick ones have more magnetic inertia, and take longer to magnetize. Bundles of wires are better than solid cores, because they take a higher degree of magnetization, owing to surface exposure; and this is not proportionately counteracted by their higher residual magnetism.

Professor Hughes is also of opinion that all matter, and even ether, has inherent magnetic polarity and a saturation point. The curve of saturation for the atmosphere is the same in character as that of iron.



VIEW OF CATSKILL CREEK BRIDGE, ON THE N. Y., W. S. & B. R.R., LOOKING TOWARD THE HUDSON.

Scientific American.

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REMOVAL.

The SCIENTIFIC AMERICAN Office is now located at 361 Broadway, cor. Franklin St.

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(Illustrated articles are marked with an asterisk.)

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SEPARATION OF OIL FROM IRON CHIPS.

After good lubricating oil has once been used, coming in contact with the metals and the oxygen of the atmosphere, it has changed its character so much that it is not proper for use as a lubricant, except in the "running through" for lathe and similar work, in cutting screw threads and lubricating for lathe tools. It cannot be returned to the shafts or to the permanent lubricating cups, and do good service. But this once used oil has its second and third use when separated from its surroundings. Oily chips from the lathe, the milling machine, the screw cutting machine, can be cleaned of their load of oil and the oil be returned for use, unchanged except for its semi-oxidation; the contact of iron or of brass will not, of itself, affect the oil. The exposure in dribbles and drops encourages the oxygen of the atmosphere to combine with the carbon of the oil and so change its quality as to prevent its economic use as a lubricant for permanent employment, while it does not impair its value for temporary purposes. For these purposes it does not matter that the oil has partially returned to its base as an acid; its use in running through a screw machine or a lathe is so short that no injury can result. But if once used and exposed oil is fed to shafts and to engine cylinders, the acid from the oxygenized oil will surely make trouble. The proper method of feeding lubricating oil is that of an atmospherically closed reservoir, types of which are largely in use.

But to save oil waste the centrifugal machine is largely in use, and its adaptations are being extended to comprehend the oily debris of many various manufactures. A recent examination of this contrivance, at an establishment that works steel, iron, and brass with oil in streams, shows that the centrifugal machine saves the oil so completely that the resultant turning and drilling chips may be handled without serious soiling of the hands, and the filtered oil appears to be almost as limpid as before using. This appearance is, however, deceptive, for the oil contains chemically, if not suspended mechanically, a large amount of the oxides of iron, steel, brass, and bronze, with which it had been intimately associated, rendering it unfit for purely lubricating purposes. But the method of the centrifugal machine is a reasonable and useful one.

PROGRESS IN IRON FOUNDRYING.

The art of producing iron from its ores, and of remelting the iron to forms, has always been of an experimental character, owing to the lack of certainty as to its component parts and their proportions. Irons themselves differ in composition so greatly that it is one of the most exactive of arts to produce an unvarying grade for certain and demanded purposes; and the ores vary so much in the same mines that those coming under the same generic, and even specific, terms are not always analogous. As an instance, the Black Band ore mined at Mineral Ridge, Trumbull County, Ohio, is of one character when found under the sixth coal level, and of an entirely different character when appearing as an outcrop near the surface, where it is scarcely better than "kidney" ore or the ordinary "shell" ore, both of them too much oxidized to be of much value in the mechanic arts, except as makeweights. In fine castings, especially those of light weight, there is wasted usually about 700 pounds out of a ton of castings in "sprews," "gutes," and "cullings." This "back stock," or scrap, must be carried over from the first to possibly the fourth day, and be worked in only when the nature of the floor or bench permits it. And even under the circumstances most favorable, these leavings accumulate, to the annoyance of the foundryman and the injury of his customers. It is evident that the intelligent selection of irons and fuels, and especially the determination of the character of ores by analysis or experiment, ought to reduce the present uncertainty of product and insure a result in accordance with the foundryman's design.

This has been the endeavor of a competent mechanic, Mr. J. B. Renshaw, of Hartford, Conn., who has made a study of ores, their fluxes, the resultant iron, and the after-castings his business for several years. At length he has succeeded in putting the work of the foundry on a basis that removes it altogether from the line of speculation and experiment, and relegates it to one of the exact arts. His results from his studies are accepted in practice by a large number of manufacturers who make their own castings, and also by the managers of a number of blast furnaces, who reduce iron ores for castings and for the puddling furnace. One of these latter says that he is producing the best iron in the world from formulæ laid down by this investigator, and that he can sell all he makes, at the works, at satisfactory prices far beyond those of ordinary pig. He says his iron is readily taken, delivered in New England, at \$30 per ton, to be used for light castings in combination with cheaper irons, and carrying a large amount of back stock. In this instance, the iron, which is of a very freely flowing nature, and is especially adapted to fine castings, as "bench hardware" and "builders' hardware," is made from 66 2/3 per cent of Black Band ore and 33 1/3 per cent of the Arnold ore from the Adirondacks, on the western shore of Lake Champlain. This mixture makes, also, iron for the puddler equal to the ores that produce the famous Lowmoor.

Further experiments and analyses have proved that the Black Band (two-thirds) and the Lake Superior hematite (one-third) make a superior neutral iron, possessing great strength with remarkable softness and fluidity. A neutral iron thus produced will reproduce in the castings the very

qualities desired. In some respects the Black Band ore is remarkable. It is found in layered masses, as though deposited by water, the layers of iron being sandwiched by alternate layers of coal, so that the ore, when heated, is self-coking. In some instances these alternate layers are so thin that they measure only one-eighth of an inch each in thickness. Where they are thicker, the coal or slaty lignite appears to break into the mass. When melted alone this ore gives a tough result, almost like puddlers' screenings.

These results are only a portion of the outcome of several years of experiments and investigations; the most important parts are those which determine for the practical foundryman the sorts of iron he should use to produce his desired result, and the proportion of the different irons. These data have been determined by trials and experiments in the laboratory, the blast furnace, and the cupola, by chemical analyses, and by microscopic examinations; and that it is possible to determine, before a melting is made, just what iron shall be used, and the quality of the coke for melting, has been rendered certain.

Two other aids complete the means for insuring a certain result that shall be unvarying. One is the use of a centrifugal gate to be used in pouring, by which all the scum and lighter portions of the fluid iron are removed in the act of pouring. The other is the use of test bars—thin castings in the form of the blade of a draughtsman's square—a piece two inches broad, one-eighth of an inch thick, and two feet long, with a hole of from three-quarters of an inch to one inch diameter at one end. Each of these bars is poured from every melting, and it bears on it the date of the pouring. Thus the fluidity of the iron is proved, if it passes from a gate at one end and passes completely around the holes. Bits may be broken off for file tests and other experiments, while the preserved slips are proofs of the quality of the castings for that day, thus being evidence in case of dispute or doubt, and a guiding reference for the future.

What will Burst a Gun?

Perhaps the illustrations given as answers to this question in the SCIENTIFIC AMERICAN of March 22, 1884, are not comprehensive enough. For the safety of amateur sportsmen other instances of gun barrel bursting should be cited.

In bravado a young man placed the muzzle of his fowling piece under the water, and fired the charge. The result was the bursting of the barrel near the breech and the mutilation of his hand. Another placed and held the muzzle of his piece square against a piece of plate window glass, and fired the charge—powder and a bullet. The glass was shattered, so was the gun barrel. Another instance was that of an experimenter who had heard that a candle could be fired from the barrel of a gun through an inch board. He drove a candle into the muzzle of the gun, fired, and the explosion split the barrel almost its entire length, and did not even drive the candle from the muzzle. Still another burst of a gun barrel was caused by the use of wet grass for a wad, well rammed down over a charge of shot. But perhaps one of the most singular exhibitions in this line was a Colt's navy revolver, which some years ago was sent to the factory in Hartford, Conn. This was before the adaptation of these pistols to the metallic cartridges, and it is probable that in loading with open powder and ball only a small amount of powder got into the chamber, and the bullet was not propelled with sufficient force to drive it from the muzzle; at least the bullet did not go out, but lodged. As the shooter did not know whether the bullet escaped or not, he kept on firing until the barrel burst or bulged, and when it was sawed in two longitudinally there were found fourteen bullets wedged one into the other, and so much "upset" by the hammering of the successive explosions of the powder charges that some of them were not less than one inch diameter, being flattened disks instead of conical bullets.

Compressibility of Liquids.

From a paper recently presented to the Academy of Sciences of Berlin, by Mr. Quincke, it appears that the compressibility of liquids, which is generally considered to be practically nil, may be shown under pressures of even less than one additional atmosphere. Mr. Quincke experimented with liquids contained in glass bulbs, with a capillary tube attached to them vertically; the bulbs were placed in the chamber of an air pump, and the decrease of volume resulting from increased pressure was observed, which method promised more exact indications than the opposite one of watching the expansion under diminished pressure. Water carefully freed from air by continuous boiling was compressed by 49 millionths of its original volume under a total pressure of two atmospheres. The following figures express the compressions of some liquids resulting from one millimeter additional pressure, also in millionths of the respective volumes: Glycerine, 0.03; olive oil, 0.07; alcohol, 0.12. The observations, which extended over a large number of liquids, agreed well with one another of former, but not such extensive, researches by M. Grassi. Within the limits of pressure of one additional atmosphere, the compression remains proportional to the pressure. The experiments further confirm the theory that a certain relation exists between compression and the coefficient of refraction, but as yet they are not decisive enough, whether one or the other of the various ratios, which have been based upon theoretical calculations, is correct.