THE ACCIDENT TO THE BROOKLYN BRIDGE.

Excessive loading of the central span of the Brooklyn Bridge, due to a blockade on the roadway, assisted possibly by extreme expansion due to the heat, caused, on the evening of July 29, a buckling of the bottom chords of the four inside stiffening trusses. The accident occurred in the main span in the neighborhood of the point marked B in the accompanying sketch diagram, or about four hundred feet from the Brooklyn tower. A similar buckling is evident at the corresponding point on the New York side.

The main features of the construction of the bridge are as follows: The floor is suspended from four 15-inch wire cables and stiffened against distortion under moving loads by six trusses. Two of these, 12 feet in depth, are placed on the extreme outside of the bridge. Next to them come the road ways, and inside the roadways are two cable roads, each of which runs between a pair of 17-foot stiffening trusses. A footway is carried between the cable roads above the center line of the bridge. These six trusses are not continuous, but are all cut and provided with slip joints at three different points in the bridge. One set of joints occurs in the center of each 900-foot shore span, and there is another set at the center of the main 1,595-foot span. The shore ends of the trusses rest upon the anchorages, and where the trusses pass through the main towers they are securely anchored to the masonry. The movement due to expansion in the trusses thus takes place from the shore anchorages outward and from the main towers toward the center of each span.

In addition to stiffening the floor by these trusses, Mr. Roebling, following a common practice of his day (since discarded), inserted in the bridge a large number of "land stays," *A A*, which are attached to the bottom chord of the trusses and tie them back to the top of the towers, where the upper ends of the stays are rigidly fastened. These were introduced for the purpose of further stiffening the floor and preventing deformation due to unequal loading. That they do prevent deformation is undoubtedly true, and not only so, but it is probable that they carry the greater part, if not all, of any moving load that comes upon that part of the bridge to which they are attached, and this, we think, is evident from the following considerations: The main cable, being capable of deflection under a moving load, and the land stays being tied to the towers, it follows that a moving load at any part of the bridge to which the land stays, *A A*, are attached, say, for instance, at *B*, will exert a pull. not in the vertical suspender that runs up to the cable, but in the diagonal land stay that runs up direct to the top of the tower. For it is a well understood fact among bridge engineers that the stresses due to a given load on a bridge or other framed structure will always find their way to the abutment or pier by the most direct route, especially if the direct course be the most rigid. Even if the effect of the load at *B* were disposed (so to speak) to exert itself by way of the vertical suspender and the main cable, the cable would instantly begin to deflect and would throw the load entirely upon the non-deflecting land stay. What is true of one stay is true of all; and if it were possible to cut all the suspenders and land stays and insert a dynamometer in each one, it would be found, we think, that practically the whole stress of a moving load, whether it was a train or a string of trolley cars, was reaching the piers by way of the diagonal land stays.

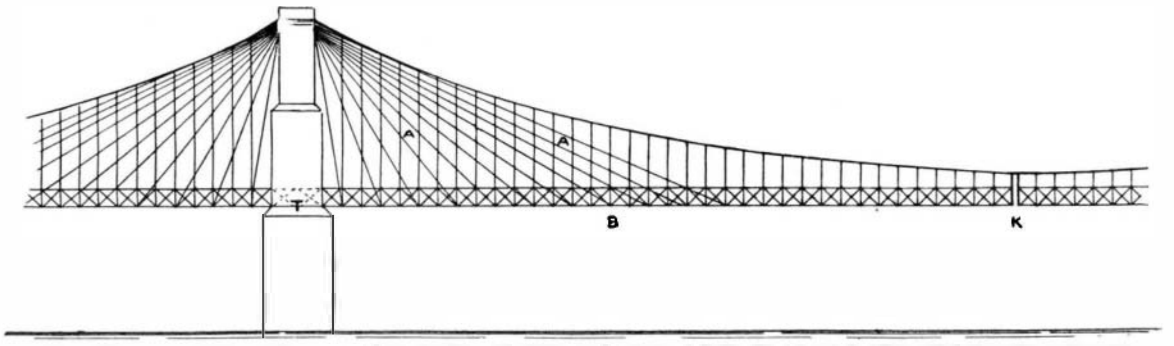

DIAGRAM SHOWING THE ARRANGEMENT OF TRUSSES AND LAND STAYS ON THE BROOKLYN BRIDGE.

Now if the bottom chords of the stiffening trusses, to which, as we have seen, the land stays are attached, were continuous, the effect would be to produce a tension in them, the land stays and chords forming a kind of secondary suspension system between the towers. But as the trusses are cut at the center and fixed at the towers, it follows that the pull of the stays compresses that portion of the chords which lies between the stays and the towers. This compression increases toward the towers, where the combined compression due to the pull of all the land stays over a distance of 500 feet has to be resisted.

It is highly improbable that provision was made for taking the compression due to the whole live load on 500 feet of the span; it is more likely that the land stays, like the stiffening trusses, were treated as subordinate features in the bridge, intended to produce a more even distribution of the load upon the main cables. That this is the case is evident from the very light sections of the bottom chords of the trusses, which, although they have been strengthened toward the towers, have not been reinforced in anything like the degree that the compressive strains due to the pull of the land stays would call for.

There is no question that the Brooklyn Bridge is carrying considerably more load than it was originally designed to do. Since it was first opened there have been added two extra tracks for the cable cars, two lines of feeder rail for the electrical equipment of the cable road, two extra cables, two tracks of 90-pound rail for the trolley cars, two lines of brackets of unusually heavy design for carrying the overhead trolley wires, a line of heavy, 8-inch, cast iron pipe for the pneumatic postal delivery, and, most serious addition of all, a line of trolley cars, many of them modern two-truck cars of extra length and weight. All thisconstitutes a large though not a dangerous increment in the dead and live loads over that for which the bridge wasdesigned. While the increased loading does not materially encroach on the "factor of safety" (to use a good old term, which bridge engineers are inclined to discard), it was certain that, if there was a weak point in the construction, the additional weight would find it out.

The board of experts who investigated the question of permitting trolley cars to run on the bridge stated that it would be safe for them to do so provided that a clear space of 102 feet was maintained between cars and the speed did not exceed 7 miles an hour. These two limitations have been steadily ignored. The speed is frequently nearer 12 than 7 miles, and we have often seen the cars strung out across the bridge or bunched in sections of it with less than a car's length intervening between them. This crowding invariably occurs when there is a congestion at either end of the bridge or when any breakdown or hindrance occurs on the bridge itself.

On the occasion of the Friday evening accident, a fallen horse on the roadway occasioned a blockade in which the cars became closely bunched. It happened to be an exceptionally hot day, and there is evidence that the ends of the trusses at the crown of the bridge may have been in contact. If this did occur, the trusses being fixed at the towers formed a very flat arch, and an additional compression would thereby be set up in the chords.

The buckling is not an indication of weakness in the bridge proper, the trusses merely serving to preserve the true curve of the roadway by distributing a rolling load over a considerable length of the main cables. The occurrence is of great interest however as showing the action of the diagonal land stays under a live load. In the new East River Bridge, now under construction, these stays are omitted, and the desired end is secured by making the stiffening trusses of great depth and strength.

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Shiploads of Brimstone.

Alfred S. Malcomson has published an interesting statistical table in which the world's consumption of brimstone is shown for seven years, says The New York Tribune. This commercial commodity is of great importance in many branches of manufacture, but the fact is not generally known in business circles that 118,137 tons came to the United States from Sicily in 1897, and that the year before the importation was even larger.

This commodity comes exclusively from Sicily, and to a great extent from the port of Palermo. It is shipped in bulk like coal, and looks, in its raw condition, like pieces of broken stone about the size of those which are used on macadam roads. It is a dull gray, and from that to a bright yellow, according to its quality; the higher the grade, the yellower the stone. It is handled by the large importers in its crude form only, and these dispose of it to the manufacturers, by whom it is subjected to processes which eliminate the dross and bring to the surface its valuable properties. It is used by the manufacturers of fertilizer materials and sulphuric acid, and large quantities are consumed by the manufacturers of wood pulp and paper.

The brimstone goes in great quantities also to the sulphur refiners, and after it becomes sulphur it plays an important part in the manufacture of vulcanized rubber. The addition of sulphur to plastic rubber, vulcanizing the mass between two tin sheets as an experiment, gave to the world the valuable commodity known as hard rubber; and no substitute has yet been found for the yellow dust in the process.

The brimstone statistics show that the United States receives more of the material than any other country. For the same time that 118,137 tons reached the ports of New York, Baltimore, Philadelphia, Charleston, Boston, Wilmington, and Norfolk, the following exports were made from Sicily to other parts of the world:

	Tons.
France	84,895
Italy	73,052
United Kingdom	24,520
Russia	17,532
Portugal	7,054
Germany	19,721
Austria	15,993
Greece-Turkey	13,866
Belgium	9,253
Sweden, Norway, and Denmark	11,226
Spain	4,039
Holland	3,599

The wine growing districts of Europe use large quantities of the material to destroy the insects which attack the vines, and, although many substitutes are employed, the most careful growers never abandon brimstone for that purpose.

The supply in Sicily ready for transportation is larger now than it has ever been before, there being no less than 240,367 tons in storage.

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Experiments Regarding the "Setting" of Plaster of Paris.

J. A. Belcher reports (Treatment) the results of experiments undertaken to determine the effect of various agents on the "setting" of plaster of Paris: "Two drachms of plaster, mixed with one drachm of a five per cent solution of sodium chloride, hardened in two minutes. Mixed with one drachm of a five per cent solution of sugar, it hardened in three minutes and a half. Mixed with one drachm of a one per cent sodium chloride solution, it hardened in five minutes. Mixed with one drachm of an 0·5 per cent sodium chloride solution, it hardened in five minutes. Mixed with one drachm of a five per cent calcium chloride solution, it hardened in six minutes and a half. Mixed with one drachm of tap water, it hardened in nine minutes. Mixed with one drachm of distilled water, it hardened in nine minutes. Mixed with one drachm of saturated solution of sodium chloride, it hardened in eighteen minutes. Mixed with one drachm of a five per cent solution of glycerin in distilled water, it hardened in nineteen minutes. Mixed with one drachm of a five per cent solution of white of egg in distilled water, it hardened in twenty minutes. Mixed with one drachm of a ten per cent solution of white of egg in distilled water, it hardened in twenty-five minutes. Mixed with one drachm of a ten per cent solution of glycerin in distilled water, it hardened in thirty-five minutes. Mixed with one drachm of a twenty-five per cent solution of glycerin in distilled water, it hardened in sixty minutes.

These figures tell, says Mr. Belcher, their own tale, and show that where it is of importance to make plaster of Paris set rapidly it should be mixed with a five per cent solution of common salt, and this may be made roughly by adding a tablespoonful of salt to a pintof water.

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An Ancient Hospital.

At Baden, near Zürich, Switzerland, in connection with recent excavations at Windisch, the Roman Vindonissa, an ancient military hospital has been discovered. It has fourteen rooms, which appear to have been well supplied with medical, surgical, and pharmaceutical apparatus, including probes, tubes, forceps, cauterizing implements, and even safety pins; medicine spoons of bone, silver measuring vessels, jars and pots for ointments, etc. Some coins were also found, those of silver being of the reign of Vespasian and Hadrian, those of copper bearing the effigy of Claudius, Nero, Domitian.

At Vindonissa, two great Roman military roads meet—one leading from the great St. Bernard along Lake Leman and then by Aventicum and Vindonissa to the Roman stations on the Rhine; the other from Italy to Lake Constance by the Rhætian Alps, the present canton of Winterthur, Baden, and Windisch. This last point was the station of the seventh and eighth legions.

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Artificial Albumen.

A cable dispatch to The New York Sun says that Dr. Leo Lillienfeld, of Vienna, has demonstrated to the Chemical Congress in session in that city the discovery of the method of producing artificial albumen which is absolutely identical to natural albumen, which hitherto has been believed could be produced only by chemical means. Dr. Lillienfeld calls the product "pepton." At present no further details are obtainable, so it is impossible to say whether or not the process is a practical one from a commercial point of view.