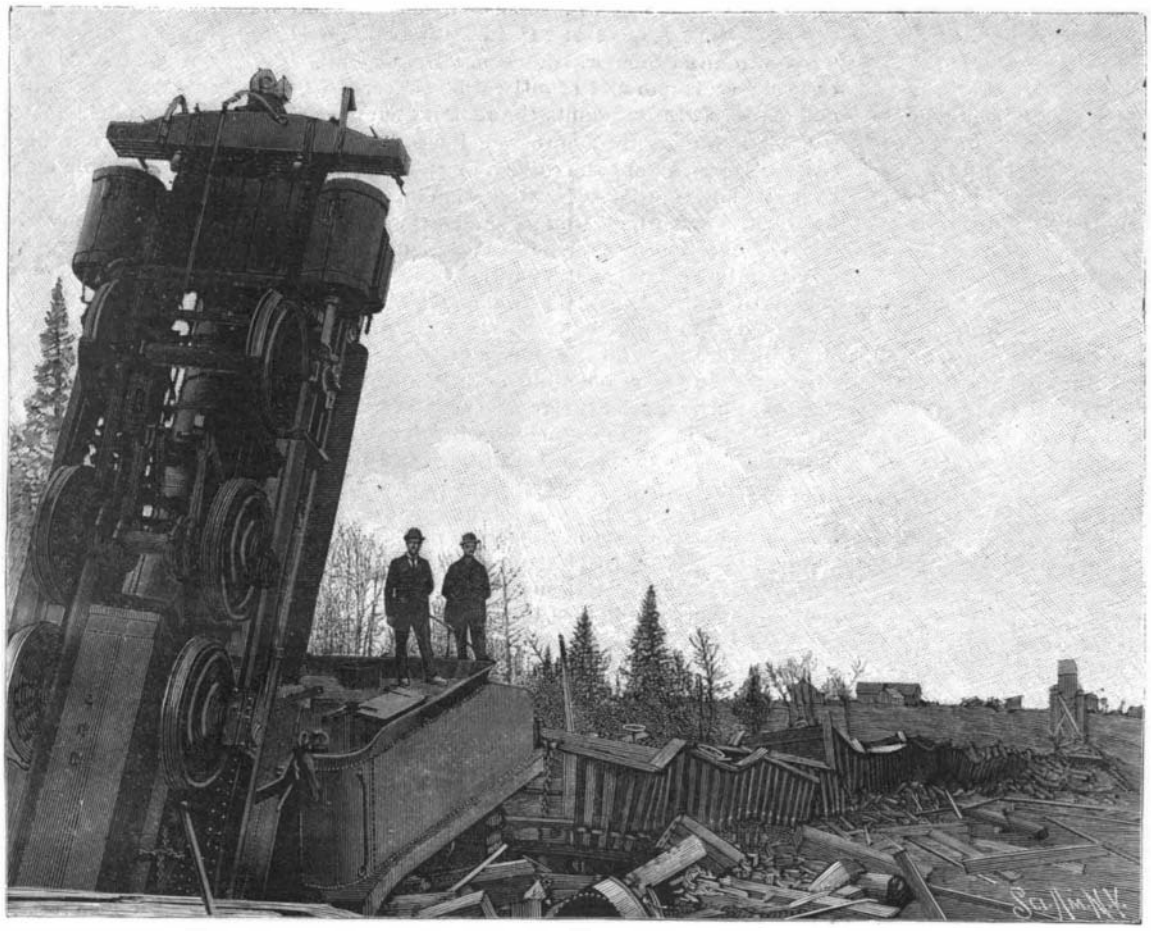
A REMARKABLE BRIDGE DISASTER.

We present two illustrations of a bridge disaster which recently occurred on the Belt Line branch of the Great Northern Railroad, where it crosses the Nemadji River, near Superior, Wisconsin. The Nemadji at this point flows through a shallow valley over which the railroad is carried at an elevation of about from 50 to 60 feet above the river. The crossing itself consists of a single track deck span of the combination type, with timber posts and top chord and steel bottom chord and diagonals. The approach at either end consists of trestle-work of the standard type, with pile foundations, and its whole length from bank to bank is about 1,200 feet, consisting first of 200 feet of trestle, then a combination truss of about 110 feet span followed by about 900 feet of trestle work across the bottom land.



NEMADJI RIVER TRAIN WRECK—SHOWING FALLEN ENGINE AND TRAIN.

At the time of the accident a heavy ore train, consisting of several fully loaded ore cars, some box cars, a flat car, and a caboose, and drawn by one of the powerful freight engines of the company, was crossing the structure. The whole train with the exception of two box cars, the flat car, and caboose had passed over the river crossing, when the trestle collapsed at a point somewhat to the rear of the engine, and the whole train with the length of supporting trestle beneath it fell over in the direction of the center line of the structure and assumed the remarkable position shown in the two accompanying illustrations. It would appear that the locomotive was well clear of the dangerous point in the structure at the time it gave away, but that it was drawn backward by the weight of the falling train behind it. The tender assumed a fairly upright position, but the locomotive fell cab downward and was left standing on end as shown. The remarkable feature of the accident is that none of the cars and no part of the bridge fell either to the right or left, the whole structure pivoting forward and downward upon its foundation, the cars in many cases remaining upon the rails. The last two box cars, the flat car, and the caboose, remained on the truss above the river, the couplings fortunately breaking and preventing the end of the train from being drawn down into the general wreck.

While at first sight it would seem astonishing that the whole train with its supporting trestle should fall symmetrically forward and not as one might expect to either side, a brief study of the wreck as shown in the upper engraving will explain this phenomenon. It will be noticed that the superstructure, that is to say, the longitudinal stringers, cross-ties, and the track, is carried upon vertical "bents," which consist usually of heavy timbers twelve inches square, although in this case they are built up of 6 × 12 inch timbers spliced together. As a rule there are four timbers to each "bent," the two on the inside being generally vertical and those on the outside having a considerable amount of batter or inward inclination from the ground to the top cap, or transverse carrying piece. The supporting timbers are braced at intervals of about 16 feet of their height by horizontal timbers, and they are further "sway-braced" by diagonal 4 × 12 inch timbers, all the sticks at every point of intersection being firmly bolted together.

NEMADJI RIVER TRAIN WRECK—LOOKING FORWARD FROM REAR OF TRAIN.

Upon the ground each bent is carried upon a transverse 12 × 12 inch timber which either rests upon short pieces 6 × 12 inches by 3 feet in length, or is carried upon piles which are driven to a firm bearing in the ground.

It will be noticed that this construction, while it provides ample strength for carrying a vertical load and remarkable lateral rigidity insuring safety against overturning, depends for longitudinal stability mainly upon the superstructure, that is, the stringers, ties, and track; so that should the superstructure be broken through at any point, there is nothing to prevent the whole system of vertical bents from pivoting forward like a line of child's building blocks, and falling upon one another. As long as the superstructure remains intact, the longitudinal forces acting upon the bridge, such, for instance, as the forward thrust resulting from a sudden application of the brakes of a train, are transmitted through the floor system to the opposite abutment; but it is evident that a break at any point in the continuity of the floor imperils the stability in a longitudinal direction of the whole trestle, even if it should happen to be some thousands of feet in length.

The proper safeguard against an accident of this kind is to introduce longitudinal diagonal bracing, extending from the caps of the bents immediately below the floor system, down to the foundations. It is not necessary to insert these braces at every bent, for if they were introduced, say, at every fourth or sixth bent, the collapse of a portion of the bridge would be limited in its destructive effect to a certain stated length of the trestle, instead of, as now, involving the collapse of the whole structure. It will be noticed that in the case of the Nemadji bridge the wreck of the trestle to the rear of the train was prevented by the existence of the truss bridge across the river, whose piers, coupled with the inertia of the truss itself, offered sufficient resistance to longitudinal overturning.

The Fall of Meteorites in British Central Africa.

A fine collection of meteorites has just been added to the Department of Minerals in the British Museum. It consists of four stones which were seen to fall on January 25 in the native villages on the eastern slopes of Mount Zombo, British Central Africa. Two of them weighed 14 and 17 ounces respectively and the other two 29 and 19 ounces. At Zomba a crash like thunder was heard and the reverberations lasted for a few minutes afterward and the detonation was heard at a place 90 miles distant. At one of the new villages the people were found squatting around the stone in a circle discussing the "miracle" as they termed it. None would approach the stone and it was still lying where it fell when the officials arrived. As far as it is at present known, the area over which the Zomba stones fell represented 9 miles long and about 3 miles wide. It is probable the larger number of stones may have reached the earth.

To Move Buildings in Budapest.

A Chicago company is to undertake modern building moving methods in Europe. This company has closed contracts for changing the location of nine structures in the city of Budapest, Hungary, where grading and reconstruction of the street system have been found necessary. The American system of building removal was unknown, but the government engineers began investigations which ended in American engineers being asked to bid on the moving of public and other structures.

The Proper Reading Distance.

At a distance of several meters or yards, says Dr. Norburne B. Jenkins in The Medical Record, little or no muscular effort is required for the normal eye to see objects distinctly; but an extreme exertion of the ciliary muscle, which controls the crystalline lens, is necessary if the vision be directed to an object a few centimeters or half-inches distant from the eye. The following may illustrate the work of the muscles of the eye in reading at several distances: A sheet of paper about twenty centimeters (eight inches) square, printed with type sufficiently large to be easily read at five or six meters or yards, is placed at this distance from a person with normal or emmetropic eyes. Practically no contraction of the muscles of convergence or of the ciliary muscles is necessary in order to read the type. Should the paper be placed a meter or yard from the eyes, the ciliary muscles and the muscles controlling the motions of the eyeballs are called upon for additional work, but no inconvenience is occasioned to emmetropic eyes by prolonged vision at this distance. If the paper now be placed within a few centimeters or half-inches of the eyes, the ciliary muscles contract to their utmost. The internal recti likewise are in a state of extreme exertion in accomplishing the convergence necessary in order that both eyes may see the same type at the same instant. The muscles are no longer adequate to the increased tension. They become exhausted and vision is embarrassed. The type is alternately blurred and distinct, in consequence of the alternate failure and recovery of the muscles. Should this process continue for many minutes, pain and vertigo come on, and the sufferer is forced to direct his vision from the paper. The nearer objects approach the eyes, the greater will be the necessary muscular effort and the sooner will the muscles refuse to perform their functions; the farther the type is held from the eyes, the less is the requisite muscular effort; hence it is probable that the farthest point at which distinct reading-vision is possible is the proper distance for continuous reading. Probably this point is more than thirty-five centimeters (fourteen inches) distant from the eyes, and is dependent upon the strength of the muscles, habit, and the visual acuity.

The Development of Submarine Telegraphs.

The development of the submarine telegraph from a mere gutta percha coated wire laid in New York Harbor by Prof. Morse in 1842 to the great cables which now engirdle the entire earth except the bed of the Pacific is described in a statement just issued by the Treasury Bureau of Statistics, entitled "Chronology of Submarine Telegraph Construction throughout the World, and the Development of Submarine Telegraphy." This publication, which has been prepared by the Bureau of Statistics in view of the special interest just now developed in a submarine telegraph line to connect the United States with Hawaii, Guam, the Philippines, and the Asiatic coast, shows not only the location, number, and length of the submarine telegraphs of the world, but also the history of this great system and the part which American genius and enterprise have had in its development.

The statement credits Salva, a Spaniard, with the first recorded suggestion of submarine telegraphy, made before the Barcelona Academy of Sciences in 1795. Aldini, a nephew of Galvani, performed experiments in the transmission of electric signals under the sea near Calais, France, in 1803; Schilling ignited gunpowder by electricity transmitted through a subaqueous conducting wire under the Neva River near St. Petersburg in 1812; telegraph signals were transmitted through insulated wires under the River Hugli, in India, by the director of the East India Company's telegraph system in 1839; and in 1842 Prof. Morse transmitted electric currents and signals through an insulated copper wire laid for that purpose between Castle Garden and Governor's Island in New York Harbor, and in the following year suggested submarine electric communication between the United States and Europe. In 1845 Ezra Cornell, in conjunction with Prof. Morse, laid and successfully operated submarine copper wires in the Hudson River between New York and Fort Lee, and in 1847 a section of the telegraph line connecting New York and Washington was laid through the waters of a narrow creek by J. J. Craven, of New Jersey, thus demonstrating the practicability of actual submarine telegraphic service. In 1850 a submarine telegraph line was laid across the English Channel and signals exchanged, but without further success, though in the following year a cable containing four copper wires insulated with gutta percha and protected by galvanized iron wires wound spirally about it was laid across the English Channel and put into successful operation as a submarine telegraph line.

These experiments having proved the practicability of submarine telegraphy, the great enterprise of a telegraph line under the Atlantic Ocean was undertaken, and the subsequent developments are described in the statement as follows:

1857. First attempt to lay a submarine telegraphic cable across the Atlantic Ocean, the enterprise being headed by Cyrus W. Field, of New York, and Charles Bright, J. W. Brett and others, of England. The cable was to extend from Valentia, Ireland, to Newfoundland, the length of cable necessary being estimated at 2,500 miles. The construction of this cable was similar to that across the English Channel. After 255 miles had been laid from Valentia westward, the cable broke and the work was abandoned.

1858. Renewal by Mr. Field and his associates of the attempt to lay a submarine telegraphic cable across the Atlantic. The United States naval vessel "Niagara" and the British vessel "Agamemnon," carrying each one-half of the cable, proceeded to mid-ocean, and after joining the ends of their respective sections, on July 29, proceeded westward and eastward, paying out the cable and reaching their respective destinations, Newfoundland and Valentia, on the same day, August 5, 1858, when electrical connection between the continents was at once established over 2,050 nautical miles of cable which they had thus laid. Congratulatory messages were exchanged between the President of the United States and the Queen of England, and there was public rejoicing in both countries over what was pronounced the great event of the century. After less than one month of operation, however, the cable ceased working and it was never operated further, nor was any part of it ever recovered. During the time of its operation, 730 messages of about 10,000 words were passed over it. Its total cost was $1,256,250.

1859. A submarine telegraphic cable to connect England with British India was laid through the Red Sea and Arabian Sea to Kurrachee, India, having a total length of 3,043 nautical miles, but with several intermediate landings. Some portions of the line worked satisfactorily for thirty days, but few if any messages were sent over the entire length, and it soon proved a complete failure.

1860. Elaborate study of the entire subject of submarine telegraphs and the construction of cables was made by a committee appointed by the British Board of Trade, resulting in an expression of the belief that submarine telegraphy might, despite past failures, become successful and profitable if sufficient care were exercised in constructing, laying, and managing the cable.

1861. A submarine telegraphic cable, which had been manufactured with great care, was laid across the Mediterranean from Malta to Alexandria, Egypt, with intermediate landing places at Tripoli and Benghazi. The cable consisted of seven copper wires stranded together, covered with several coatings of gutta percha alternated with other non-conducting and waterproof material, and in turn covered and protected by eighteen iron wires wound spirally about this core. This cable proved a permanent success and went into general operation shortly after its construction. The speed of transmission, which on the Atlantic cable and shorter submarine lines had been three words per minute, was brought up to ten words per minute on each separate section, but was only three words per minute when all the sections were united and operated as a single line of 1,331 miles.

1862. A submarine cable which had been laid across the Mediterranean Sea between France and Algeria in 1861 proved a complete failure after a few months of experiment.

1864. Construction of a cable line to connect India with England undertaken by the Indian government, the line to be laid through the Arabian Sea and Persian Gulf to connect with land lines, thence to Calais, and by the short submarine line under the British Channel to England. The submerged line in the Arabian Sea and the Persian Gulf had a total length of 1,450 miles, but with three intermediate landing places. This line consisted of a copper core surrounded by layers of gutta percha, alternated with other non-conducting and waterproof material, being protected by an outer sheathing of twelve galvanized iron wires wound spirally about it, which in turn were protected by double wrappings of tarred hemp yarn. All of these materials and the various sections of the cable were constantly and thoroughly tested electrically and otherwise during its construction. The line when laid proved a complete success, becoming the first successful telegraphic connection between England and India.

1865. Another attempt made by Cyrus W. Field, of the United States, and his associates in the United States and England to lay a submarine telegraph cable from Valentia, Ireland, to Newfoundland and the United States. The cable, for which the contract price was $3,000,000, partly in cash and partly in shares of the company, consisted of seven copper wires surrounded by numerous coatings of gutta percha and other waterproof nonconductors. This was in turn surrounded by ten Bessemer steel wires, this being the first use of steel wires for cable protection, each wire being separately wound with pitch-soaked hemp yarn, the shore ends being also further protected by thirty-six heavy iron wires wound spirally about the completed cable. The steamer "Great Eastern," then the largest steamship afloat, was specially fitted up for laying this cable. Great care was exercised in every particular, but, after 1,186 miles had been laid westward from Valentia, the cable broke in water over 11,000 feet deep, and the attempts to recover it were unsuccessful.

1866. Mr. Field and his associates renewed their efforts to lay a cable across the Atlantic. A new company, with $3,000,000 capital, was formed, with the double purpose of attempting to find the end of the cable partially laid in 1865, and complete the line, and also to lay another cable parallel with and near to it. The cable manufactured for the proposed new line was similar to that of 1865. The "Great Eastern" was remodeled to further meet the requirements of the work, and left Valentia, Ireland, July 13, 1866, paying out the cable in a line about 25 miles north of that followed in the preceding year. She safely arrived at Newfoundland in fourteen days from the date of leaving Valentia, and electrical communication was immediately established between the United States and England, which has never since been more than temporarily interrupted. The "Great Eastern" then returned to the spot where the cable was lost in 1865, and, after eighteen days' work, succeeded in bringing the end on board from a depth of over 11,000 feet, the tests immediately made showing it to be in perfect working connection with the Valentia end. A splice was made and the laying of the line toward Newfoundland resumed, and on September 8 the cable was landed at that point and the second successful line of communication between the United States and Europe thus completed, Newfoundland being already in submarine telegraphic communication with the mainland and telegraph systems of the United States. The length between Trinity Bay, Newfoundland, and Valentia, Ireland, is given by the American Cyclopedia at 2,143 miles. The rate of speed in transmission over these cables was at the beginning eight words per minute, but increased to fifteen words per minute.

The success of the 1866 cables so completely demonstrated the practicability of submarine telegraphy that its progress thenceforward was very rapid. A second Anglo-Mediterranean line was laid from Malta to Alexandria in 1868, proving a complete success. A cable between France and Nova Scotia was laid in 1869, and another from Suez to Bombay, India. In 1871 a cable line was laid along the eastern coast of Asia to connect with land lines already constructed across Siberia and Russia. These land lines had been built shortly after the failure of the first Atlantic cable experiment, in the hope of connecting Europe and America by way of Siberia, Behring Straits, Alaska, British America, and the United States; but that plan becoming unnecessary after the success of the 1866 cable experiments, the land line across Russia and Siberia was utilized to connect a cable system of the eastern shore of Asia with the land and cable systems of Europe and America. In 1873 South America was connected by cable with the United States and thence with Europe; in 1875 cables were laid along the coast of Africa, connecting its important points with Europe and America; in 1880 cables were laid across the Gulf of Mexico and along the western coast of South America and connected by an overland line across the Isthmus of Panama. The invasion of the Pacific has been already begun by the construction of lines extending from Australia 1,200 miles southeastwardly to New Zealand and 800 miles northeastwardly to New Caledonia, but leaving the Pacific the one great body of water which has not yet been completely spanned by submarine telegraph wires. This it is believed is now practicable, since the distance between the four landing places now under the control of the United States, Hawaii, Wake Island, Guam, and the Philippines, is in each case less than that through which submarine cables are now being daily operated between France and the United States.

New Field for Fruit Preserving Machinery.

For some time past there has been considerable agitation going on in Jamaica as to the most practical way in which the surplus fruit and vegetables can be preserved for shipment. There is an excellent opportunity for those who have devices for evaporating or preserving fruit and vegetables to patent and introduce their machines into Jamaica and where there must shortly be an extensive demand for them.

Exhibition of Liquefied Hydrogen.

Great interest was exhibited at the Royal Institution, London, on June 7, when Prof. Dewar for the first time exhibited liquefied hydrogen to the public. He delivered a lecture on the subject and showed that the air surrounding the liquid was solidified like snow. Strange to say, cork placed in the liquid sank like a stone.