time to time 'made known' to the scientific world, are not yet published *in extenso*, with the illustrations prepared for the purpose.

"It is, then, specifically for Professor Hall's investigations in North-American paleontology, notably the paleontology of the state of New York and the regions adjacent, and of the earlier geological formations, that the committee suggests this award. In this field Professor Hall holds a position like that which has been so long occupied in Europe by Mr. Barrande. If his actual publications are as yet less extensive than those which have made the name of Barrande illustrious, this has not been from the lack of material, still less from lack of industry and scientific acumen on Professor Hall's part, but because he has not enjoyed the advantages of independent fortune and munificent patronage. Giving due credit to the state of New York for what it has done to further the publication of researches in its service, it still appears that his prolonged labors have been carried on under many discouragements and with insufficient means. It is understood, however, that deficiencies in this respect are about to be remedied; and it is hoped that this veteran paleontologist may have the satisfaction of superintending the full publication and proper illustration of his completed investigations.

"In recognition of the great value of the scientific work to which Professor Hall's life has been so untiringly and successfully devoted, in encouragement of his closing labors, and in testimony of the society's high appreciation of these services to science, your committee would recommend that the maximum of the prize be awarded upon this occasion."


PORTRAIT OF PROFESSOR JAMES HALL OF ALBANY.[1]

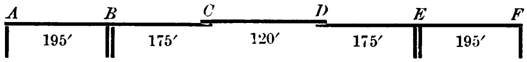
[1] From a crayon drawing, after a photograph taken for *Science*, April 17, 1884, by T. W. Smillie, photographer of the U. S. national museum.

THE CANTILEVER-BRIDGE AT NIAGARA FALLS.

THE new bridge across the Niagara River, built to connect the Canada southern railway with the New-York central and Hudson-River railroad, and opened for traffic in the early part of the present year, has been widely noticed in the newspapers, and referred to as a marked advance in engineering. Quite a general interest in regard to it has therefore been aroused by the apparent novelty of the design, and the rapidity of construction. As the railway suspension-bridge is below, and within some three hundred feet of, the cantilever-bridge, the contrast between them is forced upon every observer. While the cost of the two bridges, aside from the approaches, was probably very nearly the same, the suspension-bridge required three years for its construction, and will carry one train and such load as may come upon the lower roadway; the cantilever-bridge was erected in seven months and a half from the beginning of the work, and is designed to carry a freight-train on each of its two tracks at the same time, each headed by two seventy-six ton engines, and crossing without slackening speed. The ability to accommodate a greater traffic, and the rapidity of construction, may justly be ascribed to the advances made in American types of iron bridges.

One of the first questions asked concerns the meaning of the term 'cantilever.' It signifies, as an architectural term, 'a bracket, or projecting member, to support a load, such as a cornice or balcony.' The illustration accompanying this article gives a very good view of the structure as a whole; and the action of the cantilevers, as well as the several members, can be understood from the following diagram.

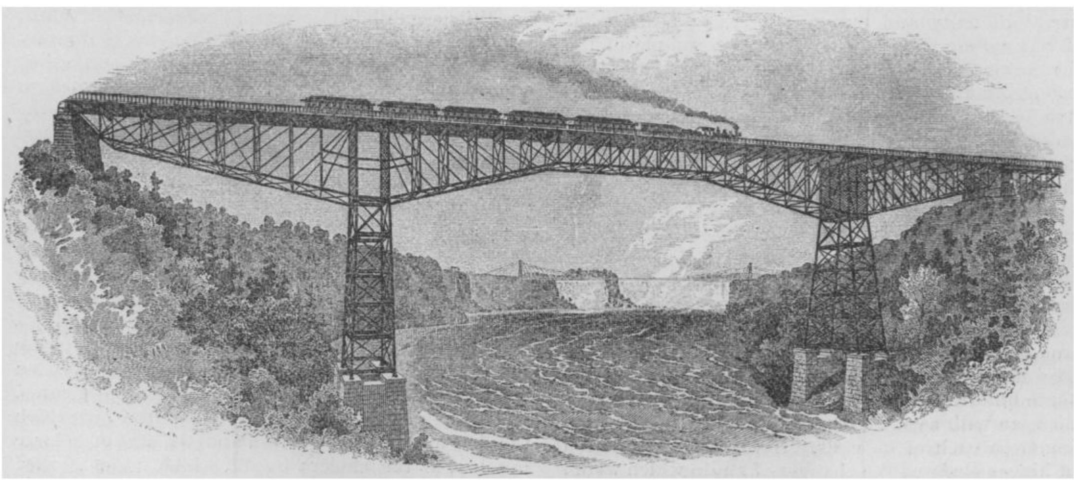
The shore abutments are at A and F, nine hundred and ten feet apart. The piers B and E, having a width on top of twenty-five feet, support two trusses,



A C and D F, the lengths of whose arms are marked below them: on their outer ends rests the independent truss C D, one hundred and twenty feet in length. The parts B C and D E are the cantilevers, carrying the truss C D, and projecting from the piers B and E as a bracket from the face of the wall. The ends A and F are prevented from rising, under any load between B and E which may not be balanced by the excess of weight in A B and E F, by anchoring bolts at A and F, extending to iron beams placed beneath the shore abutments. These abutments weigh one thousand tons each: the maximum lifting-force to which either one will be subjected is three hundred and forty tons. The expansion and contraction from changes of temperature are provided for between B and E by joints at C and D which allow longitudinal motion, and at A and F by pendulum links which permit a similar movement.

A detailed statement of the rate of progress in construction and erection will show quite clearly the advance made in late years in the art of bridge-building, and the ease with which structures of the American type, jointed at intersections and connected by pins, can be put together. The contract for the bridge was signed on April 11, 1883; and a clause was included by which the builders would forfeit five hundred dollars per day for all time required to finish the structure after Dec. 1. Ground was broken for the foundations of the towers, April 15. Laying of the concrete foundation, eight feet thick, began on June 6; and of the masonry piers, thirty-eight feet high and twelve feet square on top, June 26. The masonry on the American side was finished Aug. 20, and on the Canadian side Sept. 3. The two towers or steel piers, each of which has four legs, sixty feet by thirty feet apart at the base, twenty-eight feet by twenty-five feet apart at the top, one hundred and thirty-two feet high from the top of the masonry to the bottom of the truss, and thoroughly braced in all directions, were begun Aug. 29, and completed Sept. 18.

Scaffolding or false-works for the support of the portions A B and E F having been put up, these shore-arms were built upon it in the usual manner of bridge-erection, and were finished in time to begin construction of the river-arms on Nov. 1. This portion of the bridge was built out, piece by piece, triangle by triangle, from the piers, with no other outside support than a travelling framework above and projecting forward from the bridge itself: this traveller carried a suspended platform to insure the safety of the workmen. The sections from the two shores were built out and joined Nov. 21, without serious accident or delay. The track was down, ready for a train, in seven months and a half from the beginning of the work, and with eight days to spare on the contract time.



THE CANTILEVER-BRIDGE OVER THE NIAGARA RIVER.

The bridge has two trusses, twenty-eight feet apart, fifty-six feet deep over the towers, twenty-one feet deep at the shore-ends, and twenty-six feet deep at the mid-span. Ample wind-bracing is provided. The material used in the towers and heavy compression members is open-hearth steel: most of the other members are of wrought-iron. One admirable point in the design of the engineer, Mr. C. C. Schneider, and in the way in which it was executed by the builders, the Central bridge-works of Buffalo, N.Y., was the fact that no piece, while the bridge was in process of erection, was subjected to a strain greater than, or different from, what it must undergo in the completed structure. At the formal test and opening, Dec. 20, the bridge was traversed by two trains, advancing side by side from one end, and composed of twenty locomotives, and enough cars loaded with gravel to together cover both tracks completely. The independent span *C D* was occupied entirely by engines when the bridge was fully loaded. The deflection of the point *C* under the test was between six and seven inches, being an aggregate arising from the yielding of *A B*, the compression of the tower, and the deflection of *B C* itself. On the removal of this load, of double the amount which will probably ever be imposed upon the structure, the bridge completely recovered itself.

The application of the cantilever in bridge-building may be seen in several other instances in this country. Sometimes it has been used to diminish the opening to be spanned by a single truss, and more frequently it has been introduced to facilitate the erection of a bridge in places where temporary supports in mid-channel could be obtained only with great difficulty and expense. A wagon-bridge at Fort Snelling, Minn., furnishes an example of the former class; but the cantilevers are reduced to simple triangular brackets, projecting some thirty or thirty-five feet beyond the faces of two adjacent piers, and reducing the span to two hundred feet. The Cincinnati southern railway bridge, over the Kentucky River, has three spans of three hundred and seventy-five feet each. As the gorge which this structure crosses is two hundred and seventy-five feet deep, and ordinary false-works were out of the question, the spans were built out from each cliff as projecting trusses, anchored back to the rock. By the aid of one temporary timber tower on each side, and the iron piers, the bridge was thus joined in the middle. The lower chord connections were then severed at three hundred feet from each bank, leaving the middle span with a cantilever of seventy-five feet projecting from each of its ends. Here the introduction of hinges obviated the changes of strain which would otherwise be caused by the effect on the tall iron piers of changes of temperature. The Minnehaha bridge, across the Mississippi River, between St. Paul and Minneapolis, has three spans, and was erected like the Niagara bridge, — the two shore-arms on false-works, and the middle span as two cantilevers, which are connected by a hinged joint in mid-river, without any independent span.

A design for the Frazer-River bridge on the Canadian Pacific railway, by Mr. Schneider, although not yet erected, antedates the Niagara bridge, and is like it, only on a smaller scale. The design for the Blackwell's Island bridge, across the East River, New York, which was awarded the first prize in 1876, introduced cantilevers and an independent span. A similar type of bridge is in progress at St. John, N.B.; one is proposed for the new Harlem-River bridge, New York; and the great bridge for crossing the Frith of Forth, now under construction, is a bold design of this type, having two openings of seventeen hundred feet each. Others might be mentioned if space permitted.

CHAS. E. GREENE.

THE CHOLERA BACILLUS.[1]

THE question, which, in my last report of Jan. 7, was left unanswered, — whether the bacilli found in the intestines affected with cholera are parasites due to cholera alone, — may be looked upon as answered.

It was at first exceedingly difficult, on account of the varying conditions under which the pathological changes took place in intestines affected by cholera, and on account of the great number of bacteria constantly present in them, to find out the bacillus proper to the disease. In most cases death occurred, not at the height of the cholera process, but during the period of reaction immediately following, in which such important changes take place in the condition of the intestines and their contents, that it is impossible, from such cases alone, to gain a clear conception of the cholera process. Only when one has had an opportunity to dissect a number of uncomplicated cases, and to compare with them the conditions exhibited in persons when first attacked, is it possible to gain a correct insight into the pathological conditions of cholera. On this account it was always kept in view, to use the greatest caution in accepting any theory as to the connection of the bacterial condition and the cholera, or as to causal connection of the bacteria with cholera, till the full proof might be obtained.

In the last report, I could already state that the peculiarities of the cholera bacteria were so well determined that they could safely be distinguished from others. Of these characteristics, the following are the most striking: the bacilli are not perfectly straight, like other bacilli, but slightly curved, like a comma. The bending may go so far that they take the form of a half-circle. In the pure cultivation from these bent rods often arise s-formed figures, and more or less long, slightly wavy lines, of which the first are made up of two, and the last of a large number, of the cholera bacilli, which, by continued increase, have remained connected. They possess powers of locomotion, which can best be seen, and in most marked degree, in a drop of cultivation-liquid suspended on a cover-glass: in such a preparation, one sees the bacilli moving with the greatest velocity in all directions through the field.

Especially characteristic is their action when cultivated in gelatine, in which they form colorless colonies, which at first are closed, and appear as if they consisted of very brilliant little glass particles. Gradually these colonies liquefy the gelatine, and spread out to a considerable extent. In gelatine cultivation they are, therefore, through this remarkable appearance, very surely distinguished from other bacteria colonies, and can easily be isolated from them. Moreover, they can pretty surely be distinguished by cultivation in hollow slides, as they always go to the edge of the drop, and in that position can be recognized by their peculiar movements,

[1] Sixth report of Dr. KOCH of the German cholera commission, dated Calcutta, Feb. 2, 1884. Translated from the *Berliner klinische wochenschrift* for March 31. An abstract of the seventh report will be found in the Notes and news.