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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

DISTORTED BRIDGE STORIES.

As we have been compelled sometimes to criticise in the public interest the city's bridge construction, we are glad of the opportunity to say a word of commendation or reassurance when honestly we can do so.

Our criticism of the manner in which the details of the Queensborough Bridge were altered, upon the decision to add two elevated tracks to the load for which it was originally planned, appeared to be well founded, and has since been confirmed by independent experts. It would still appear that the thorough investigation which has resulted was very necessary to ascertain, beyond all question, that the strength of the structure will be sufficient before putting upon it all the live load which was intended.

When, however, the adequacy of the Manhattan Bridge begins to be questioned upon entirely false presumptions, we are glad to do what we can to allay alarmist rumors. It is not likely that the city engineers would so soon forget the former lesson; and the evidences offered in the sensational press against the character of the structure now building are too obviously based on amateur ignorance of inevitable conditions.

It has been reported that some eagle-eyed pedestrians, who daily cross the Brooklyn Bridge, detected a noticeable change in the hang of the great cables of the Manhattan Bridge, as the members of the lower deck were suspended from them, farther and farther out from the piers, and that they speculated upon the question whether the strength of the cables, or other parts of the bridge, could be sufficient, if so small a part of their eventual load could so distort them.

It is a little difficult to believe that such distortion of the cables is perceptible to the naked eye, unassisted by surveying instruments, in a full-length elevation of the bridge as observed from the Brooklyn Bridge; but there is no doubt that the distortion takes place. There is no more doubt that the engineers not merely anticipated and provided for it, but knew that it could not possibly fail to take place in the natural course of events.

The cables, as first strung, carrying nothing but their own weight, hang in a curve known to engineers as a catenary. This curve in the case of the Manhattan Bridge is well shown in the large illustrations of our Engineering number of December 5th last. When the roadway comes to be suspended from the cable, the latter assumes a different curve, which, if the load is distributed uniformly along the length of the cable, approximates more or less closely to a parabola. If the roadway serves no other purpose and is flexible, it will undulate with the passage of loads across it, and a corresponding distortion will take place in the supporting cable. There are primitive suspension footbridges in existence in which this effect is most noticeable; but it is obvious that such distortion, if it were permitted to take place, would greatly add to the strains in bridges so heavily loaded as those of New York, and would be entirely impossible in practice.

The main office of the truss, which we conventionally consider principally as a roadway, is to stiffen the cables and prevent change of shape and oscillation due to moving loads. The dead weight of this truss is entirely supported by the cables; in the case of all the East River bridges it is not rectilinear, but forms a very flat arch. The truss, although its purpose is to stiffen the cables, cannot be erected in one piece; and as, during erection, the different members extending outward from the piers are successively suspended from the cables, the latter are distorted, the points from which members are hung being slightly below their final position, while those farther on, from which members are not yet hung, are slightly above. The effect of this is well shown in our illustration of April 10th, in which the whole length of the bridge appears in sharp perspective, the parts of the truss already erected appearing, not as parts of a continuous curve, but as two curves which will not coincide with the completed arch. The reason of this is that the "lower deck" members, first hung, did not form a rigid, but a flexible structure. The unloaded center portion of the cable in the meantime flattened through the loading of the parts nearer the piers, and in the case of an elementary flexible cord would have been drawn into a straight line.

When the lower deck members met and the cable was uniformly loaded, it resumed its position as a regular curve, but then began another curious change. As the top chord and heavy upper floor were added, not from the piers outward, but from the center inward, the cable assumed a position (the truss not yet being rigid) in which its central point was lower than its final position, and points intermediate between it and the top of the tower became higher than their final position, just as an elementary cord would hang in a V shape if loaded only in the middle.

These changes, however, though interesting to watch, are no criterion of the ultimate strength of the structure. Not only have they been anticipated by the engineers, but special provision has been made to allow the cables every facility for deflection during the course of construction, in order that when the dead load is complete and uniform, each individual wire of the cables may be in the best position to carry its equal individual share of the total load.

SIGNALING TO MARS.

Not since those historic flashes from Mars were received, some years ago, which were probably caused by the reflection of sunlight falling on snow-covered surfaces, and which were promptly interpreted by Tesla and some exuberantly imaginative astronomers as attempts on the part of a hypothetical race of Martians to communicate with this earth of ours, has so much excitement been created as Prof. Pickering's proposal to build a system of mirrors, by means of which light can be rhythmically flashed to Mars. According to Prof. Pickering, a system of reflecting surfaces of adequate area could be constructed at a cost of $10,000,000. If Mars is inhabited by a race more highly developed than we, on the theory that their planet is older than ours, it is argued that they will have sufficient intelligence to devise a means of answering. Prof. R. W. Wood of Johns Hopkins University suggests the simpler and cheaper expedient of employing a huge strip of black cloth, which could be wound from one roller to another, and made to appear and disappear at regular intervals. He suggests the alkali deserts of the Southwest as a suitable place for the experiment. In all probability, neither Prof. Wood nor Prof. Pickering seriously believes that Mars is inhabited.

Would it be worth while to carry out the idea? To us it seems that if the experiment proved a failure, and no answering signal were received from Mars in a reasonable time, the matter would not be conclusively settled. Knowing practically nothing of the conditions on Mars, it would naturally be unsafe to conclude from a failure that the planet is uninhabited, for which reason the habitability of Mars would still engross Flammarion, Lowell, and the host of newspapers that accept their utterances as astronomical gospel. On the other hand, if an answering signal should be received, it would be safe to say that the event would transcend in human interest and importance the most stirring occurrence in the history of the earth, and would inaugurate a new era in the progress of the human race.

Even in the face of this tremendously alluring but exceedingly remote possibility, it seems to us that the $10,000,000 stipulated by Prof. Pickering, and the smaller indeterminate sum required by Prof. Wood, could be more worthily expended, particularly so when we examine the evidence on which the theory of Martian habitability is based.

To the indefatigable studies of Prof. Lowell we owe whatever facts have been gathered that bear at all on the question. But Prof. Lowell's arguments have been riddled by the inexorable logic of geologists, astronomers, and physicists. He is wedded to the Laplacean theory of planetary evolution, although that theory is considered inadequate by many astronomers in the light of recent celestial observations. He assumes that the history of the earth is the history of Mars. He advances the theory that Mars is a planet which has shriveled up during the course of ages; that its surface is one vast parched desert, with the exception of the snow that gathers each winter about the poles; and that the chief concern of the inhabitants, if inhabitants there be, is to conserve this paltry supply of water, and to conduct it, as the snow melts in the spring, to those regions in the equatorial and temperate zones which would still blossom if they were watered. Evidence of this gigantic irrigation system, which dwarfs anything of the kind that we have ever attempted, Lowell finds in that network of lines which Schiaparelli first discovered, and which were called by him "canals" for want of a better name. As spring and summer approach, the lines slowly creep down from the poles toward the equator, and the dull red or orange of the supposed desert region changes to green. With the advent of autumn and winter, the green resumes its dull red or orange hue, and the lines or "canals" gradually disappear. In these chromatic changes Prof. Lowell sees the seasonal growth and decay of vegetation. His argument for the habitability of our planetary neighbor is based on the undeniably remarkable regularity of the "canals." It is pointed out that they are usually the shortest distance between the points that they connect, and that they meet in groups of three, five, seven, and more in well-defined spots, which he terms "oases," like so many spokes converging in a wheel-hub. In other words, there is nothing haphazard in the arrangement of these canals as Prof. Lowell sees them. They are to him so artificial that they are the symbols of an intelligent race, who have sunk all political and international disputes in the one vital problem of postponing the day when their orb must eventually dry up and they themselves perish.

To reinforce his argument, Prof. Lowell points to the earth. He argues that all terrestrial life emerged from the ocean, although no geologist will positively assert how life did originate on this planet; that the earth was once wrapped in a damp, cloudy envelope, although there is much evidence that moisture, even in geologic times, was of local prevalence only; that the earth is gradually drying up, although all geological evidence points to the fact that the proportion of land to sea has always been a fluctuating quantity, with no marked tendency in either direction; and that deserts on the earth are the harbingers of an ultimate dearth of water extending over the entire earth, although geologists maintain that deserts have always existed. Perhaps the most vigorous attack on Lowell's theories has been conducted by Prof. Andrew E. Douglass, who has studied the "canals" by the methods of experimental psychology, and has shown that there are fundamental defects in the human eye which produce faint canal illusions, and that these have worked serious injury to our observations in the past. It must be confessed, however, that Prof. Douglass has not explained away the seasonal appearance and disappearance of the "canals" and "oases."

Ingenious as Prof. Lowell's explanation of Martian phenomena undoubtedly is, so much of it is based on unsound geological reasoning, and so much on sheer conjecture, that it seems almost futile to make any attempt at signaling in the hope of obtaining something like experimental evidence that Mars is really a living world peopled by intelligent beings.

DIRECT-CURRENT VERSUS SINGLE-PHASE TRACTION.

At the annual electrical night of the New York Railroad Club, there was an active discussion of the problems of railway electrification, which in some respects was in marked contrast to preceding discussions of the same subject. Hitherto, we have been accustomed to listen to rather heated discussion of the merits of the two leading systems of electrification as put forward by the advocates of the high-tension overhead and the low-tension third-rail methods of propulsion, in which each side has claimed a practical monopoly of advantages for its own particular system. During the last year or two, however, there has been afforded an excellent opportunity to test theory by practice; notably, on the two important electrical installations which have been in operation on the New York Central and New Haven systems. Also in various parts of Europe and America, the single-phase and the direct systems have been in operation under varying conditions of traffic. As the outcome of this experience, there has grown the conviction that each system is suited to certain special conditions; and that in the electrification of steam railroads, it is probable that both the high-tension and low-tension methods of propulsion will be employed, even on the same stretch of road.

In future changes from steam to electricity, it is probable that the direct-current, third-rail system, using from 600 to 1,200 volts, will be employed in terminal stations, yards, and the zone of suburban service. Beyond this zone, if in the future it should be found desirable to electrify the trunk lines for long distances between important centers, it is almost certain that the alternating-current single-phase system will be adopted, using a voltage of 10,000 to 12,000 or even more.

It is significant that the Pennsylvania Railroad Company, in spite of the fact that most of the electrical work at New York is being done by the Westinghouse Company, who are the sponsors for the single-phase system in America, have decided to equip their vast system of tunnels and terminals in New York city with the third-rail direct current, leaving themselves free to adopt the single-phase system for any further extensions beyond Harrison into New Jersey and Pennsylvania.