# SCIENTIFIC AMERICAN

**ESTABLISHED 1845**

**MUNN & CO., - - Editors and Proprietors**

**Published Weekly at**

**No. 361 Broadway, New York**

*TERMS TO SUBSCRIBERS*

One copy, one year for the United States, Canada, or Mexico ......... $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

*THE SCIENTIFIC AMERICAN PUBLICATIONS.*

Scientific American (Established 1845) ........................... $3.00 a year
Scientific American Supplement (Established 1876) ............. 5.00 "
American Homes and Gardens ..................................... 3.00 "
Scientific American Export Edition (Established 1878) ......... 3.00 "

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, OCTOBER 28, 1905.

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.


## A LESSON FROM THE LEWIS AND CLARK FAIR.

The city of Portland, Ore., is to be congratulated on the fact that in the highly successful Lewis and Clark Fair, recently closed, it has proved that by the exercise of careful forethought and good management it is possible to carry through one of these national expositions as a paying proposition, and turn over a cash dividend to the stockholders at its close. No doubt one secret of its success is to be found in the fact that the Fair was planned on a scale commensurate with the present stage of development of the Pacific Coast, and that a conservative estimate was made of the probable number of visitors. That the gate returns should have shown a total admission of 2,500,000 is a highly creditable result, and particularly so when we bear in mind that the total population of the State in which the Fair was held is less than one-fifth that number.

We have long been of the opinion that these national expositions have grown altogether too big and cumbersome. The two elements of bulk and acreage, which have been blazoned as their chief glory, are really their chief defect, and the bane of every weary pilgrim that has toiled through their miles of boulevards and plazas, or plodded through aisles of interminable length and oppressive monotony. When such Brobdingnagian buildings as those of the St. Louis Fair are scattered over two square miles of territory, it is clear evidence that the builders have lost all sense of proportion; for only a race of giants, striding ten feet to our one, could cover such an exposition with any degree of comfort, or in any reasonable time.

If we make our future expositions smaller, we can fill them with more select exhibits. The commissioners will be more concerned about the quality and less about the quantity. Where such an enormous building, for instance, as the Agricultural Palace at St. Louis is put up, it becomes a problem how to fill it; for on a floor space measuring 500 feet by 2,000 feet, there are bound to be whole acres of stock exhibits which are simply repetitions of other acres similarly filled.

Nor are such vast proportions necessary to produce the desired architectural results. If the St. Louis buildings and grounds had been scaled down nearer to the proportions of those at Portland, the effects (landscape, architectural and illuminative) would have been scarcely less striking, and the proper acquaintance and appreciation of them would not have entailed such mental and physical exhaustion. Furthermore, a reduction in the scale of future world's fairs would not only serve to get rid of many miles of stock exhibits, such as may be seen in a day's walk through any large city's business center, but it would bring the first cost and operating expenses down to a point at which, as in the Lewis and Clark Fair, the customary deficit would give place to a cash dividend.

## LONG-SPAN BRIDGES OF THE WORLD.

It is surely a sign of the great magnitude of the engineering works of the present day, and the multiplicity of such works, that the magnificent bridge which is being thrown across the St. Lawrence at Quebec should have attracted so little public attention. Time was, and not so very long ago, when the spanning of a broad river or estuary like the St. Lawrence or the Firth of Forth, held the attention and commanded the admiration of the whole world. It was thus when the Roeblings spun that seemingly delicate cobweb of wires across the East River, New York, which is now world-famous as the Brooklyn Bridge. It was so when, a few years later, Sir Benjamin Baker and his associates boldly set out to build a double-track steel highway across the stormy Firth of Forth, a few miles above Edinburgh, announcing that they intended to cross the channel in two bold leaps each of 1,710 feet, with the historic Inchgarvie Island as a single intermediate stepping-stone. In each case, the work of building these monumental engineering structures was followed in its successive details with absorbing interest, from the sinking of the huge caissons and rooting them to the solid rock far below the river bed, to the erection of the giant towers and the stringing of the airy cables, or flinging out the giant cantilever arms to join hands in midstream, nigh upon a thousand feet from the points of support.

Bridge building upon a Titanic scale was a novelty in those days, and comparatively novel also were the sinking of wooden or steel caissons through water and underlying mud and sand to a rocky bed, and the outbuilding of gigantic trusses, hundreds of feet beyond their point of support without the aid of temporary falsework or scaffolding. Familiarity, however, even in engineering works of great audacity and difficulty, breeds the inevitable contempt, and hence it is that the spanning of the St. Lawrence has awakened an interest that is almost purely academic and confined largely to the technical press and to the limited circles of our engineering societies.

The great cantilever bridge which is now being built across the St. Lawrence River at Quebec will include the largest single span ever erected in the history of the world. It is well understood among engineers that the true test of the magnitude of a bridge is not its total length as made up of many individual spans, but the length of the individual span itself, and in this respect the Quebec Bridge is preeminent. It reaches across the St. Lawrence River in a single span of 1,800 feet. This is nearly 100 feet greater than the spans of the Forth Bridge cantilevers, which measure 1,710 feet in the clear. Next in length is the Williamsburg suspension bridge, which is 1,600 feet in the clear, and then follow the Brooklyn Bridge, 1,595 feet, and the new Manhattan Bridge adjoining it, which will be 1,470 feet in the clear. Had the various railroads which have their terminals in Jersey City shown the same liberality and zeal displayed by the Pennsylvania Railroad Company a few years ago, there would now have been under construction, across the North River, a colossal suspension bridge, which would have far exceeded in size and importance the great bridges above mentioned. We refer to the North River suspension bridge, designed by Gustav Lindenthal, which would have crossed the North River with a single span 3,100 feet in length between the towers, and would have measured 7,340 feet over the anchorages. The cables, each 8 feet in diameter over the outer covering, would have carried a triple-deck suspended structure, with a promenade on the upper deck, six railroad tracks on the middle deck, and eight railroad tracks on the lower deck; and over this single structure it was intended to have brought in all the traffic of the Jersey roads to a single station in the heart of Manhattan. The four towers carrying the cables would have been 550 feet in height, the same as that of the Washington monument. This wonderful structure came very near to being built, and had the work been put through it would have constituted the noblest work of engineering in this or any other country in the world.

Although the new St. Lawrence Bridge will exceed our East River bridges in total length of span, it will not compare with them in the magnitude of the traffic that it can carry. Its total width of 75 feet is not much more than half that of the Williamsburg Bridge, which measures 120 feet over all and provides two 18-foot roadways, four trolley tracks, two elevated tracks, two passenger footways, and two bicycle tracks. Even greater than this is the capacity of the new Manhattan Bridge which, on the lower deck, provides for four lines of street cars, two passenger promenades, and a broad carriageway 35½ feet in width, and also carries on the upper deck four elevated railway tracks. The total width of the floor of this bridge will be 122 feet.

As the St. Lawrence Bridge is the first cantilever structure that compares in magnitude and length of span with the Forth Bridge, the latter forms the proper basis of comparison. At the time that it was constructed the engineers, who were responsible for its design, had absolutely nothing to guide them in the way of long-span railroad bridges, since nothing approaching the proposed bridge in magnitude had hitherto been constructed. In determining what section to use for the members of the cantilevers, it was decided to use the tubular section, for the reason that it presented the stiffest and strongest form for a given weight of material. It was also decided, in view of the fact that abnormally high wind stresses had to be provided for (56 pounds to the square foot), to give a very pronounced batter or inclination to the towers and cantilevers. Both of these features added greatly to the labor and cost of construction. In the interim since the building of the Forth Bridge, we have learned that wind-pressures on long-span bridges are much less than was supposed, being, indeed, scarcely half as great. Moreover, steel mills can now furnish rolled rectangular steel in sizes which were not obtainable when the Forth Bridge was built. Consequently, the St. Lawrence bridge is being built with its cantilevers and towers in vertical planes, and the materials used are entirely of standard shapes, such as can be rolled in the mills. Instead of the 12-foot tubes of the Forth Bridge, we have built-up lattice chords and posts and 18-inch eye-bars in the Quebec Bridge, and the combined result will be a structure relatively lighter and cheaper to build, and of unquestionably more graceful appearance than the far-famed bridge across the Firth of Forth.

## LIFE ON OTHER WORLDS.

The recent utterances of the venerable Dr. A. R. Wallace, fellow-discoverer with Darwin of the origin of species, tending to show that our earth is the only body in the known creation suited for life such as we find it here upon the globe, has awakened a wide interest among progressive scientists. It is recognized by all who keep up with the thought of the age that evolutionists are not so sweeping in their claims now as they were a quarter of a century ago, when the Darwinian theory was new.

Dr. Wallace is now a very old man, and like Lord Kelvin, he seems to find a Providential design in the arrangement of the material universe. It is perhaps true that the very greatest and best-balanced minds of all ages have inclined to such beliefs, and yet in recent years the progress of applied science has been so sweeping and her voice so omnipotent that many persons have shared Tyndall's views of testing the efficacy of progress by experiment. The difficulty is that such tests could never be carried out satisfactorily.

Now, when Dr. Wallace asserts that our earth is the sole abode of life in the universe, a renewed interest springs up among scientists. One school claims that he is old and in his dotage; the other, that he has become wise in his old age.

Astronomers can see with a great modern telescope at least 100,000,000 stars in the entire universe. The question arises, "How many other bodies like our earth exist in space?" Prof. T. J. J. See, of the United States navy, claims that the study of the double stars rather supports Dr. Wallace's contention. In 1896, Dr. See published a work on the orbits of all the double stars which could be determined at that time, and he found the double stars so different from the solar system that he says no other system like that to which the earth belongs is known to exist in the heavens. The double stars revolve in orbits of high eccentricity, and the two members of a system are usually equal or comparable in mass; while our planets move in very circular orbits, and have masses which are infinitely small compared to that of the sun, about which they revolve. The result is that our planetary system affords equable conditions of heat and light, such as organic life requires, while the system of the double stars would furnish such great changes of light and heat that life could not survive on a planet attached to a member of a double, such as Sirius or Procyon.

The sun has a mass 746 times greater than all the planets combined, and this makes him an autocrat over the planets, whose motions he dominates absolutely. The double stars are in reality systems of double suns, and mathematicians claim that a planet could not move safely and quietly in such a system—that it would sooner or later come into collision with one of the stars, or be driven from the system never to return, in either case destroying the chances of organic life. The number of dark bodies in the heavens is immense, and, of course, it is possible that some of these may afford conditions suitable for organic life; but up to this time, astronomers are unable to point to a single body of this kind outside of our solar system. This in a measure supports the contention of Dr. Wallace.

Speaking of dark planets attending the stars, Dr. See writes in a recent publication as follows: "If such inconsiderable companions as our sun possesses attend the fixed stars, they would neither be visible nor could they be discovered by any perturbations which they might produce. It is, therefore, impossible to determine whether the stellar system includes such bodies as the planets, and we are thus unaware of the existence of any other system like our own. On the other hand, the heavens present to our consideration an infinite number of double systems, each of which is divided into comparable masses. These double systems stand in direct contrast to the planetary system, where the central body has 746 times the mass of all the other bodies combined.

In binary stars, the mass distribution is essentially double, while in the solar system it is essentially single; whether observation will ever disclose any other system of such complexity, regularity, and harmony as our own is an interesting question for the future of astronomy.

It thus appears that so far as telescopic research has yet extended, we know of no other world suited for life outside the solar system. For some reason, our system appears to be absolutely unique in the known creation; but of course astronomers are too conserva-