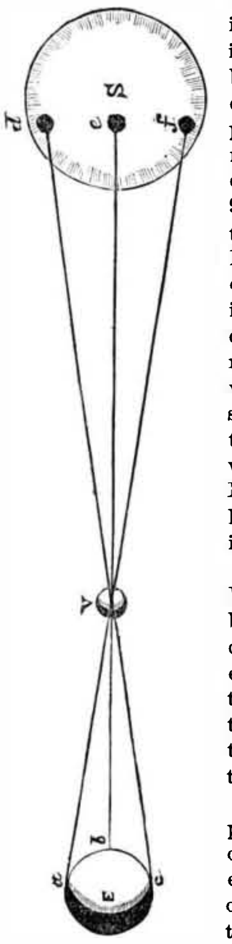
THE TRANSIT OF VENUS.

On the 9th of December, 1874, the planet Venus will pass between the earth and the sun, and will appear as a round black spot traveling across the sun's face. This phenomenon is what is meant by the transit of Venus, and it is expected that by its careful observation data will be obtained by which, generally speaking, we shall be able to measure the distances of the heavenly bodies, their weight, and their dimensions.

As matters now stand, our knowledge of the celestial world in the above respect is not exact, although a scale of measurement has been approximately constructed. The last observed transit of Venus, which took place in 1769, gave us data on which our ideas of celestial distances are now based. But errors have been discovered in the observations, owing, perhaps, to the primitive instruments used. For example, the sun's distance, then estimated at about 92,000,000 miles, is now believed to be at least 500,000 miles too great. Naturally, the finding of such serious errors has caused great anxiety in the scientific world to make the coming observations perfectly accurate, and hence the transit will be watched with the greatest care by some two hundred observers, stationed in seventy different places where it will be visible: that is, in Northern India, Australia, New Zealand, Mauritius, Japan, etc., but not in the United States.

Fig. 1.

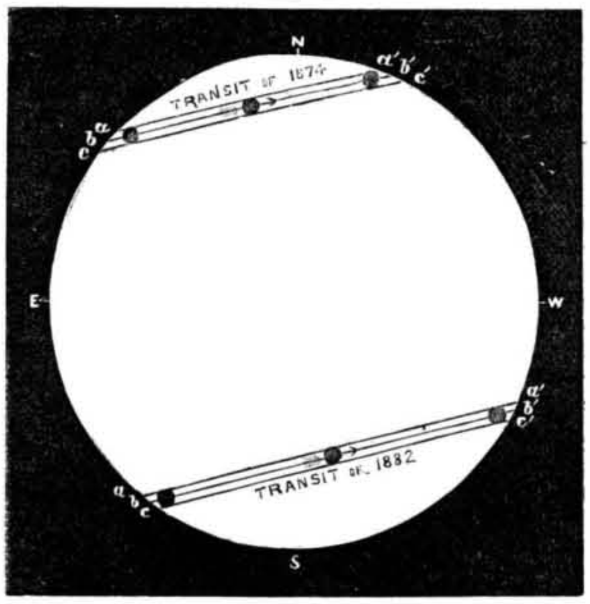


Now by means of the transit of Venus, it is expected that we shall be able accurately to measure the distance between the sun and our earth; and with this gage once established, it will be a very easy matter to apply it to the spaces between the orbits of all the other bodies of the solar system.

The most direct and valuable practical result of the determination of the sun's distance is that which enables us to tell the exact attraction of the sun for the moon, and hence to predict the motions of our satellite. Our lunar tables, by the aid of which we can determine longitude, will then be rendered, instead of approximately, absolutely correct. The result will be that the moon will become not only our nocturnal luminary, but a reliable clock, from which the astronomer or navigator can read the time with certain accuracy.

When Venus crosses the sun's face, the observers on opposite sides of the earth will see the planet on different points of the sun's disk. This will be clear from Fig. 1, where S is the sun, E the earth. If three observers, stationed at a, b, and c on the earth, note the transit at the same time, to the first the planet will appear to be at f, to the second at e, and to the third at d. In our second figure are shown the positions of the planet as regards the sun's disk in the transit o 1874, and also in the transit to happen in 1882. At northerly stations, Venus will seem to pass along the line $c\,c'$; at southerly posts along $a\,a'$, and at central points along $b\,b'$. The arrow shows the direction of the motion. Now, if we can measure the solar parallax—that is, the distance between lines $a\,a'$ and $c\,c'$—we shall know the angle subtended by any known distance on the earth's surface at the distance of the sun, and hence be given the necessary means for the trigonometrical solution of the triangles, and the determination of the sun's distance

Fig. 2.



To find this distance, various ways will be used. Observers stationed in both northern and southern hemispheres will measure the lines $a\,a'$ and $c\,c'$. This gives the length of two chords of a circle, from which it will not be difficult to find the distance between them. This is called Halley's method. Then another way is for two observers, widely separated, to note the exact time when the planet enters and leaves the sun's disk. The difference in the hour and minute recorded will show what effect the separation of the observers has on the apparent position of the planet. This is the principle of Delisle's plan. Besides this, the sun will be photographed, and the positions of the black spot as seen from different places can be afterwards compared. A new instrument, called the heliometer, will also be used to measure directly the distance of the black spot from the edge of the bright circle of the sun.

It is generally admitted that the United States has shouldered the most difficult share of the work, not only in appropriating the largest sum, but in accepting the most difficult stations. Of the latter our astronomers take eight—three in the northern hemisphere and five in the southern. The former are at Wladewostock, Yokohama, and in Northern China, the latter at New Zealand, Tasmania, and Chatham Island on the east, and Macdonald Island and the Crozets on the west. Our expeditions rely chiefly on Halley's and the photographic methods, but Delisle's and the direct plans will also doubtless be availed of. The whole transit will be visible at all the stations. We have already noted the departure of the Swatara, and of the various parties to their distant posts.

All the English expeditions, excepting one, which goes to Alexandria, in Northern India, in October, are already *en route*. They are stationed at Oahu and at Rodenck's and Falkland Islands.

The Germans send four parties to Falkland, McDonnell's, and Kerguelen Islands, in the southern hemisphere. France sends five expeditions—two to Northern China, one to Japan, one to Campbell Island, and one to St. Paul's Island. Russia has twenty-five stations in Siberia. Besides these national preparations, a number of private observations will be taken by parties under Lord Lindsay at Mauritius, and at the observatories of Madras, Capetown, etc.

Heat and its Relation to Construction.

The present extensive use of iron in building operations necessitates the careful consideration by architects of the molecular changes which that metal undergoes, owing to changes of temperature, and the consequent effect of the same upon the structure. It is well known that a powerful conflagration, occurring in an iron edifice, warps and twists the walls and facings to such an extent as to necessitate their prompt destruction; while a like casualty, taking place even in a brick building in which iron beams and girders are employed, is often apt to expand the metal so greatly that walls are dragged out of place and thrown down. Cases have also occurred in which, owing to careless construction, summer heat and winter frosts have caused serious deterioration in iron fronts and have necessitated alterations and the application of strengthening devices, involving considerable trouble and expenditure.

The *Building News* of recent date contains a carefully prepared article on heat and its relation to construction, which embodies several useful hints and suggestions.

It is somewhat surprising, says our contemporary, that architects and engineers so frequently neglect this expansibility of metal in girders, ribs, columns, etc., and provide no means for their free movement. Sometimes, it is true, the bearings of long girders in bridges are made of sufficient depth to allow for this increase of length; but even in these cases the mere weight of iron and superincumbent loads upon the points of support render the intended result nugatory, the weight of the iron girder alone often creating so much friction on the bearing surfaces as to overcome the rigidity of the supporting piers or walls, or the cohesion of mortar at certain points. This immovability of the ends of iron girders and joists is often increased by their being clenched or fixed by the weight of wall above, which often improperly is allowed to bear upon the top flanges.

To obviate this, some engineers have contrived movable bearings, more or less effective. One simple method we would suggest. Let each template be of cast iron of sufficient substance and bearing surface, and let it be placed upon an under template of stone or metal, the surfaces being either left smooth simply or brought into contact by a friction roller, of small diameter and of the length of the bearing surface. By this means free dilatation could take place, provided, of course, the ends of girders are left a free space of sufficient distance. No weight should be allowed to rest upon the ends of these beams, but in all cases the bearings should be free all round, and may be made as cast iron sockets, built into the wall, or standing out independently.

The linear expansion a bar of iron undergoes when heated from the freezing to the boiling point, or from 32° to 212° Fah., is about one 812th of its length; at higher temperatures, the elongation becomes more rapid. Thus the progressive dilatation of wrought iron, as determined by Daniell's pyrometer, allowing one million parts at 62°, is as as follows:

At 212°.	At 662°.	At fusing point.
1,000,984	1,004,483	1,018,378

Cast iron is rather less.

It may be mentioned here, that the expansions of volume and surface are calculated by taking the linear expansion as the unit, following a geometrical law; thus the superficial expansion is twice the linear, and the cubic expansion three times the linear.

These figures show how sensible a change takes place when iron undergoes an ordinary variation of temperature; and it may be said that in all ordinary cases of building this change is quite sufficient to cause serious disruptions of parts. Thus a bar or beam of even 10 feet long and subject to an ordinary change of temperature, say from 32° to 180°, will elongate more than $\frac{1}{8}$ of an inch—a sufficient modicum to cause fracture in stonework, to snap the thread of a screw, or to endanger a bridge floor or roof truss. When we think of lengths ten and even a hundred times this dimension, the danger of uncompensated expansion or contraction is increased a thousand fold. In ordinary cases, the margin of safety is really dependent upon the amount of flexibility or elasticity of the parts of a building connected with iron, or to imperfection of joints; yet we should not rest satisfied with such presumptive security.

It would appear that the most promising mode of using iron is in combining it with concrete, brickwork, and other materials; but it appears to us such a combination would be still more advantageous if the iron were completely imbedded or encased in such materials.

It appears that there are some substances particularly bad conductors of heat; such are brick earth, composed of a variety of bodies, and porous: porcelain, asbestos, pumicestone, charcoal, sand, etc. These substances are, in fact, such bad conductors that a red hot iron ball may be held some time in the hand if it be first coated with one of them. Such materials offer themselves as coverings for iron girders, columns, etc., and we do not see why compound materials of a porous kind, as animal charcoal and plaster, should not be applied to such iron work *in situ* by first filleting the girder or column, or surrounding it with a perforated plating of thin earthenware or metal on which to lay the coating, which could be run as molded work or finished ornamentally. A lining or casing of such materials, molded to the form of the iron to be protected, could also easily be prepared in cast blocks, rebated or grooved together, the external facing being molded to any section.

Animal charcoal should be one of the ingredients in the compound used, as it is one of the worst known conductors. Fire clay lumps could be well treated in this manner, or plastering—which materials have been suggested lately by recent English experiments which proved that iron protected with fire clay can withstand a fierce heat and yet remain uninjured in its elasticity, while the brick arching and concrete backing can resist any amount of heat likely to occur. We think, if an air space were left between such casing and the iron, it would provide a still more effectual barrier, though a few perforations would be required in the casing to allow the heated and expanded air to escape. If, also, brick earth mixed with charcoal were used, a still more effectual nonconducting casing would be obtained, and the iron would be comparatively preserved at a moderate temperature. By thus encasing a good conductor of heat in a bad one, the evils of expansion and contraction are avoided, or considerably lessened, and we are thus left the advantage of using in our construction a material which may aptly be called a "good servant but a bad master."

A FOUR-ANTLERED DEER'S HEAD.

The *American Sportsman* publishes a description of a remarkable specimen of the deer (*cervus Virginianus*), the head of which carries four antlers, three on one side and one on the other. The editor of our contemporary gave the head a critical examination, and found that the antlers are located in their natural positions, having a total number of twenty-one tines—eight on one side and thirteen on the other. To the casual observer, no deformity at the base of either is perceptible, although a minute examination and strict measurement would reveal a slight variation in diameter at the extreme base. If there is any enlargement, however, it is indicated, if not visibly shown, above the burr.

The enlargement, if any exists, is so slight as only to be detected by the most skilled eye. At this point of the pedicel there appear to branch out three distinct antlers with tines. One very remarkable feature, as will be noticed in the engraving, is the fact that on either side of the head there projects from the burr a small tine, the one on the left resembling in size and shape a large tooth. On the right side can be seen, between the burr and the brow antler proper, an additional tine.

The engraving very faithfully represents a significant fact in connection with these horns, namely: the extreme points of the brow antlers curve naturally toward each other, while in other species they are quite erect.

TO AVOID explosions with hydrogen generators, adapt a safety jet made of disks of wire gauze placed in the delivery tube between plugs of cotton wool.

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