SIR G. AIRY'S AUTOMATON TRANSIT OF VENUS.

The Astronomer Royal has recently designed and constructed a working model to show the phenomena of the transit of Venus, of a peculiarly complete and simple character, which we show on page 227. A few words only are necessary to enable any of our readers to appreciate its object and scope. A transit of Venus occurs only twice in about 120 years; the importance of observing this phenomenon we propose to discuss in a future article. In the meantime we would merely point out that the feature to note is the exact instant at which the edges or limbs of Venus and the sun are in contact during the passage of the former across the disc of the latter.

Very great difficulties have been found on the occasion of previous transits in obtaining reliable observations, owing to the peculiar optical effects accompanying the phenomenon and the consequent difficulties in ensuring the observation of the same particular phase in the transit by all observers, as well as the doubt arising from the exact effect of the peculiarities of each telescope and each observer. So great indeed have been these difficulties, that the observations of the transits that have hitherto taken place—observations made at great trouble and expense—have been found of very doubtful value. It is, therefore, most important that uniformity in habit of observation should be acquired by all the officers and others leaving England to observe the transit of Venus in 1874 To this end systematic practice of some kind is clearly desirable. How is this to be obtained with a phenomenon occurring only twice in 120 years? Careful observations of the transits of Jupiter's satellites have been recommended, but Sir G. Airy has met the difficulty by a device which appears to give a singularly close copy of the transit of Venus, and on which observers may try their powers to their heart's content. Before giving a description however, it is well to understand the difficulty to be dealt with in the observation of a transit of Venus. Fig. 1 represents the sun with Venus coming on to it about the moment of internal contact. There is a ligament connecting the black disc of Venus with the sky at the point of contact. This ligament is the main cause of the trouble. It is nearly, if not always seen, and is explained in the following way:—

Any brilliant object dazzles the eye, and by irradiation appears to be larger than it really is; thus, in Figs 1 and 2, we suppose the real size of the sun to be indicated by the dotted line, while the apparent disc is the size of the larger circle. So again Venus should be seen the size of the small dotted circle, but the sun so far encroaches on her that she only appears to be the size of the black disc whenever her edge is seen against the sun. But up to the moment that the entire edge of Venus enters within that of the sun the light cannot encroach at the part that as yet is not projected against the sun but only against the sky. Consequently, the limb of Venus that last enters on the sun's disc is for a time seen its full size, and the light, as the limb of the sun concealed by it, can neither encroach on the sky or on Venus. In short, at this point the edges of Venus and the sun are those shown by the dotted circles, and thus the black sky and black disc of Venus meet where the circles *s s* and *v v* meet, and thus the ligament is formed. It has been supposed that directly Venus enters within the sun's disc, as shown in Fig. 2, the light rushes in and encroachment takes place. Supposing this to occur immediately after internal contact, it is clear that when understood the peculiarity of the phenomenon would greatly facilitate its being accurately observed and recorded It is clearly necessary, however, to ascertain the truth of this supposition.

Fig. 3 shows the apparatus designed by Sir G. Airy to represent the transit of Venus, at which the officers and other observers now practise. A glass slide A A, with a black disc (to represent Venus) fixed on it, is drawn by clockwork across the opening S1, S2, cut in a screen. The curves S1, and S2, correspond to the limbs of the sun at the moments of ingress and egress. By means of the looking-glass D, the reflected beams of the sun are thrown through the opening S1, S2, and the result is that the phenomena of encroachment of light and the ligament, or "black drop," is seen as in an actual transit. The rate of motion and size of Venus are calculated so as to give the same apparent dimensions and movement when seen on the main building by observers on the top of the magnetic buildings in the Royal Observatory, Greenwich, as those of Venus at the expected transit. The limbs of the sun are brought together and make an arch, in order to give ingress and egress without unnecessary loss of time. We have said that our observers are practising daily at this model, and it may be expected that their personal equations and the effects of peculiarities in telescopes will be clearly established We may add that some rather unexpected facts have come out, which seem to indicate that a modification of the generally received explanation of the behaviour of the black drop, which we have given above, may be necessary For example, it is found that with a smaller telescope Venus is seen to leave the limb and enter within the sun's disc later, and come in contact again at egress earlier, than with a larger glass. Then, again, it is found that with a brilliant blaze of sunlight a ligament is seen in a position when with a faint light it would have disappeared *This is rather contrary to the generally received ideas.* It is premature, however, to say much now. A few weeks' work may establish very valuable results.—*The Engineer.*

LAKE SUPERIOR IRON MINES.

An occasional correspondent of the *New York Tribune* says that the iron interest controls all the capital, thought, and energy of Marquette, Michigan, and is the great industry of the district. Fifteen years ago the first ton of ore was taken out of the Marquette hills and sent to Detroit to be made into pig-iron; the report was that it was too soft, and therefore unfit for use. Now the mines of Marquette produce nearly one-quarter of all the iron ore mined in the United States, or 1,200,000 tons per year. It is expected that the production this year will equal 1,500,000 tons. The ores in this section are classed in order and quality as the magnetic, the specular, and the hæmatite. The two former varieties are found in immense quantities, will yield from 67 to 70 per cent. of pure iron, and can be hammered into shape almost without being reduced by heat to pig-iron, these ores are now found to be indispensable for mixing with the "cold short" ores of Pennsylvania, Ohio and other points in the West. For this reason they will always be in demand. In quality, the iron ore of Missouri, particularly that of the Iron Mountain near St Louis, resembles the specular ores of Marquette, but they yield only some 60 to 63 per cent pure iron, and are accordingly of less value. The iron ores of Tennessee, to which the attention of the iron manufacturers of the West was recently turned, have been found to be of the "cold short" variety, and although found in immense deposits, cannot be successfully used for pig-iron without mixing with the ores of Lake Superior, which are all "red short" ores, and do not become brittle when cold. Immense quantities of the Marquette ore are shipped regularly to Pittsburgh, Cleveland, Chicago, Detroit, and elsewhere in the West. The Pittsburg furnaces are universally using these ores, and cannot compete in quality with imported iron without them. Pittsburg manufacturers are also largely interested in the mines in this section, and their capital is always ready for the development of any new enterprise in mining here which possesses proper qualifications for success

Marquette enjoys a remarkably favourable situation, for it can ship its ores by water at small cost to nearly all the great iron manufacturing centres of the West; for this reason it must for ever enjoy a position in iron mining scarcely rivalled by that of any locality in the West. The attention of England's manufacturers is also turned in this direction, and a recent shipment of 3,000 tons of pig-iron to Montreal, destined finally for England, [?] will show to what extent the exportation of these ores may be carried on. Although Marquette has confined its efforts almost entirely to the mining of ore, a blast furnace and a rolling mill are now in successful operation For the manufacture of pig-iron it enjoys some advantages, for coal can be laid down here much cheaper than at Detroit The vessels employed in taking the iron ore down the lakes are satisfied to take a return cargo of coal even as ballast, or for the nominal charge of 75 cents. per ton. There are immense fields or bogs of peat in this district, and much attention has been given towards its fit preparation as a substitute for coal in the manufacture of pig-iron and for charcoal steel. Some samples of steel made by the use of peat were recently submitted to the inspection of steel manufacturers in Pittsburg, who reported that in quality and texture they were fully equal to any steel made with charcoal This fact is of great importance, and may tend to a revolution in the present process of manufacture. For making Bessemer steel no ores have