

herited the peculiar position of its flowers from the ancestors of the family of Orchids, which undoubtedly, like the most nearly allied families, possessed an untwisted ovary, and the imperfectly twisted condition of the ovaries of some individuals of *G. odoratissima* may be looked at as an effect of atavism.

Nigritella differs from *Gymnadenia odoratissima* in the position of its flowers, and in being fertilised in the daytime. Whilst the latter seems to be fertilised especially by crepuscular and nocturnal Lepidoptera, the former, on the contrary, is easily seen to be fertilised by diurnal butterflies. In contrast to the pale flowers of *G. odoratissima*, those of Nigritella are of a dark purple red colour, shining magnificently in the sunlight, whilst at the same time they exhale so remarkable a vanilla-like odour that I have more than once recognised this species sooner by smell than by sight. I have never met with any other flower which attracts diurnal Lepidoptera more efficaciously than this. When descending from the pass of Fluella, towards Zernetz (July 9), during about an hour I collected in a small locality the following species, having observed them all fertilising the flowers of Nigritellas. (a) Rhopalocera: (1) *Lycæna semiargus* Rott., frequently; (2) *Melitæa Athalia* Rott.; (3) *Argynnis Euphrosyne* L.; (4) *Hesperia serratula* Ramb. var.? (b) Sphingidæ: (5) *Ino statives* L., Alpine varieties, in great number. (c) Noctuæ: (6) *Agrotis ocellina* W. V., several specimens; (7) *Prothymia ænea* W. V. (d) Crambina: (8) *Botys arealis* Hb., var. *opacalis* H.; (9) *Diasemia litterata* Scop., in great number; (10) *Crambus dunetellus* H. var., very frequently. (e) Tineina: (11) *Bupalis* species.* In the subnival region round "Quarta Cantoniera," besides Nos. 3 and 5, I observed (12) *Melitæa Parthenie* Bkh., var. *varia*; (13) *Zygæna exulans* Reiner, both not only perseveringly seeking for the honey of Nigritella in the sunshine, but also lodging after sunset in the heads of their favourite flower, from which in the evening and morning numerous individuals could easily be taken off which had been killed or benumbed by the cold.

HERMANN MÜLLER

THE TRANSIT OF VENUS

DURING the past week a few additional telegrams have appeared in the *Times*; these, with the *Times'* notes upon them, in a condensed form, we give here.

From the Hague we learn that the Government has received advices from the Dutch expedition sent to Réunion for observing the Transit of Venus. The sky being cloudy, the expedition was only partially successful.

The Astronomer Royal has received the following telegram from the Sandwich Islands:—

"Transit of Venus well observed at Honolulu and Atooi; cloudy at Owhyhee. Sixty photographs; Janssen failed; internal contact uncertain several seconds; complete disc of Venus seen twelve minutes before; 120 micrometer measures."

From New Zealand intelligence has been received that the observation of the Transit of Venus made by the British astronomical party at Honolulu has been successful, except as regards the photographs, which failed.

It will be seen that the bad news for the English plans from New Zealand is fortunately not followed up from the Sandwich Islands. There the ingress, at one end of a base line stretching to Kerguelen's Land, has been secured, and if the observations have been successful at the latter place, Delisle's method can be applied for the ingress.

The telegram from New York is enough to give rise to some uneasiness. The first telegram stated that the Transit was well observed at Honolulu and Atooi, while there were clouds at Owhyhee; and then followed

* For all the names I am indebted to Dr. Speyer, of Rhodou.

some statements which might have applied either to Owhyhee solely or to the whole attempt. From the last telegram we learn that the photographs failed at Honolulu, where in the telegram to the Astronomer Royal it was stated that the Transit had been well observed. There is, therefore, a distinct strengthening of the idea that the remarks "Janssen failed," "internal contact uncertain several seconds," apply to all the stations. We sincerely trust this may not be so, for the whole value, to the English plans, of the occupation of Kerguelen's Land is that observations of ingress may be made there to correspond with those made in the Sandwich Islands,—the ingress being accelerated in these latter and retarded at Kerguelen. A long experience with transits of Mercury and solar eclipses has now convinced astronomers that corresponding observations mean observations made by similar instruments under similar conditions. For instance, it will be useless to compare an eye observation of a contact made at the Sandwich Islands with photographs of the contact made by Janssen's beautiful contrivance at Kerguelen, whence we are not afraid of hearing that "Janssen failed," for Father Perry, in whose charge the revolving apparatus is, is one of the very few men long practised with astronomical instruments who form part of the English staff.

Lord Lindsay telegraphs to Lady Lindsay from the Mauritius:—

"Transit observed; last half satisfactory. Good photographs, measures, and time determination. Altogether well satisfied."

The private expedition of Lord Lindsay to the Mauritius deserved to succeed. We regret that the degree of success obtained is not so high as that which Lord Lindsay's energy, skill, and care had merited. Had observations been secured here and at Réunion at the commencement of the Transit, both Mauritius and Réunion would have been Delislean stations for observations of ingress—almost, indeed, as good as Kerguelen's Land, where it is to be hoped the official astronomers have obtained observations to pair with those made at the Sandwich Islands. But, as Lord Lindsay saw nothing of the beginning (ingress), and as the sky was cloudy at Réunion, the parties at Kerguelen's Land are now the only hope of the Delisleans, and this makes one regret all the more that the Americans were foiled in their attempt to occupy the Crozets. But Lord Lindsay's hopeful telegram evidently means that he has obtained enough photographs and measures to employ with advantage the direct and heliometric methods of determining the least distance of centres; these methods being precisely those which the German parties, also in the Mauritius, were to employ, obtaining corresponding observations at Chefoo, in the north of China.

The *Times* Malta correspondent writes under date Valetta, Dec. 15:—"The Transit of Venus was distinctly witnessed at Malta on the 9th inst. The external egress of the planet from the sun occurred precisely at 7.26 A.M. local mean time."

"Melbourne, Dec. 29.—Intelligence from New Zealand announces that the American astronomer, Prof. Peters, was successful in his observation of the Transit of Venus. The German expedition to the Auckland Isles also achieved satisfactory results."

THE SPECTROSCOPE AND THE TRANSIT OF VENUS

A RECENT article in the *Times* (Dec. 24) speaks of the application of the spectroscope to the observations of transits; it is so much to the point that we reproduce a portion of it here:—

The news from Malta which we gave yesterday of the unhoped-for observation of external egress there under

good conditions, coupled with the further information which we published on Tuesday, detailing the care taken at Jassy to insure the accuracy of the observation of external contact at egress by Doctors Weiss and Oppolzer, furnishes a good opportunity of referring to the whole question of such contacts, and of pointing out an almost general omission in the scheme of observations.

A few general considerations will show how, in the opinion of some competent judges at all events, there is a remedy for such a state of uncertainty as we have described in the case of external contacts. We have first the essential consideration which underlies the various methods of utilising a transit, that when Venus is as near to us as she is on the occasion of a transit—Venus, of course, is always nearest to us when she is between us and the sun—unless she be exactly between us and the sun, so that we can use the sun as a screen or background, and see Venus moving like a black spot upon it, she will not be visible to us at all, as her bright side will be turned away from us. To point this statement we may remark that this is not the case with Mars, the path of which planet lies outside ours. Mars, in fact, is brightest and best visible when nearest to us, and his distance has been measured, as astronomers have just measured the distance of Venus, by using the longest possible base line on the earth and determining the apparent change of place of Mars among the stars as seen from the opposite points, thus using the stars as a background. The processes, it is true, are different in their details, but the same in intention. The special observations of ingress, egress, nearest approach to sun's centre, and the like, in the case of Venus, arise out of the fact that the only available screen is a limited one and of a certain shape, and, it may be said, are so many contrivances which enable us to use the centre of the sun's disc, as we use a star in the observations of Mars. In either case, of course, whether we determine the distance between the earth and Mars or the earth and Venus, we determine the distance of the sun and the dimensions of the whole solar system.

Now, within the last few years it has been established that the sun, with its sensibly circular boundary which we see every day—the screen which we use in the case of transits of Venus—is by no means the whole of the sun; it is only the central brighter portion of it. An exterior nebulous mass, feebly luminous compared with the central one, lies outside it, and in consequence of its feeble light it is quite invisible to us, except during total eclipses of the sun, when the moon cuts off the brighter light of the central portion, and allows us to see the exterior, irregularly-bounded one, extending for hundreds of thousands of miles away into space in all directions.

Although, as we have said, this exterior portion cannot be seen, except during eclipses, in consequence of the strong illumination of our atmosphere near the sun's place, the lower brighter parts of it can yet be rendered visible without an eclipse by the use of a spectroscope, and it is no exaggeration to say that by the aid of this instrument a large part of the sun outside that part of it ordinarily visible can be seen as sharply and as conveniently as any part of the sun's surface can be observed by a telescope.

The method by which this is accomplished will be easily understood by anyone who will take the trouble to look at the flame of a candle, the wick of which has been almost covered with common salt, through one of those "drops," triangular in section, which form part generally of a common lustre or a chandelier. A small prism will, of course, be better still. If the "drop" or prism be held close to the eye and upright, some four or five yards from the candle, at such an angle that the flame can be seen through it, a perfect yellow image of the wick and flame will be seen. Besides this image there will be a blaze of

colour to the right and left of it, but the yellow image of the flame will be brighter than the rest.

Now, common salt is a compound of sodium with chlorine, which compound is decomposed by heat; and it is the vapour of the metal sodium set free which gives us, at the heat of the candle flame, light of one colour only, which cannot be dispersed or split up by the prism. The flame of the candle, on the other hand, gives out white light, which, being composed of light of all colours, is split up by the prism; so, while the prism has no action on the one, it has an enormous action on the other, and as a result gives us a perfect image of the flame, built up by the simple light of sodium vapour, brighter than the spectrum of the flame itself in that region. Further, the white light of the candle gives us no clear image, because in fact there are millions of images of every tint superposed; so that we get but a confused rainbow effect, due to the white light. The exquisite sodium image of the flame is due to the fact that there is no overlapping; and again, the reason that the addition of the salt to the flame, while it scarcely increases the light of the candle, gives us a spectral yellow image brighter than the background, is easily explained by the fact that in this part of the spectrum, as the coloured band is called, the sodium light is helping the yellow light of the flame, which gets no such help in other parts of the spectrum.

Now, we know as a matter of fact that the exterior regions of the sun give a spectrum similar in character to that given by the sodium vapour in the candle flame, and that the sun itself gives us a spectrum similar to that of the ordinary flame of the candle, and that it is because our air is illuminated by light of this kind stronger than the light of the external part of it that it is invisible to us.

To see, then, the external regions of the sun to which we have referred, the physicist looks at them through a prism, as in the candle experiment; in fact, he uses many prisms to spread out to the utmost the sun-light reflected to us by our intervening atmosphere, which sunlight, as we have seen, has a spectrum similar in its nature to the spectrum of a candle flame. When he has done this he sees the images of the strange forms in these external regions, as the yellow image of the candle was seen, the light producing which was concealed by the brighter light of the flame till the prism was brought into play. Of course, he knows now exactly in what part of the spectrum the light which they give out is to be found. He knows that all round the sun there is an atmosphere of vividly bright hydrogen, the light of which is red; he therefore looks in the red part of the spectrum, and the atmospheric veil being withdrawn by the prism in the way we have stated, he is enabled to trace by the red light given out by the hydrogen exactly what the hydrogen is doing, and where it exactly is. He knows that magnesium is sometimes ejected from the sun with terrific force into this sea of hydrogen, and he knows that the light of magnesium vapour is green, so he examines the green part of the spectrum and so observes the exact size and shape of these volcanic bursts of magnesium vapour.

We then come to the point of this long digression. When we bring the spectroscope into play the sun is made larger; outside the round disc there is discovered a continuous envelope extending to various heights, which we can observe. Our screen, therefore, is increased, and exterior contacts are exterior contacts no longer, if we can manage to see Venus passing over the newly-discovered region before she reaches the disc.

How, then, can this be accomplished? There are three ways in which this can be accomplished. We have first that ordinarily employed in observations of the chromosphere—as the newly-discovered region which surrounds the sun and can be spectroscopically observed without an eclipse is called. We have next a method devised by

Father Secchi; and still a third, independently lit on by several investigators.

In the method ordinarily employed, in order to avoid as much as possible the overlapping of images of sensible breadth (which prevented the white light of the candle flame from giving us even a distant approach to a pure spectrum), the light is allowed to fall on the prism through a very fine slit of a certain height. On this slit an image of the sun is thrown by a fine telescope. If the whole length of the slit is immersed, so to speak, in this image, we shall see nothing but the spectrum of the part of the disc which falls on the slit. If it is only half immersed in it, we shall see less of the spectrum of the disc, but we shall see also the spectrum of the chromosphere, as the obliterating effect of the reflection of the sunlight by our air has been destroyed by the prisms.

This spectrum will consist of bright lines, and if we can manage to place the slit on the precise spot occupied by Venus the lines will be broken, as the chromosphere will be eclipsed in this part by the planet; and we can follow the planet's motion until the break in the line travels down to the spectrum of the sun; this will mark the instant of exterior contact at ingress. At egress the problem is simpler, as the actual place occupied by the planet prior to external contact can be seen by an observer set to watch the sun's image on the slit of the spectroscope.

An obvious objection to this method, if a better one can be found, lies in the fact that Venus has, as it were, to be "fished for" prior to external contact at ingress, and that the slightest error in following the planet's motion would render the mode of observation useless.

The next method is one devised by Father Secchi. Using a spectroscope as before, instead of throwing a simple image on the slit, by an object-glass merely, he throws a spectrum of the sun on the slit by means of prisms, placed either before the object-glass or between it and the slit. He states that by this method the solar disc is seen with its spots and edge quite clearly defined, and that the spectral lines of the chromosphere are also seen. Further, the slit can be opened wider with advantage than under the first method. It is clear, therefore, that when Secchi's method is employed, if it does all that he says it does, observations of exterior contact would be easy.

The third method is a photographic one, and if it succeeds at all would do away with the main objection to the first two. A reference to the candle experiment will make it quite clear. If we imagine for a moment the white light of the ordinary flame of the candle to be abolished, it is clear that we should see nothing but the pure yellow image due to the monochromatic vapour of sodium. Similarly, if we imagine the light of the sun abolished, we should see the whole ring of the chromosphere if we looked at it through a simple prism, *as a ring*, or as a series of rings, according to the kinds of light given out by the vapour of which it is composed (the rings taking the place of the lines when we use a slit). In this way the chromosphere and the coronal atmosphere which lies outside it were actually seen in their true ring-like form by Prof. Respighi and Mr. Lockyer in the Indian eclipse of 1871, the light of the sun being temporarily abolished by the interposition of the moon.

In the third method, then, instead of a slit, a disc is used. All the sun is thus hidden, with the exception of a very small ring at the extreme edge, underlying the chromosphere. It is certain that the whole ring of chromosphere can thus be photographed every day the sun shines, as it is now observed on every such day by Mr. Seabroke at the Temple Observatory at Rugby School; and it is believed that the lower surface of the chromosphere can be thus photographed as *hard* as the outline of the sun itself, for there are many favouring conditions which, however, it would take us too long to enter upon in this place.

It is clear that by the application of this method there is a possibility of obtaining a whole series of photographs both before and after Venus is seen on the sun, and it is also clear that the method can only be tested on the occasion of a transit.

We know that Lord Lindsay's expedition, which has been organised with a completeness which puts our official programme into the shade, is to test Secchi's method, and that Dr. Janssen was to use some spectroscopic combination. The Italian parties, as we have already mentioned, were to limit themselves to external contacts as observed by the spectroscope, but their Government subsidy came so late that it is certain they were not equipped in the most complete manner, and it is probable that their original programme has been considerably curtailed.

Although the spectroscope forms no part of the equipment of the English parties, as it certainly should have done, seeing that they intended to observe contacts more than anything else, we may still hope that some of the methods will have been tested, and that the value of the aid they bring to observations of external contact may be determined.

NOTES

THE Belgian Academy of Sciences have conferred upon Prof. Huxley, Sec. R. S., the dignity of Foreign Associate. Such a step on the part of so very Catholic a body may make amends for the anathemas of the Irish prelates.

WE are glad to be able to contradict a statement which has appeared in some of the papers that Prof. Bunsen was about to leave Heidelberg. He has, we learn, no intention of doing so. The loss of Professors Kirchhoff and Königsberger is one which this University will feel most severely, and we cannot help wondering what the authorities at Carlsruhe were about to render it possible for two such men to be tempted away. Prof. Kirchhoff has declined the directorship of the Solar Observatory at Potsdam, and goes to Berlin as free Academician and as Professor in the University; Prof. Königsberger has accepted the post of Professor at the large Polytechnic School in Dresden.

THE scientific results to be obtained from Arctic exploration will be carefully attended to in making the arrangements for the forthcoming Arctic expedition. Each officer will take up a special branch of scientific investigation, and will devote himself, during the interval between his appointment and the sailing of the expedition, to acquiring such knowledge as will enable him to exert his energies most usefully. There will also be a civilian naturalist or geologist in each ship, who will be carefully selected with reference to special knowledge and other qualifications. It is possible also that an Engineer officer may accompany the expedition, with charge of magnetic and pendulum observations. Some of the men forming the ships' companies will also be selected for their special qualifications. Among these, a dog-driver, named Karl Petersen, formerly cooper at the Danish settlement of Upernavik, has already been entered. There will also be three ice quarter-masters in each ship, chosen from the crews of the whalers, and one of the first duties of Capt. Markham on his arrival in England will be to proceed to Dundee for the purpose of selecting and entering these men. Capt. Markham was telegraphed for to Lisbon on the 20th, and is expected to arrive in London this week.

LIEUT. BELLOT, brother of the unfortunate Bellot, the Arctic explorer, to whom we alluded in a recent number, has obtained leave from the French Government to volunteer for the English Arctic Expedition.

ON Dec. 11, at 4.45 A.M., a severe shock of earthquake was felt by Gen. Wansouty and two friends, who intended to spend