THE TRANSIT OF VENUS.
From Our Own Correspondent.
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PREPARATIONS MADE FOR ITS OBSERVATION.

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WASHINGTON, Monday, May 18, 1874.

The transit of Venus is a very rare phenomenon. The transits occur in pairs eight years apart. The pairs are separated from each other by a period of 112 years. For example, the transit that happens this year will be followed in eight years by another, and that in 112 years by another, and then in eight years more by another, and so on. There is another singular thing about it, both transits of a pair happen either in June or December, and that alternately. Occasionally it will happen that one transit of a pair will take place almost exactly over the sun's centre, and in that case the next transit of the pair, which otherwise would occur eight years later, will be omitted altogether, as the planet will pass just below or just above the sun's disc.

Until very recently the transit of Venus has been considered the best means of getting the sun's distance from the earth, and, perhaps, the only means. For that reason, and also on account of the extreme rarity of the phenomenon, they have attracted great attention from astronomers. Now other methods of getting the sun's distance are known, but whether they will prove as accurate as the transits of Venus is a question as to which there is considerable difference of opinion among astronomers. One of these methods, depending upon the perturbations of planets in the course of some hundred years, will undoubtedly give a more accurate value of the sun's distance than can be obtained in any other way. But as the present generation cannot wait long enough for that method to be applied, they are compelled to resort to direct observations.

Until within the last ten years the result obtained by Encke, from observations made at the last transit, has been accepted as the true distance between the earth and the sun. This result was 95,000,000 of miles. Latterly, however, other methods of observation have been discovered and employed, and they all tend to show that this distance is too great by three and a half or four millions of miles, and that the true distance is about 92,000,000 of miles. This latter result is now generally accepted by astronomers. It is liable to a large uncertainty, and it is hoped that the observations on the coming transit will give a result whose probable error will not be more than 500,000 miles. This term "probable error" is a technical expression in general use by astronomers and mathematicians, and is the allowance made for the degree of inaccuracy in their observations. When they say, for instance, that the probable error in the result that makes the sun's distance 92,000,000 is within 500,000 miles, they mean that it is an even thing that the actual difference is either greater or less than 92,000,000 of miles by the amount of that error.

To form an idea of the difficulties to be encountered in determining the distance of the sun within that limit, suppose a human hair to be set up at a distance of half a mile from the observer, and that the true line of sight passed on the right-hand side of that hair. Now, if by any mischance the observer should observe the left-hand side of the hair instead of the right, that error in calculating the sun's distance would make a difference of about a million of miles. Consequently, to obtain the true distance of the sun within a half million of miles it is necessary to determine the true line of sight within the breadth of a hair viewed at the distance of a mile. In view of these and many other facts the importance of the coming transit is evident, and all nations of the civilized world have taken measures to observe it. By good fortune none are more thoroughly prepared for the work than the Government of the United States.

About three years ago Rear Admiral Benjamin F. Sands, at that time Superintendent of the Naval Observatory, took the initiatory steps to bring the matter to the attention of Congress. Through his exertions, aided by the Secretary of the Navy, an appropriation of $3,000 was obtained for the purpose of determining upon the best form of apparatus to be employed in the observations. While this measure was pending in Congress it was suggested to the Navy Department that, instead of making the affair exclusively a naval one, it would be well to give it a more national character. For that object Congress provided that the money thus appropriated, together with all future appropriations, should be expended under the direction of a board composed of the Superintendent of the Naval Observatory, the Superintendent of the Coast Survey, the President of the National Academy of Sciences, and the two Professors of Mathematics attached to the Naval Observatory. In accordance with this act the board, as originally constituted, consisted of Rear Admiral Sands, Superintendent of the Naval Observatory; Prof. Benjamin Peirce, Superintendent of the Coast Survey; Prof. Joseph Henry, President of the National Academy of Sciences; Prof. Simon Newcomb and Prof. William Harkness, the two last-mentioned being the Professors of Mathematics at the Observatory. Last month, in accordance with the laws of Congress, Admiral Sands was retired on account of age and long service. Prof. Peirce also recently resigned the Superintendency of the Coast Survey. Two changes were thus introduced into the commission; Admiral Davis, the new Superintendent of the Observatory, took the place of Admiral Sands, and Capt. Patterson the place of Prof. Peirce. These are the only changes in the commission, which otherwise remains as it was originally organized.

After full consideration of the subject, this board decided that the United States should send out at least eight parties to observe the transit, each party to be equipped with the means of making both eye and photographic observations. As these parties would go to countries rarely visited by scientific observers, it was also deemed desirable that they should be provided with the means of making as many physical observations as possible. This plan was laid before Congress two years ago. Among the incidental advantages which it presented was that of fixing accurately the latitudes and longitudes of many important points in the western hemisphere, a practical service to navigation of the greatest possible consequence. Besides, the geographical position of many of the most important cities in the Indian Ocean are at present but very inaccurately determined. Assistant Secretary of the Treasury Sawyer, then a Senator, took the deepest interest in the subject, and it was very largely due to his exertions that the bill appropriating $50,000 for the purchase of instruments was passed. The commission forthwith made the necessary plans, and the instruments were contracted for. Their construction has been in progress ever since. They were all completed during the last Winter and present Spring.

The Winter following the board reported what progress had been made to the Secretary of the Navy, and in accordance with his urgent recommendation $100,000 was appropriated to complete the remaining preparations of the commission and pay for the expenses of the observations. Thus provided for the commission proceeded to make detailed plans for the organization of the parties. They decided that all the stations and all the parties should be fitted out in exactly the same manner, and consequently a description of one is a description of all. Each party is to consist of five persons; an astronomer, commanding; an assistant astronomer, second in command; a principal photographer, and two assistant photographers.

The instruments with which they are to be furnished are as follows: A telescope, having an object-glass of five inches aperture, and seventy inches focus, equatorially mounted, provided with a driving clock, the whole so arranged as to be adjustible to any latitude in either the northern or southern hemisphere; a portable meridian instrument, (for determining both time and latitude,) having an object-glass two and a half inches aperture, and thirty inches focus; an astronomical clock; two chronometers, and a chronograph. There is also included a complete set of photographic apparatus, arranged according to Prof. Winlock's plan—that is, a telescope, five inches aperture, and forty feet in length, lying horizontally in a north and south direction, the image of the sun being reflected into it by means of a mirror. Besides, there are a number of small instruments, such as levels, a theodolite, magnetic apparatus, tools, and general camp equipage of every variety.

For convenient use in the field, three portable observatories will be sent with each party. One is for the equatorial telescope, one for the meridian instrument, and the third for the photographic apparatus. These houses have all been constructed in Washington, and are now erected on the grounds of the Naval Observatory, forming a curious and interesting village. This has been done to try the apparatus, and everything has been set up and thoroughly tested. The photographers have been educated for their work by photographing an artificial transit arranged for the purpose.

All the astronomical and physical instruments and portable observatories have been designed by Prof. Harkness and constructed under his supervision. The photographic apparatus has been designed by Prof. Newcomb. It should be mentioned, however, that great aid has been given in the photographic arrangements by Mr. L. E. Walker, photographer of the Treasury Department, and latterly by Prof. Henry Draper, of New-York.

The transit happens on the 8th day of December. It will last about four and a half hours. Of course, it will be visible from all places where the sun is above the horizon during that time. At the beginning of the transit the sun is just setting at a point a few hundred miles west of our Pacific coast. At the end of the transit it has just risen in British India and Russian Siberia. Consequently the most favorable places for observing the transit are on the opposite side of the earth from the United States. In selecting stations the commission has given much attention to the weather that is likely to prevail at that season of the year in the different positions from which the transit can be seen. They have found it so much more favorable in the northern than in the southern hemisphere that they have decided to make three stations in the former and five in the latter, in order to equalize the chances of getting observations in both hemispheres.

In connection with the discussion of the present transit, a good deal has been said about the comparative merits of Delisle's and Halley's methods of observing; but the American Commission has paid very little attention to this dispute, because they intend to rest their observations chiefly on photography. An observer in the northern hemisphere will see the planet cross the sun's face somewhat nearer the centre than an observer in the southern hemisphere. Each party will take about one photograph per minute, if the weather is clear. By combining all the photographs taken at any one place, it will be possible to trace the exact path of Venus over the sun's disk, as seen from that place. Then, by comparing the track pursued by Venus as seen from northern stations, with that track as seen from southern stations, all data necessary for determining the sun's distance will be obtained. The principle on which the computations are made is very abstruse and difficult, and not exactly explainable except to a person having some knowledge of the higher branches of mathematics. In addition to the photographic observations, as much care will be given to making observations of contacts as though this were the only method employed, and the results depended entirely upon it.

After the transit is over, all the parties will hand in their reports to the commission, and these reports, together with careful descriptions of all the apparatus used, will be published. The commission will probably make a preliminary discussion of the observations, and determine the distance of the sun from American observations alone. This, however, cannot be considered a definitive solution of the question. Before the question can be considered finished it will be necessary to combine the discussions and observations made by all parties of all nations who may be so fortunate as to see the transit. This work will probably require two years at least.

The Swatara, which will take all the southern parties to their stations, will leave New-York about the 1st of June. As the commission has been delayed, and will be somewhat pressed for time, the vessel will probably sail directly from New-York for the Cape of Good Hope, without making land before reaching that point. She will remain a short time at the Cape of Good Hope, to compare chronometers at the Royal Observatory situated there. At the same place a store of provisions will be laid in, and, above all things, a large number of hens will be taken on board, and upon their good conduct the success of two or three of the parties will greatly depend. For, at Crozet, and Kerguelen Islands, there will be no way, so far as is now known, for procuring eggs to albuminize the photographic plates than through the good offices of the Cape of Good Hope hens.

From the cape the Swatara will sail to the Crozet Islands, where there is liable to be considerable delay, because there is no good harbor at all on the islands, and the possibility of landing depends upon the weather. The only landing-place is exposed to easterly winds, and whenever a gale comes up any vessel lying there has to take to sea. The vessel then proceeds to the Kerguelen Islands. Both the Kerguelen and Crozet Islands are uninhabited. The parties left on them will have to stay till the vessel returns. Provisions will be left for them sufficient for a year, in order to insure against any possible accident.

From Kerguelen the vessel goes to Hobart Town, in Tasmania, (or Van Diemen's Land of the old geographies,) where a party will be landed, and another will be left at Bluff Harbor, in New-Zealand; and then the Swatara proceeds to Chatham Island. This island is either uninhabited, or else inhabited by cannibals; it is not definitely known which is the fact. The vessel will remain at this station till after the transit, unless it is found desirable or necessary for her to run back and forth to a German station a few hundred miles further south to compare chronometers and determine longitude with the Germans. After the transit is over the vessel will return and take up the parties at the different stations, and then will, if it is found practicable, be employed to determine telegraphic differences in longitude between such stations as are reached by submarine cables.

The parties for the northern stations will leave here some time in June. They will go to San Francisco, whence they will proceed by Pacific Mail steam-ship to Yokohama, Japan. They will arrive there about the middle of August. The station in Japan has not yet been determined. The Lackawanna will be in waiting at Yokohama for the purpose, and will take two of the parties on board and carry them, one to Ti-an-sin, in China, and the other to Vladivostock, in Russian Siberia; and after the transit the same vessel will bring the parties back to Yokohama, and they will return to the United States by the Pacific Mail Line.