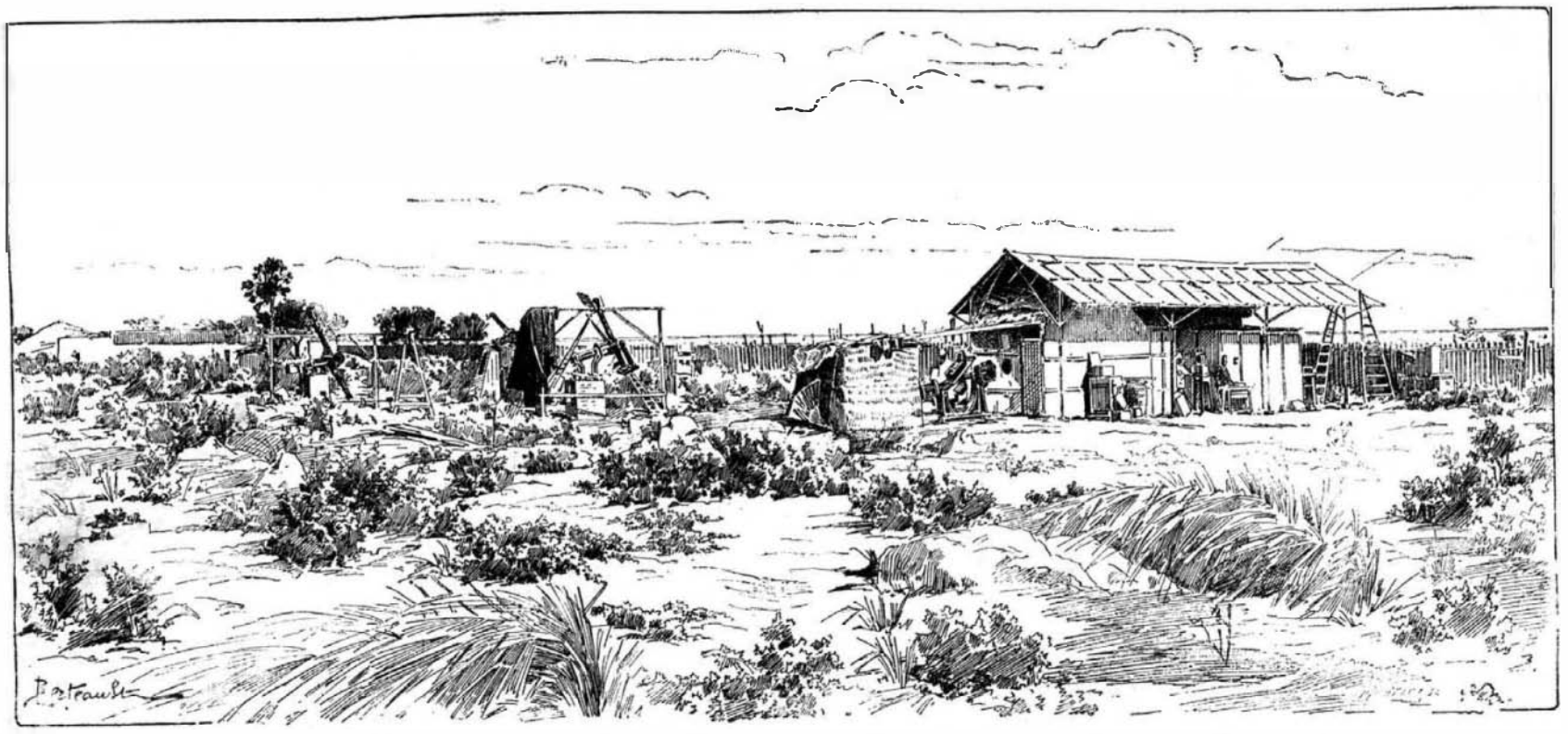
THE TOTAL ECLIPSE OF THE 16TH OF APRIL IN SENEGAL.

Total eclipses of the sun, which, in broad daylight, bring on the darkness of night for a few minutes, are very rare in any given place on the earth, and constitute an extraordinary event for all the beings of creation and even for astronomers. The latter, however, are informed in advance, for the progress of what is called position astronomy permits of determining and predicting the exact positions of the sun and moon, and consequently of obtaining in advance the precise moments and places in which the moon will partially or totally conceal the sun. Such perfect knowledge of the celestial motions is due in great part, it must be said, to the work that has been laboriously pursued for the last fifty years in our great national observatory.

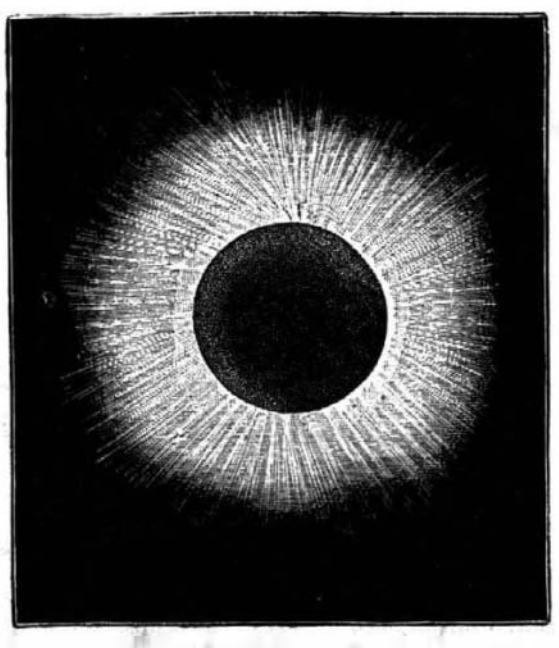
Eclipses are therefore easily predicted at the present time, and, in the very first place, astronomers observe them in order to verify the accuracy of their calculations; but, for such verification, a partial eclipse suffices. Thus, the eclipse of the 16th of last April, which was but partial in western Europe, and in Algeria, was followed with great care at the numerous observatories of these regions.

But when the eclipse is total, and such was the case on the 16th of April in Chile and Brazil and in Senegal, it offers a capital interest to another and entirely new branch of astronomy, which is daily becoming more and more important, and that is physical astronomy. It is, in fact, during the time in which the sun is completely concealed that it is possible to recognize and observe the atmosphere of the sun, in-

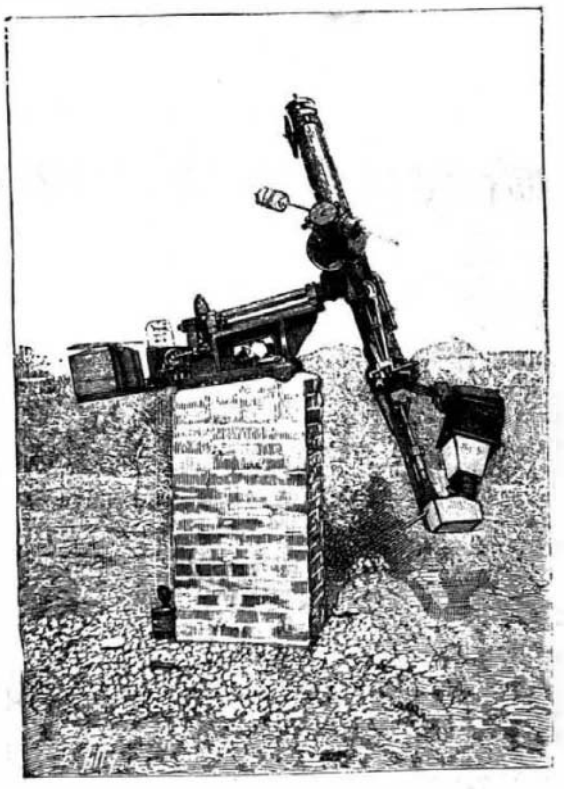


GENERAL VIEW OF THE OBSERVATORY ESTABLISHED AT FOUNDIOUGUE BY THE DESLANDRES MISSION.

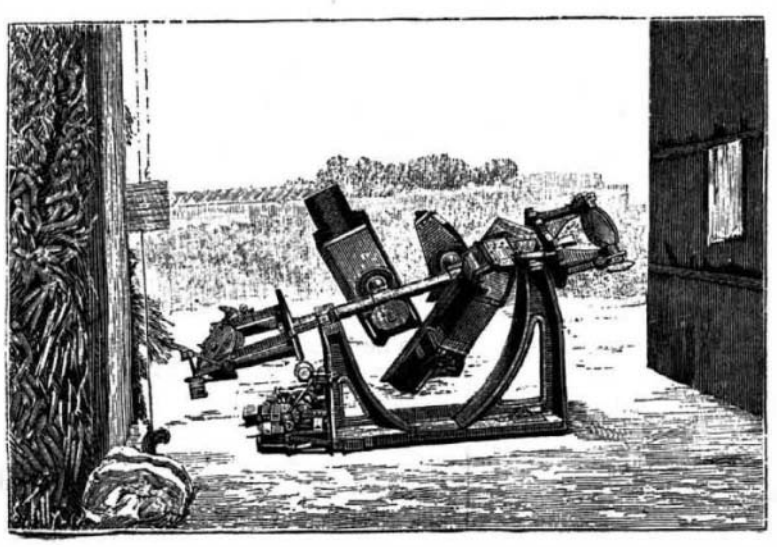
APPARATUS FOR PHOTOGRAPHING THE SOLAR CORONA.



THE SOLAR CORONA DURING TOTAL ECLIPSE.



APPARATUS FOR MEASURING THE ROTATION OF THE CORONA.



DOUBLE SIDEROSTAT FOR FURNISHING SOLAR RAYS TO VARIOUS APPARATUS.

AN EQUATORIAL WITH SPECTROSCOPE ATTACHMENT.

ECLIPSE OF THE SUN ON APRIL 16, IN SENEGAL.

visible at ordinary times, and to study its physical constitution. The phenomenon, moreover, is one of the grandest and most astonishing that can be seen, and, at all epochs, has excited the liveliest curiosity, or even great terror. The ancient authors have left us very accurate descriptions of it.

The sun, ordinarily so perfectly round, presents in the first place a slight hollow with circular edges due to the interposed moon, but which is capable at first sight of astonishing one; for the moon, being near the sun, presents to us its non-illuminated surface, and has not been able to announce its presence. Then the moon, which has a very marked motion with respect to the sun, gradually conceals it, and, about an hour afterward, the sun is reduced to a thin luminous crescent. At this moment the brightness of the day is much diminished and the temperature sensibly lowers. The heavens and the surrounding objects assume a strange hue, somewhat livid, that cannot be forgotten by those who have once seen it. Meanwhile, the thin crescent of solar light rapidly diminishes and disappears. The darkness becomes abruptly emphasized, and a new and unexpected phenomenon offers itself to the gaze. Around the black and perfectly circular disk of the moon is seen a wide luminous ring of silvery light that presents in its interior portion, near the lunar limb, parts of a bright red similar to flames. In its external portion, the ring has diffuse edges from which detach themselves luminous jets that are feeble, but characteristic. The ring, which resembles the halo that surrounds the heads of the saints in the pictures of the old masters, has received the name of corona. The red flames are called protuberances.

The apparition is of short duration, seven minutes at the most in the most favorable cases, and in Senegal it lasted but four minutes and eleven seconds. But what is the nature, the cause, of this apparition? Astronomers have discussed this question at length. Is the corona a dependence of the sun, or rather, as several eminent scientists have supposed, is it due to the moon or to the atmosphere of the earth, or, finally, to an optical illusion?

As everything relating to the sun is of great importance to us, various governments have, since 1840, been sending special missions for studying the phenomenon in countries favored by a total eclipse. But the question was not completely cleared up till 1868, thanks to a new method of investigation, viz., that of spectral analysis; for ordinary observations with the simple telescope could not suffice. This method, with special instruments called spectroscopes, composed in general of prisms, analyzes the luminous sources and decomposes them into their elementary colors. Now, by this simple examination, it has the wonderful property of revealing at a distance the chemical composition of the luminous sources, and, through the application of the principle of Mr. Fizeau, permits of determining their motion and the velocity with which they recede from or approach the observer.

The application of the new method during the great total eclipse of 1868 observed in the Indies gave great results. The corona and the protuberances are dependencies of the sun, and constitute what may be called its atmosphere. The protuberances are gaseous flames composed in great part of hydrogen. The corona offers nearly the same gases at a lower temperature and mixed with fine liquid particles and incandescent solids.

But one of the observers of the eclipse went further than his colleagues; after the eclipse he immediately pointed out a simple method that permitted of observing the protuberances in ordinary times outside of eclipses. This great discovery has been fruitful. Thanks to it, it has become possible to explore the immediate environs of the sun at every instant, to follow the formation, the changes and the motions of those protuberant flames that have sometimes dimensions ten times the diameter of the earth, and to recognize the fact that they are due to eruptions of the solar surface and to volcanoes of the sun in relation with the spots and faculæ. Great special observatories have been created in all countries for such study of the sun, insomuch as (according to some authors, Father Secchi among others) these perturbations of the sun have a marked influence upon the general disturbances of our atmosphere.

Meanwhile these successive results with the sun further increased the interest of total eclipses, for the atmosphere of the sun plays in every way a great role in the emission and transmission of solar energy, and it is visible in its entirety only during total eclipses. Daily observation gives only a very small part of it—the most brilliant, it is true.

So all eclipses have been carefully observed for the last twenty years. The English in particular have not neglected one of them. The principal ones in France have been observed by Mr. Janssen and Mr. De la Baume-Plurinel. As the eclipse of April 16 was one of the longest of the century, the Bureau of Longitudes, which, in France, gives an impulse to astronomical studies, took the initiative of asking the Minister of Public Instruction and the Chambers for special credit for the observation of the eclipse in Senegal.

Two missions even were organized; one for position astronomy and one for physical astronomy. The first mission, the main object of which was not the eclipse, but a special study of the austral heavens, started first under the direction of Mr. Bigourdan, an astronomer at the observatory. It established itself at Joal, upon the seashore, at twenty-five miles to the south of Dakar.

The sole object of the second mission was the study of the eclipse and corona. It was confided to Mr. Deslandres, an astronomer at the observatory, who was recently intrusted with the creation in this establishment of a new service of physical astronomy.

These missions have a very special character. They have to give all their useful effect in a few minutes, and yet they are at the mercy of a cloud, which, at a critical moment, might conceal the phenomenon. They have to utilize as well as possible the very short time of observation, and organize each experiment in advance and in its least details, in avoiding every maneuver not strictly indispensable. It is especially for expeditions of this kind that it may be said that preparation is everything.

The special plan adopted by Mr. Deslandres and the execution thereof, with the results obtained, were recently presented to the Academy of Sciences. Mr. Deslandres organized, in the first place, the observations of the preceding eclipses for the photography of the corona and the study of its chemical composition, and then he prepared several new experiments. He proposed to himself particularly to study by spectral analysis the general motions of the solar atmosphere and to measure its rotation. This latter experiment is delicate, but interesting, on account of the various opinions put forth as to the formation and nature of the corona, in the absence of any precise fact. Is the corona due to the numerous and rapid meteors that traverse it, or is it in its exterior portion assimilable in part to a ring such as one of those of Saturn? In those two cases it would have a rapid rotation, but if it is formed of emanations, the eruptions of the sun itself, it must revolve with a much less speed.

The mission embarked at Bordeaux on the 5th of March with a large amount of material, up to thirty tons in volume, including three large astronomical instruments, a large shed, and the numerous accessories necessary for physical studies. It comprised Mr. Deslandres, head of the mission, Messrs. Millechan and Mittau, his assistants at the observatory, and Mr. Coculesco, a Roumanian astronomer, who joined the mission, but with a special credit from his government and instruments belonging to the latter. Upon reaching Dakar it found a naval advice boat, the Brandon, ready to carry it to the place of observation, and on the 19th of March it landed at the little village of Foundiongue, upon the river Saloun, at ninety miles from Dakar. This station, which had been selected also by an English astronomical mission that arrived later, offers a dry air and pure sky, but it is one of the hottest points in Senegal, where, as in France, the temperature this year in March and April was higher than usual. This excessive heat was the principal obstacle to the astronomers, who had necessarily to work in broad sunlight for a month in order to mount and regulate their instruments. Despite the unfavorable prognostics of the sailors and the people of the country, not a member of the mission was taken sick.

This was fortunate, since, being composed of few members, it would have suffered greatly had one of the latter failed. On the day of the eclipse, but at the cost of great fatigue, the observatory was completely installed, the instruments being ready and well regulated. We give a general view of this installation. The most striking part, at first sight, is a large shed, which was constructed immediately upon the arrival of the party. It merits special mention on account of its lightness and the ease with which it could be put together and taken apart.

The framework was of light iron and the roof of compressed cardboard, after plans by commander of engineers Espitalier, the builder being Mr. Lefort, of Alfortville. This shed rendered the greatest services. As may be seen, it sheltered to the right an office and a photographic laboratory, equally of compressed cardboard, and to the left an apartment containing a large apparatus for the study of the chemical composition and motions of the corona. This apartment is annexed to a special astronomical instrument called a double siderostat. This latter presents at its two extremities two mirrors that send the solar light to the instruments placed in the two neighboring rooms. Moreover, in the center it is arranged for the reception of numerous accessory apparatus. This arrangement of the double siderostat is new. It is simple and has the advantage of furnishing solar light to a great number of apparatus at once.

Farther off, we perceive a large telescope designed for photographing the corona. It is 3 meters in length and has an equatorial mounting that permits it to follow exactly the motion of the heavens. It is derived from the material formerly constructed for the observation of the passage of Venus over the sun, but it was modified for the eclipse. Two smaller telescopes were added to it, giving an image of the sun in the same photographic frame as the large one.

The last apparatus to the left is likewise an equatorial telescope, having an objective of 15 centimeters aperture, and derived also from old material, but arranged for the measurement of the rotation of the corona. At the lower part of the telescope and upon its prolongation is fixed a large spectroscope. Finally, in the background we perceive Mr. Coculesco's apparatus.

On the day of the eclipse the sky was not very pure, being slightly whitish, but nevertheless the two missions, English and French, obtained satisfactory results, and the French mission in particular was enabled to carry out successfully the new experiments that it had projected.

Twenty-two photographs of the corona were obtained by the French mission. The view that we give of the corona is from one of these photographs, which was so taken as to show especially the external part. Other photographs show only the more brilliant interior part and the protuberances. On another hand, the study of the chemical composition that had been undertaken by photography in a hitherto unexplored part of the coronal light was satisfactory, and will permit of recognizing new bodies in the atmosphere of the sun. Finally, the most important research, relative to the rotation of the corona, was crowned with success. The photograph obtained shows that the solar corona revolves nearly like the sun and forms part of it. This last result, which is surely interesting and new, does honor to the French mission, which was the first to take up, and with success, the study of the general movements of the solar atmosphere.—*L'Illustration.*

A New Electric Welding Process.

At a meeting of the Society for the Promotion of Industry, held in Berlin, Dr. A. Slaby, professor at the Technical High School, gave a practical demonstration of a new electrical method of welding and forging iron. In the demonstration an iron bar, forming the pole of a source of electricity, was placed in water containing the other pole. As soon as the iron bar touched the surface of the water, the iron glowed as far as it was dipped into the fluid. Dr. Wedding, who supported the demonstrator, was able to forge the iron thus treated into a rivet. The new process, which is the invention of M. Julien, of Brussels, is carried out on the following basis:

When the poles of a source of electricity are immersed in acidulated water, or water which is made conductive by a solution of salt, and a sufficiently powerful current is passed through, oxygen is given off at the anode (a lead plate) and hydrogen at the cathode (an iron bar). On increasing the strength of the current, the development of gas can be so raised that the iron bar is completely incased by hydrogen, and is no longer in contact with the fluid. As, however, the hydrogen incasing offers a very strong resistance to the current, the electrical energy is converted into heat, by which both the hydrogen incasing and the iron bars are made glowing hot. By this method it is said that temperatures up to 4,000 degrees can be attained. According to Dr. Slaby, there is no difficulty in regulating the temperature for 800 degrees to 1,200 degrees, as required for the forging or welding of the iron, as the degree of heat depends on the proportion of the size of the anode to that of the cathode, as well as on the available electric pressure. On these grounds there is claimed for the new invention a great advantage over the Benardos process. In this the light of the electric arc is used for heating the iron. As, however, it has hitherto not been possible to properly adjust the heat, the points of welding present an uneven appearance, owing to the iron being partly burnt. The Benardos process is, consequently, only used in such cases where the joint can be subsequently touched up.

As compared with the Thomson process, the new one is said to have the advantage that with a tension of 100 to 200 volts, iron bars of two to three centimeters diameter can be welded, while the Thomson process requires exceptionally powerful currents, which cause the process to be dear and dangerous. The new process can be carried out without any particular difficulties. Any one having an electric light supply can make the experiment for himself. For the anode, as large a lead plate as possible is taken. The socket in which the iron bar is held forms the cathode.—*London Electrical Engineer.*

Hatching of Lobster Eggs.

Through some mistake the New York State Fish Commissioners had been purchasing lobster eggs that had, by chilling and other causes, become sterile and, of course, no hatching took place. This year L. D. Huntington, the president, established three stations—at Lloyd's Neck, Mattinacock, and New Rochelle—where the lobsters are secured alive and the eggs taken from them. Up to June 21 about 1,200,000 eggs were obtained from these places, and they were found to hatch readily. The commissioners expect to be able to distribute at least two and a half million lobsters this season.