

Flames From Sun Seen Without Eclipse

"A Classic of Science"

Bright Lines of Prominence Spectrum May Be Followed With Spectroscope Where They Occur Around Sun's Disk

These two reports were presented at the same session of the French Academy and published in the same number of COMPTES RENDUS hebdomadaires des Seances des l'Academie des Sciences Tome 67. Paris: Juillet-Decembre 1868. (Translated for the SCIENCE NEWS LETTER by Helen M. Davis.)

THE PERMANENT Secretary communicated the following telegraphic dispatch from Mr. Janssen, sent to observe the total eclipse of the sun: "Eclipse observed, Protuberances, spectrum very remarkable and unexpected, protuberances of a gaseous nature."

Indication of some of the results obtained at Guntoor during the eclipse of last August, and following that eclipse. Letter from Mr. Janssen to the Permanent Secretary.

Cocanda, September 19, 1868

"I have just come from Guntoor, my station for observing the eclipse, and I am taking advantage of the departure of a courier to send the Academy news of the mission with which it honored me.

Time does not permit me to send a detailed account: I shall have the honor of sending that by the next courier. To-day I shall merely sum up the principal results obtained.

The station at Guntoor was without doubt the most favored: the sky was clear, especially during totality, and my powerful telescopes of nearly 3 meters focal length allowed me to make an the eclipse.

Immediately after totality, two magnificent protuberances appeared; one of which, more than 3 minutes in height, shone with a splendor which it is difficult to imagine. Analysis of its light immediately showed me that it was formed by an immense column of incandescent gas, composed principally of hydrogen.

Analysis of the circumsolar regions, where Mr. Kirchhoff places the sun's

atmosphere, did not give results conforming to the theory formulated by that illustrious physicist; it seems to me that these results ought to lead to knowledge of the true constitution of the solar spectrum.

But the most important result of these observations is the discovery of a method, the principle of which was conceived during the eclipse itself, which allows study of the protuberances and of circumsolar regions at any time, without the necessity of recourse to the interposition of an opaque body in front of the sun's disk. This method is based on the spectral properties of the light of protuberances, light which is resolved into a small number of very bright lines, corresponding to dark lines in the solar spectrum.

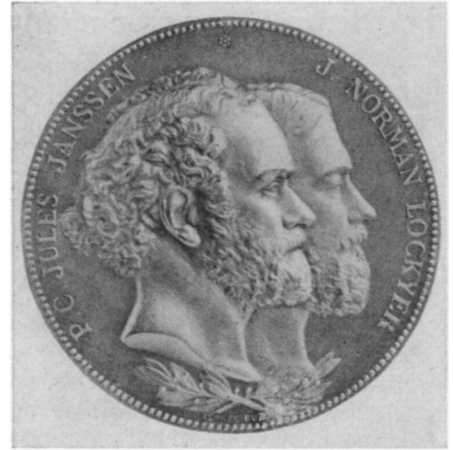
On the day following the eclipse the method was applied with success, and I was able to watch phenomena presented by a new eclipse which lasted all day. The protuberances of the former one were profoundly modified. There remained scarcely any traces of the great protuberance and the distribution of gaseous material was entirely different.

From that day to the 4th of September, I studied the sun constantly from this point of view. I made maps of protuberances which show these immense gaseous masses changing and moving about with great rapidity (often in a few minutes). Finally, during this period, which was like an eclipse seventeen days long, I learned a great number of facts, which appeared spontaneously, about the physical constitution of the sun.

I am happy to offer these results to the Academy and to the Bureau of Longitude in response to the confidence which was shown in me and the honor which was done me in entrusting me with this important mission."

Lockyer's Discovery

On a method employed by Mr. Lockyer to observe at any time the spectrum of protuberances shown in total eclipses



MEDALLION

—of Janssen and Lockyer struck by the French Government in appreciation of their simultaneous discovery.

of the sun. Note by Mr. Warren de la Rue.

"I have the pleasure of forwarding to Mr. Delaunay two letters relating to a discovery of one of my friends on the subject of the rosy protuberances which are seen during total eclipses of the sun. Mr. G. Norman Lockyer, using an especially constructed spectroscope, has been able to observe the brilliant lines of a protuberance superimposed upon the ordinary spectrum, when, in traversing the edge of the sun, the instrument happens upon such an object. This discovery was made the 20th of this month."

First Letter—

Mr. Balfour Stewart to Mr. W. de la Rue.

October 21, 1868.

"Lockyer has had a triumph; he has found the red flames with his new spectroscope. He says, October 20:

I found a protuberance today with the new spectroscope and got the positions of three lines:

One=C exactly,

One=F pretty nearly,

One, 8 or 9 degrees on Kirchhoff's scale, more refrangible than the line D!¹"
(Turn to page 76)

¹This line proved to belong to the element Helium, named by Lockyer for the sun, discovered on earth by Ramsay in 1894.—H. M. D.

7 GREAT SCIENTISTS

- 1 DR. ROBERT A. MILLIKAN, Nobel prize winner in physics, leader in scientific thought and head of the California Institute of Technology, speaks on "The Rise of Physics."
- 2 DR. JOHN C. MERRIAM, authority on the fossil animals and reptiles of western America, president of the Carnegie Institution of Washington, speaks on "The Record of the Rocks."
- 3 DR. EDWIN G. CONKLIN, Princeton University biologist, one of the world's greatest authorities on life processes, speaks on "The Mystery of Life."
- 4 DR. KARL T. COMPTON, eminent physicist, president of the Massachusetts Institute of Technology, speaks on "Science and Engineering."
- 5 DR. LEO H. BAEKELAND, industrial chemist and one of America's industrial pioneers, inventor of bakelite, velox, etc., speaks on "Chemistry and Civilization."
- 6 DR. WILLIAM H. WELCH, of Johns Hopkins University, "Dean of American Medicine" speaks on "The Tubercle Bacillus."
- 7 DR. WILLIAM M. MANN, director of the National Zoological Park of the Smithsonian Institution, leading authority on animal life, speaks on "Our Animal Friends."

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Continued from page 74

Second Letter—

Mr. G. N. Lockyer to Mr. W. de la Rue.

London, October 23, 1868.

"Many thanks for your kind letter and your congratulations; they are a sufficient recompense for much work and patience. I say this because, for two and a half years, I have worked almost against all hope.

I should have been content for the moment to have sent a note to Dr. Sharpey (Secretary of the Royal Society), and to have announced my observation to Mr. Stewart, who, by chance, spent the day following the one on which I made the discovery with me; for I wished to finish the work, or at least make some progress on it before talking about it.

Nevertheless I can only thank you for what you have done: the communication which you sent in to the Academy will be very valuable to me.

I was fortunate enough to find the protuberance again yesterday (October 22), and I confirmed everything: lines (bright) at C, almost at D and very close to F. There were certainly no lines at B nor at *b*. As for the region G, I have not examined it again.

I read the Note from Mr. Rayet, the night before my observation of the protuberance. I thought at first that I had observed only three lines, out of nine on which the observation is possible. But in studying again Mr. Rayet's diagram in Comptes Rendus I think that that diagram clears up the matter to a certain extent. You will note that *he gives a greater length to three lines*; I think that all the other lines which he has seen come from that very brilliant part of the ordinary solar spectrum which is seen when the region just beyond the edge of the sun is observed. It

seems to me that this explanation is the more probable since Mr. Rayet observed with a very wide slit. Moreover, there is in the solar spectrum an extremely bright region, between the two more refrangible lines of *b*, exactly in the position where Mr. Rayet places a short line; there is also a very bright part between *b* and F where he puts another line.

To sum up:

1. I have determined three lines;
2. Rayet gives three lines longer than the others;
3. Tennant is sure of three lines;
4. Herschel is sure of three lines.

It seems to me that the letters of Herschel and Tennant and also Rayet's diagram show that their nomenclature rests essentially upon a more or less rigorous estimation, and not upon measurements; none of these gentlemen seem to have thought of putting a faintly illuminated scale in the field of his telescope.

Thus my three lines may, after all, represent a greater amount of work accomplished than I at first imagined.

With a narrow slit, the lines have been seen even at a small distance above the surface of the sun itself. There is one especially brilliant line, and Mrs. Lockyer had no difficulty in seeing it.

The lines extended to different heights above the edge of the sun; the red was the shortest. I have even been able to get a clear idea of the shape of the protuberance which must be that shown in the figure:

When the slit has been adjusted so as to fall upon *a*, the bright line is found entirely separate from the solar spectrum.

Here is another fact: although C and F are both believed to be hydrogen lines, nevertheless they are not of equal length: the red one comes nearer to the sun."

Science News Letter, July 30, 1932

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