

DISCUSSION

A SOLAR ERUPTION AND SIMULTANEOUS
DISTURBANCES AT HUANCAYO
MAGNETIC OBSERVATORY

At the magnetic observatory of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington located near Huancayo, Peru, an unusual solar eruption was observed on April 8, 1936, by means of the Hale spectrohelioscope. That this activity on the sun produced effects on the earth is indicated by the simultaneous disturbances in terrestrial magnetism and earth-currents recorded there and also by the "fading out" of the radio-signals, which the high atmosphere, the ionosphere, normally reflects back to the transmitter-receiver used for investigations at that place.

The usual second period of observation with the spectrohelioscope (in accordance with the program of Commission No. 11 of the International Astronomical Union as arranged at the Paris meeting held in 1935) began at 16^h30^m G.M.T., and to within a minute or two of seeing the phenomenon about to be described, nothing unusual had been noticed. At 16^h45^m, activity was first noticed surrounding the largest sun-spot of a group of about six, located at approximately 23° North and 10° West of the central meridian. This increased in brightness until 16^h47^m, reaching intensity 2, and soon after this it was noticed that three other smaller sun-spots in the group had become active, although this was rather mild in comparison with the first-mentioned activity. Around 16^h50^m the flocculus about the largest sun-spot appeared to slowly decrease in size, but retained its great brilliancy. Before disappearing, the flocculus about the largest sun-spot assumed the shape of a quite perfect Latin cross. By 17^h03^m the flocculi about all the sun-spots had returned to their original appearance.

It should be noted that spectrohelioscope observations were made on April 7 in the regular periods of 15^h30^m to 16^h00^m and 16^h30^m to 17^h00^m. Observing conditions were satisfactory, but no activity of any kind was observed.

The magnetic record: The photographic records of the three magnetic elements, horizontal intensity, H , declination, D , and vertical intensity, Z , showed an abrupt departure ("sudden commencement") from the usual trend at approximately 16^h46^m G.M.T. which developed into a swing lasting about 40 minutes in H , 20 minutes in D and 70 minutes in Z . The maximum amplitude of the swing in H and also in D , was reached at 16^h51^m, whereas that in Z was reached at 17^h04^m. These amplitudes amounted to an increase of 108 gammas (1 gamma = 0.00001 C.G.S. unit) in H , a change of 2.1 minutes of arc easterly in D and a

decrease of 11 gammas in Z . The return to normal occurred more gradually than the sudden departure, which, together with the fact that the magnetic perturbations which usually occur in daytime at Huancayo may have an amplitude nearly one half that of this particular departure, make it difficult to ascertain where the part which is possibly associated with the solar eruption ends. It seems certain that it did not continue as long as two hours after its sudden commencement. No such disturbance appeared on either the preceding or following days.

The earth-current record: The four lines of earth-current systems I and III were recording smoothly and normally until 16^h45^m, G.M.T., on April 8. At that minute all four lines showed radical changes in potentials. For three of the lines, the changes in potentials went beyond the edge of the recording-paper, so the magnitude of the change is not known. However, for the east-west line of system III (adjacent to the observatory) the value changed from -35 millivolts to less than -20 millivolts. The north-south line of system III changed from -3 to more than +20 millivolts. For system I (two miles east of the site of the observatory) the north-south line changed from -6 to more than +20 millivolts, while the east-west line changed from +4 to -26 millivolts. The last-mentioned change is completely shown on the recording-paper. By 17^h03^m the values of potential on all four lines had returned to normal and the recording thereafter showed no irregularities. The disturbance was thus confined to exactly the same period as that of the solar eruption.

The ionosphere record: In accordance with established procedure in the program of ionospheric studies, a series of photographically-recorded manual multi-frequency runs was scheduled for April 8, for the determination of F_1 and F_2 critical-frequencies. The series of runs was begun at 10^h30^m, G.M.T., and was continued until 18^h26^m, there being one run in each hour, beginning on the half-hour. No unusual features were observed for any of the runs until that begun at 16^h20^m (this was begun somewhat earlier than scheduled). The previous run occupied the interval between 15^h30^m and 16^h14^m, and the range of frequencies covered was from 3,800 to 9,600 kc, at intervals of 100 or 200 kc. In this run reflections were obtained consistently. In the run which began at 16^h20^m, reflections were consistently obtained through 6,200 kc, the latter value being used at 16^h44^m. With the apparatus adjusted for 6,400 kc, recording was begun at 16^h45^m, but no reflections were obtained from any layer. Changes in frequency were continued from minute to minute through 9,000 kc at 17^h02^m, at which time observations were abandoned, since no reflections were being

obtained at any frequency. During the interval between 16^h45^m and 17^h02^m, as it appeared that the apparatus had become defective, various features of the apparatus were examined as time permitted and the antenna was inspected. Both apparatus and antenna were found to be in good order in every respect. At 17^h04^m, the apparatus was adjusted for 4,800 kc, the frequency used for fixed-frequency recording, but no reflections were obtained. No photographic record was attempted at this frequency. Beginning another run at 17^h40^m at 3,800 kc, nothing unusual was encountered throughout the whole run, which was terminated at 18^h26^m with a frequency of 9,600 kc.

Discussion: From the preceding paragraphs it will be seen that a solar disturbance began at 16^h45^m on April 8, 1936, and was accompanied by disturbances in magnetism, earth-currents and ionosphere-phenomena. According to the photographic records all these are known to have begun on about the same minute. The time-control of all instruments and apparatus at the Huancayo Magnetic Observatory is such that there is no question as to the element of time in connection with any of the records.

It seems generally accepted that solar disturbances are largely related to disturbances in the terrestrial elements just enumerated. Some think the solar disturbances precede terrestrial effects by about twenty-four to twenty-six hours. No solar disturbance was noted here on April 7 which would have preceded by twenty-four to twenty-six hours the magnetic, earth-current and ionospheric disturbances recorded here on April 8.

These observations may therefore indicate that some solar disturbances are capable of causing simultaneous disturbances in magnetism, earth-currents and the ionospheric regions. If the solar disturbance of April 8 were to lead by some twenty-six hours disturbances in the terrestrial elements, then the magnetic trace of April 9 should have been disturbed. The magnetic record of April 9 is entirely undisturbed; so, also, are the records of earth-currents and the ionosphere. Furthermore, the similarity of the time-duration for both solar and terrestrial disturbances is in this case striking. The solar disturbance was of eighteen minutes' duration; so was the major part of the earth-current disturbance. The duration of the ionospheric disturbance is not known but was evidently less than one hour. The duration of the magnetic disturbance, while not clearly defined, is not inconsistent with the interpretation suggested here.

It is of interest to note from Fig. 3 of the Bell System Monograph B-895, by A. M. Skellett, that solar disturbances about 13° west of the central meridian are most favorably located to produce terrestrial disturbances. The solar disturbance reported here was very

near this location, being centered approximately 10° west of the central meridian.

It is, of course, recognized that the material presented here is but an isolated case and does not, therefore, offer the best basis for drawing conclusions as to the relationship between solar and terrestrial phenomena. However, considering the number of elements involved and the high degree of simultaneity found for all the disturbances, the matter seems worthy of note. While there may be radiations, expelled from disturbed solar areas, which produce effects on the terrestrial elements only after an interval of twenty-four to twenty-six hours, there may also be some radiations which travel with the speed of light and which therefore produce disturbances in magnetism and earth-currents, the ionospheric regions and possibly in other geophysical elements at the instant when corresponding solar disturbances are observed.

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THE OVULE AND SEED OF *COFFEA ARABICA* L.

IN studying the vascular anatomy of the flowers of the Rubiaceae the writer came upon certain morphological features of the ovule of *Coffea arabica* L. that have been misinterpreted or overlooked.

In the first place, the ovule has no integument, a structure that is mentioned repeatedly in the literature on coffee. Though *Coffea* and *Houstonia* may not be closely related genera it might be of interest to note that Lloyd,¹ in 1902, reported that an integument is lacking in the latter genus. Froehner² mentions the integument and tells of the obturator (or caruncula), a massive outgrowth from the placenta (funiculus?). This has been observed by the writer, but there is no sign of an integument.

Another fact of far greater importance, especially in studies on the inheritance of endosperm characters, is that the endosperm is evanescent. When the embryo is very young there is apparently a scantily developed endosperm, but this disintegrates as the embryo enlarges; consequently the mature seed has none. What botanists have been calling endosperm is really perisperm, and it is the nucellus that enlarges to form the nutritive tissue around the embryo.

The fate of the polar nuclei has not yet been determined, but an investigation of this is well advanced and will be reported presently. In a subsequent pub-

¹ F. E. Lloyd, *Mem. Torrey Bot. Club*, 8: 1902 (cited by Goebel, "Organographie," Dritte Auflage, p. 2041. Jena, 1933).

² A. Froehner, "Die Gattung *Coffea* und ihre Arten," *Diss. Univ. Rostock*, pp. 10-11. Leipzig, 1898.