DISCUSSION

COSMIC AND GOVERNMENTAL PHENOMENA

ON the basis of radio communication reports submitted to the Bureau of Standards, Dr. J. H. Dellinger[1] has recently announced a "cosmic phenomenon" which caused brief interruptions of long-distance, short-wave communications on four occasions in 1935. Such interruptions were effective over the entire illuminated half of the globe and were spaced approximately 54 days apart (twice the period of rotation of the central portion of the sun).

In 1933 we were fortunate enough to secure complete records of radio echoes reflected from the ionosphere during extremely turbulent periods associated with three successive minor magnetic storms, and it appears quite certain that the observed turbulence is sufficient to produce effects similar to those described by Dr. Dellinger. Magnetic storms have been known to recur, after approximate 27-day intervals, on as many as eight successive occasions.[2] A diagram published in one of our previous reports[3] gives an indication of the sudden and violent changes in radio echo patterns which commonly occur at such times.

On checking over the original photographic records, it is apparent that they agree very well indeed with the recent reports of communication interruption. The most violent echo disturbances last only a few minutes. They are preceded and followed by subsidiary changes which prolong the individual abnormal periods to about 15 minutes. At the peak of the disturbance transmission conditions are changing so rapidly that it is difficult to imagine that any long-distance short-wave communication *could* be successful, though the service interruptions might be so brief that they would escape casual observation. The abnormalities were noted while the observing station was on the illuminated side of the earth.

During the 1933 sequence the main disturbances occurred as follows:

Feb. 19, 9:10–9:15 A.M., E.S.T. (with a minor turbulence at 10:35 A.M.).
Mar. 19, 3:45–3:50 P.M., E.S.T. (with a minor turbulence at 11:35 A.M.).
Apr. 15, 1:32–1:40 P.M., E.S.T. (with a minor turbulence at 12:10 P.M.).

Like other solar phenomena, the sequence is approximately periodic, but successive intervals may differ in length by about one day. Minor disturbances often appear on days preceding and following the main event, but the period of greatest agitation is well marked. On the third occasion we awaited the event with considerable confidence and were able to obtain the "fine structure" of the echo pattern by means of an auxiliary high-speed photographic recorder which was prepared in advance and set in operation before the commencement of the violent phase.

Until the apparent double period of 54 days, indicated by Dr. Dellinger's 1935 communication records, is further substantiated, we prefer to consider that it is somewhat fortuitous and that brief intervening disturbances at the 27-day points may have escaped observation. It would seem that this might easily occur if the most active or most susceptible radio channels happened to lie on the dark side of the earth at the crucial moment, or if the event happened at an hour when communication traffic was relatively slack. In any case, it is probable that the 1935 "storm" has lasted about as long as it is likely to endure, and that further extensions of the existing sequence of dates need not be expected.

Unfortunately no continuous automatic records could be obtained during the 1935 period covered by Dr. Dellinger's report. During the past 16 months the Federal Communications Commission has repeatedly postponed the rephrasing of certain obsolete regulations, limiting the use of automatic apparatus, which effectively block the continuation of fundamental research. The commission freely admits that the ancient clause in the regulations has no engineering justification whatever when extended to our new experiments and has therefore repeatedly promised remedial action. Already an important part of the sunspot cycle has been completely lost, by governmental decree.

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[1] J. H. Dellinger, SCIENCE, October 11, 1935.
[2] G. Angenheister and J. Bartels, Handbuch der Experimental Physik (Wien-Harms), Vol. 25, part 1, p. 674, 1928.
[3] H. R. Mimno and P. H. Wang, *Phys. Rev.*, 43: 769, 1933.

THE EPICENTER OF THE HELENA, MONTANA, EARTHQUAKE

EARTHQUAKE shocks of a destructive nature, the epicenters of which are about two miles north of Helena, Montana, occurred on October 12, 18 and 31. Geological field investigations initiated by the Montana Bureau of Mines and Geology immediately following each of the shocks established the epicenter on the southern side of Helena Valley (Prickly Pear Valley on some maps). This determination has been verified by excellent seismograph records obtained by Franklin P. Ulrich and Dr. D. S. Carder, of the Coast and Geodetic Survey, from the strong shock on October 31 and numerous minor shocks since October 19.

The earthquakes were caused by a northwest trending fault, but because of the deep cover of gravel and sand in the Helena Valley it is impossible to see the