PART IV

JOINT DISCUSSIONS

I. Solar Flares and Corpuscular Streams.

II. Nucleogenesis in Stars.

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IV. Astronomical Observations with Artificial Satellites, Rockets and Balloons.

I. JOINT DISCUSSION ON SOLAR FLARES AND CORPUSCULAR STREAMS

(12 August 1958)

ORGANIZING COMMITTEE: Prof. C. W. Allen and Prof. A. B. Severny.

CHAIRMAN: Prof. C. W. Allen.

SECRETARY: Dr M. A. Ellison.

The discussion on Solar Flares and Corpuscular Streams was organized jointly by the solar commissions of the International Astronomical Union and the Joint Commission on Solar and Terrestrial Relationships. The subject combined the interests of both of these bodies. The meeting was arranged for the afternoon of 12 August as part of the Moscow session of the Joint Commission on Solar and Terrestrial Relationships, but was extended into the session of I.A.U. Commission 11 in order to provide time for general discussion and individual contributions. At both times the chair was taken by Prof. C. W. Allen, and Dr M. A. Ellison acted as reporting secretary. The contributions were ordered, to some extent, by taking first those that related to the corpuscular stream problem and later those that were related to flares. C. W. ALLEN

1. CORPUSCULAR STREAMS FROM THE PLAGES AND THE PHYSICAL PROPERTIES OF THE STREAMS

E. R. MUSTEL

In 1942 the present author found that the passage of practically each plage over the visible centre of the solar disk is accompanied after a lapse of time Δt by geomagnetic disturbances. This proves that the streams of corpuscles from plages are approximately radial.

These results were confirmed for three periods which precede the minima of solar activity 1933, 1944, 1954.

The passage of plages over the visible centre of the solar disk explains not only separate geomagnetic disturbances but also practically all sequences of disturbances in years preceding the minimum of solar activity.

Recently our results received an independent confirmation. Radial streams of corpuscles from plages must produce certain seasonal phenomena in geomagnetic disturbances and in particular such strongly pronounced effects as the disappearance and the rise of geomagnetic *sequences* at times of equinoxes. Such effects are really often observed and our investigations show that these effects are produced by plages.*

Sometimes, before the end of a long geomagnetic sequence, the plage which created this sequence disappears but the geomagnetic sequence remains for two to three rotations and it is not accompanied by any visible mark of solar activity at the corresponding longitude. The same is true of the local magnetic field in active regions. In connexion with this we assume that the plages themselves are only a certain 'geometrical' indicator of the region from which the ejection of corpuscles proceeds, and that the mechanism of their ejection is of an electromagnetic nature.

In connexion with the radial direction of streams from the plages the velocity v may be found from the time-lag Δt. The mean time Δt for all three periods investigated is equal to 5–6 days and this corresponds to a velocity of about 350 km/sec. When we approach the minimum of solar activity the quantity Δt statistically increases and before the very minimum the value of Δt may reach 10–12 days. The latter values of Δt correspond to a mean velocity of about 170 km/sec. The reality of such small velocities v is confirmed by quite

* Recently the connexion between plages and geomagnetic disturbances is confirmed by statistical methods, see: Mustel, E. R., *A.Zh.* **36**, 215, 1959; Mitropolskaja, O. N., *A.Zh.* **36**, 224, 1959; Mustel, E. R. and Mitropolskaja, O. N., *The Observatory*, **79**, 15, 1959.

independent considerations. Towards the minimum of solar activity not only the growth of Δt exists but also that of ΔT, where ΔT is the duration of the geomagnetic disturbance. This growth of ΔT with the phase of solar cycle may be naturally explained if we admit the existence of a certain spectrum of velocities Δv in the stream. It follows from the graph connecting Δt and v, that for some fixed Δv the value of ΔT grows with the decrease of the mean velocity $\bar{v}$ of the corpuscles in the stream. It follows immediately from the graph connecting v and Δt that this effect is essential only for small velocities (from 100 km/sec to 300 km/sec) and this confirms independently their reality.

A careful inspection of geomagnetic disturbances observed before the years of minimum activity shows that often the mean *amplitude* of variations of the Earth's magnetic field strength is not changed sensibly with time (during the whole disturbance) or changes very slowly. Now if there exists a spread of velocities in the stream (even not a very large one) then it is natural to expect that this amplitude must be noticeably diminishing from the beginning till the end of the disturbance. Indeed, if all the energy of the corpuscles is mainly the kinetic energy of their translational motion (as it has been generally assumed), then the flux of this energy must be noticeably larger at the beginning of the disturbance than at the end. This contradiction led the author to consider that in many cases the total energy of the 'frozen' magnetic field of corpuscular condensations may considerably exceed the kinetic energy of their translational motion.

2. SOLAR FLARE COSMIC RAYS

J. A. SIMPSON

The rare solar flares which produce large quantities of cosmic rays arriving at the Earth enable us to study the acceleration of charged particles and their propagation in the solar system. The present paper discusses some of the main results derived from the most out-

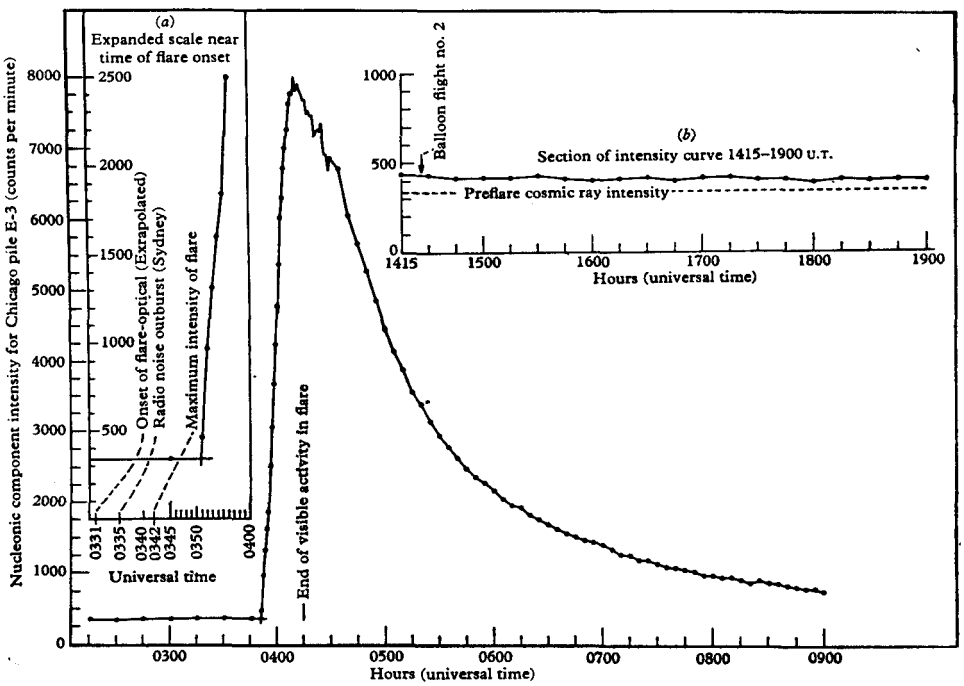

Fig. 1. Typical observation of flare cosmic rays arriving at the Earth.

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