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Transient Phenomena on the Moon

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The occurrence of short-lived, localized colour phenomena on the Moon has long been supported by amateur observers, but it is only in comparatively recent times that there has been satisfactory confirmatory evidence. In view of the recent results from the seismometer left on the Moon by Apollo 12, it seems appropriate to give a summary of the present situation with regard to these transient lunar phenomena now known generally as T.L.P.s.

An historical and overall survey of the problem has been given by Moore & Cattermole (1). Observations of temporary glows and obscurations go back for many years; for instance, one astronomer who reported them was Barnard (2), who in 1889 observed an unmistakable obscuration inside the crater Thales. The fact that most of the other reports came from amateur sources was not surprising, inasmuch as before the development of space-research methods most of the practical lunar observing was carried out by amateurs. However, in 1958 Kozyrev (3), using the 50-in reflector at the Crimean Astrophysical Observatory, saw a red T.L.P. inside the crater Alphonsus, and obtained confirmatory spectrograms. Though his interpretations might be (and were) questioned, the observation itself was very significant. Reddish T.L.P.s were also seen in 1963 by Greenacre and Barr, using the 24-in. refractor at the Lowell Observatory (4). The interest generated by these and other observations led J.Edson, of NASA, to develop a device known as a Moon-blink, consisting of a rotating filter wheel of half-red and half-blue filters, to be used to detect very faint colour phenomena which might be overlooked by ordinary visual studies (1). A programme was also initiated by the Lunar Section of the British Astronomical Association, the results of which have been summarized by Moore (5). Several well-confirmed phenomena were observed by the B.A.A. team during the next few years; for instance, near Gassendi on 30 April 1966, the observers in this case being P.K.Sartory, P.A.Ringsdore, P.Moore and T.Moseley.

The cause of the phenomena gave rise to much discussion and disagreement, but various facts became clear, particularly following analysis of the extensive catalogue of recorded T.L.P.s compiled by Middlehurst, *et al.* (6). This catalogue lists 579 cases up to October 1967, and it is evident that the distribution of 'event-prone' areas is not random, a situation which does not seem to be due to observational selection. A paper by Middlehurst & Moore (7) indicates that the areas fall into three classes: sites peripheral to the maria, ray-craters, and ring-plains with dark or partially dark floors.

This seems to be consistent with the idea that the phenomena are due to gases emitted from below the lunar crust, an hypothesis strongly favoured by McCall (8) and others. If so, then there might well be an association between T.L.P.s and the time of lunar perigee, when crustal strains are at their greatest. This seems to have been first suggested as long ago as 1960, by Miyamoto (9), and was more forcibly proposed by Green in 1963 (10).

Examination of the list given by Middlehurst, *et al.* (6) leaves little room for doubt that there is such a correlation. The whole question was regarded as important enough for NASA to support an international programme of observations during the Apollo missions (11).

At the Congress of the International Astronomical Union held in August 1970, Ewing (12) gave a report on the lunar seismic experiment. The findings from the Apollo 12 seismometer are conclusive; there is positive correlation between 'moonquakes' and the times of perigee, and so, also, with the T.L.P. reports.

It must be emphasized that T.L.P.s are not easy to observe; the chief danger is unconscious prejudice, and extreme care is needed. A faulty report is worse than useless; it is actually misleading, and may well confuse the analyses. As yet it is premature to draw any conclusions as to the origin of the phenomena. However, it seems clear that the phenomena themselves are real, and that future studies of them will be of considerable interest and importance.

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