can be shown that the agreement depends to a considerable extent on the value of σ chosen by Rushton. If it is reduced (for example, by substitution of the measured rather than the computed values), the agreement loses some of its splendor. There is no doubt that a correction for wasted light has to be applied (*7, 9*), and it is almost certain that it is substantially less than Rushton's value. The concomitant reduction in the *in situ* density of the green-sensitive value follows then even on Rushton's theory, but the agreement, particularly between pigment regeneration and dark adaptation, disappears. Possible reasons for this have been studied experimentally (*10*).

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30 April 1964

Atmospheric Data May Be Misleading

The studies of Rasool [*Science* **143**, 567 (1964)] and of Arking (*ibid.*, p. 569) are significant preliminary investigations of the heat balance of the earth and its atmosphere and of the very closely related distribution of cloud cover, as observed from meteorological satellites. We are pleased both that such studies are actively in progress and that *Science* is becoming increasingly a medium for publication of meteorological research findings.

At the same time, we are concerned that, because of the necessarily stringent limitations on the length of such papers, and because the majority of the readers of *Science* are not specialists in the atmospheric sciences, these preliminary results may, through the years, be accorded a more general validity than can be justified by the data sample on which they are based. In the past, similar initial results published in journals of wide distribution have all too often been applied as engineering data without either understanding or indication of their severe limitations.

Although Rasool discusses the known degradation of the channel 2 data in Tiros II and III, there appear to be other significant errors from still unknown effects. For example, degradation in the high equivalent temperature portion of the observations can be detected from the maximum channel-2 temperatures observed over the South Pacific subtropical high, where ocean temperatures are relatively constant. Studies by one of us (Wexler) indicate that observations in this region show a degradation of 8°C between orbits 1–5 and 42–47 of Tiros III, a further degradation of 5°C between orbits 72–77 and 98–105, and still another 5°C by orbits 212–218. These values of degradation are quite different from those supplied by NASA. The low equivalent temperatures associated with high clouds also appeared somewhat erratic during the later orbits.

Direct application of the visible spectrum channels of Tiros III (not used by Rasool) is limited by the fact that the observed albedos appear too low when compared with known albedos for clouds and various types of terrain. Nevertheless, the relative values are reasonable, and they can be corrected to give an estimate of the net incoming radiation as good as or better than that determined from climatological considerations. It seems unfortunate that Rasool did not use the Tiros data at least to verify Budyko's estimates, especially over oceanic areas where direct pyroheliometer data are nearly nonexistent.

But even if one disregards these uncertainties as to the accuracy of specific items of data, unfortunate misuses of these findings by those without thorough training in meteorology remain probable if Rasool's Figs. 1–6 and Arking's Fig. 4 are accepted as necessarily having long-term, quasi-climatological validity. These figures certainly include climatological effects and, in the case of Rasool's data, seasonal trends. But they doubtless also incorporate shorter-term atmospheric variations, whose influences cannot be judged from presently available data; and there are definite indications that the data are biased by diurnal factors introduced by the Tiros orbital characteristics.

For example, Rasool's Figs. 1–4 show relatively little change from month to month over and near North America and Australia, where data samples could be obtained twice a day, at approximately 12-hour intervals, with consequent reduction of diurnal effects. But over North Africa, orbit characteristics limit data to once a day and to varying times over the 9-week cycle Rasool discusses. Here the observed change from January to February could be largely due to the greater probability of cloud cover during the predominant afternoon and evening data-acquisition period in January as compared to the lesser probability of cloud cover during the morning February data acquisitions. Only significantly greater data samples will permit determining the relative importance of these diurnal effects as compared to seasonal changes.

In Arking's findings, effects resulting from the data necessarily being grouped near local noon are suggested, since the satellite-observed cloud cover exceeds the climatological values in the more continental northern hemisphere and the reverse is true in the oceanic southern hemisphere. There are also suggestions, in the satellite values near 30°N and 20°S latitudes, that the bright sands of the Australian, African, and North American desert areas are of greater significance than the author assumes; while these areas are only a small fraction of the earth as a whole, they do tend to concentrate along relatively narrow belts of latitude.

There are other matters, such as the effects of the diurnal variation of cloudiness on outgoing radiation, and the various complexities in the relationships between cloudiness and vertical air motions, that deserve more discussion than they were accorded or than space here allows. It is important, however, that these results be interpreted as only what they are—highly desirable but necessarily preliminary findings. Nonmeteorologists are advised to use them only with caution and preferably with the assistance of scientists fully aware of the inherent limitations to any attempts to assign them more general validity.

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14 February 1964