LETTERS TO THE EDITOR

GEOPHYSICS

Backscattering from the Upper Atmosphere (75–160 km) detected by Optical Radar

A COMMUNICATION with the above title was recently published by McCormick *et al.*[1]. This work gave, for October 29, 1965, a light return of about 10 counts per pulse at heights from 75 km to 125 km and, for October 31, about 1·5 counts per pulse at heights from 75 km to 100 km. If one takes the system parameters given and assumes 3 per cent photomultiplier quantum efficiency, 30 per cent receiving system transmission and 80 per cent atmospheric transmission, then the 10 counts per pulse corresponds to a return 150 times greater than that which would be given by Rayleigh scattering from molecules at 75 km, and 10^5 greater at 125 km.

We carried out observations with an optical radar of similar performance during ten nights between October 10 and November 14, 1965; this work is being fully reported elsewhere[2]. We calibrated the sensitivity of our equipment on the Rayleigh scattering from molecules observed below 60 km and found it to be about half that calculated above for McCormick's equipment. However, our estimates of transmission through their receiving system and atmosphere may be much too high, in view of measurements on our own system. Although our background count is much lower, we have never detected any light from above 80 km, and in the region 70–80 km our return was not more than a factor of three greater than Rayleigh scattering from molecules. To achieve these results, a rotating shutter had to be fitted to prevent the escape of fluorescent light after the transmission of the main Q-switched pulse; previously a large apparent return from high levels had been obtained.

These results indicate a very large difference in the constitution of the upper atmosphere above Maryland and South-east England at this time; data from their observations on other nights, which were not reported, would show if this was exceptional. Alternatively, McCormick *et al.* may not have succeeded in removing the effects of fluorescent light from their results, despite their measurement of the background count.

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[1] McCormick, P. D., Poultney, S. K., van Wijk, U., Alley, C. O., Bettinger, R. T., and Perschy, J. A., *Nature*, **209**, 798 (1966).
[2] Bain, W. C., and Sandford, M. C. W., to be published in *J. Atmos. Terr. Phys.*

The Satellite Geoid may have a Westward Drift

SOME time ago in a communication, I presented a model which speculated on the origin of the D″ layer between the mantle and the core of the Earth[1]. This layer is believed to be predominantly a molten sludge of mantle material but is richer in silica and lighter in density than the mantle because some iron has been lost to the core. At the core–mantle boundary, the electric currents generate Peltier heating; mantle material will be melted, gradually become a molten sludge and produce undulations at the boundary.

If the process of Peltier melting is slightly dominant over the process of Peltier freezing, the molten sludge will gradually accumulate. By integrating the equation of state at the core–mantle boundary, we note that Peltier heating is aided by ohmic heating while, of course, Peltier cooling is suppressed; since the electrical resistivity of mantle is much larger than the resistivity of the core, the ohmic heating is quite significant within the mantle. Thus we speculate that the electric current loops which give rise to non-dipole magnetic secular variations give rise also to a molten sludge and some undulations at the core–mantle boundary.

The molten sludge with lower density than mantle gives rise to a negative gravity anomaly, while the molten iron of the core with respect to the sludge yields a positive anomaly.

If the gravity anomalies are due to the sludge and the molten iron, then a westward drift of the gravity anomaly is also expected. Vogel[2] and Egyed[3] have also speculated on the possible relationship between magnetic secular variations and the gravity anomalies. The model which I introduced[1] attempted to describe the relationship between the magnetic and the gravity anomaly and predicted a similar westward drift for the gravity anomalies.

The total gravity anomalies on the equatorial belt have a maximum amplitude of ± 20 mgals over some 10,000 km distance. If the westward drift is uniform and about 0·5 degree per year, this leads to a 0·2 mgal change per year which cannot be easily distinguished with the present gravity meters. The mean free air anomalies calculated by Jeffreys[4] for gravity data recorded before 1950, when compared with the satellite geoids calculated by Izsak[5] and Kaula[6] for 1960, show a distinct westward drift of 12–15 degrees (Fig. 1). Kaula's data are based on observations made during 1960, while those of Jeffreys probably extend over a much longer period. The westward drift on the non-dipole magnetic anomalies according to Runcorn[7] is 0·2–0·8 degrees per year. If the longitudinal location of the anomalies calculated by Jeffreys, Izsak and Kaula are reliable, then the estimated westward drift of gravity anomalies is of the same order of magnitude as the westerly drift of the non-dipole magnetic anomalies.

Some of my colleagues believe that if the satellite geoid had a westerly drift, such a phenomenon would

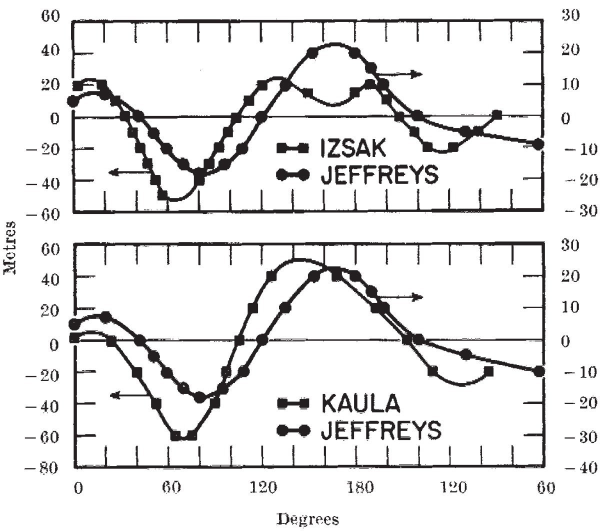

Fig. 1