during the winter. On the other hand, a density gradient of about 15 per cent exists from the equator to the pole over the summer hemisphere.

The proposed model covers only the variations of density with a time-scale greater than one day. During strong solar flares the density of the upper atmosphere may increase considerably for a short time. The function $g(a)$ in Fig. 2 relates to the time November 1957–July 1960. Apparently in the yearly variation an annual and a semi-annual period are superposed[7]. The first has been already found in the variations of the F-layer[10] and recently also in the exospheric electron-density after whistler observations[11]. The semi-annual effect has been recently found also for the E-layer[12]. Because the annual and semi-annual effects are probably caused by the influence of the inter-planetary plasma on the upper atmosphere, its amplitude may vary with the solar cycle. This is shown by the last observations up to February 1961, when the sunspot activity was already weak. During this time the annual and the semi-annual effect was found to be considerably lower than that during the strong sunspot maximum of 1957–58. Further, some minor irregularities of the air drag seem to remain, perhaps due to inhomogeneities of the interplanetary matter. In summary, the fluctuations of the density (and temperature) of the upper atmosphere are so complex that any model may differ considerably sometimes from the real values.

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Palæomagnetic Evidence relevant to a Change in the Earth's Radius

Cox and Doell[1], applying a suggestion of Egyed[2] to test the reality of the expansion of the Earth through geological time, have calculated the radius of the Earth implied by comparison of Permian palæomagnetic measurements in the Maymecha–Kotuy region of Siberia and localities in western Europe, and find that although the standard deviation of the individual results is very wide indeed, the average of the computed radii of the Earth is close to the present radius. From this they conclude that the substantial post-Palæozoic expansion of the globe deduced by me on tectonic grounds is unlikely.

Cox and Doell state that "in the expansion of the Earth envisaged by Carey, Heezen and Egyed, the continents do not increase in area; hence, the distance between any two points on a stable part of one continent remains constant". When applied to the geotectonic synthesis presented by me in the paper quoted by them[3], this statement is certainly invalid. In each of the figures for the Asian continent in my paper I show the Asian block as composite, and elongation since the Palæozoic is explicitly shown on Fig. 9, and implicitly on Figs. 10, 39*b* and 39*d*. The Ob rhombochasm is discussed on pp. 203–204 and rhombochasm is defined on p. 192 as "a parallel-sided gap in the sialic crust occupied by simatic crust and interpreted as a dilatation". The extensions specified above fall between the sampling areas used by the authors and involve an extension of some 900 km. This is of the right order for the angular distance measured between these districts to remain unchanged if the surface area of the Earth had increased some 45 per cent since the Palæozoic.

The magnetic data presented by Cox and Doell are therefore what they should be if the tectonic synthesis presented by me is correct.

It would be possible to apply Egyed's method to places on the Earth which would provide a decisive test. This may be done, either by comparing localities which do satisfy the conditions stated by Cox and Doell, or alternatively by selecting localities on separated blocks such as Africa and South America or Australia and Siberia and testing whether the surface distance between them on the Palæozoic reconstruction, taken with their ancient latitudes implied by the palæomagnetic data, correspond to an Earth of the present radius or of a different radius. I examined the data superficially from this point of view in 1958, but concluded that the uncertainty within the magnetic data then available was too wide to give a useful result.

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It is important to note that if, during an expansion of the Earth, each point on the surface were to move radially outward, then all sampling areas would have the same relative geographical co-ordinates before and after expansion. Palæomagnetic results could not be used to detect an expansion of this type. However, an alternative model of expansion is that in which most or all of the increase in area is reflected by an increase in the area of the ocean basins. We considered Prof. Carey's model of Earth expansion to be of this general type, since he concludes[1] that the Atlantic, Indian and Pacific Ocean basins formed by dilatation attendant on expansion. If the ocean basins formed in this way, the method we used would show an increase in the Earth's radius, even if the continents had also grown a lesser amount.

The crucial point raised by Prof. Carey concerns a proposed separation of the two sampling areas used in our calculation. The 900-km. dilatation suggested by him would certainly mask an increase of 1,100 km. in the Earth's radius, provided the elongation took place along the meridian connecting the two sampling areas and the ancient pole. Implicit in Prof. Carey's reconstruction of the Eurasian landmass[2] there is, indeed, a 900-km. displacement of the Siberian sampling area with respect to Europe; its direction, however, is not along the ancient meridian, but rather at an angle of some 50° to it. The component of elongation in the ancient meridional direction in Prof. Carey's reconstruction is less than