Figs. 2 and 3 are polar equidistant geographic grids (light lines) with the geomagnetic L grids (heavy lines) superimposed. These grids were interpolated from data published by Hakura[3] and Campbell and Matsushita[5]. The accuracy is believed to be within 2° of great circle arc which is adequate for many purposes; however, they are included primarily for illustrative purposes. Copies of larger grids (23 × 26 cm) are available.

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Profile of Upper Atmosphere Density at Heights between 130 and 160 km, from the Orbit of the Satellite 1968–59B

ANALYSIS of satellite orbits has provided a fairly complete picture of upper atmosphere density at heights between 170 and 1,200 km, embodied, for example[1], in the COSPAR International Reference Atmosphere 1965. At heights below 170 km, however, very few absolute values of air density have been obtained from orbital analysis, because satellites with perigee heights below 160 km usually decay quickly and have not yielded many useful data. Numerous measurements of air density have been made at heights between 80 and 110 km, by falling spheres ejected from rockets and other techniques. But the launchings are fewer and most of the techniques are less accurate above about 120 km. So the height range between 120 and 170 km has remained relatively uncharted.

On July 11, 1968, a heavy sphere, of mass 272 kg and diameter 0·61 m, was launched by the US Air Force into a polar orbit with an initial perigee height of 150 km. This satellite, 1968–59*B*, was designed by the USAF Cambridge Research Laboratories[2] and carried accelerometers to measure atmospheric drag *in situ*. Because of its exceptionally large ratio of mass to area, the satellite remained in orbit for 38 days, and analysis of its orbit offers the opportunity of finding values of air density at heights between 125 and 160 km.

We have recently analysed[3] the sets of orbital data available in the USAF *Spacetrack* bulletins, and have obtained twenty-eight values of air density at heights between 124 and 160 km. These are shown as circles in Fig. 1, where the broken line indicates the variation of density with height given by *CIRA 1965*, for the appropriate level of solar activity (model 5). The nineteen values of density obtained from 1968–59*B* at heights between 148 and 158 km are extremely consistent among themselves, and when converted to densities at the mean height of 153 km, they show remarkably little variation from day to day, with no departures of more than 4 per cent from the mean value. The relative errors in these values are estimated as ±3 per cent (*S.D.*), caused chiefly by inaccuracy in the orbital elements. The values of density at heights between 141 and 148 km in Fig. 1, which lie above the unbroken curve, occur at a time of increased solar activity (August 14–16): if the values are corrected for the apparent effect of solar activity, the unbroken curve in Fig. 1 represents the profile of density versus height from our analysis of 1968–59*B*. The numerical values are given in Table 1.

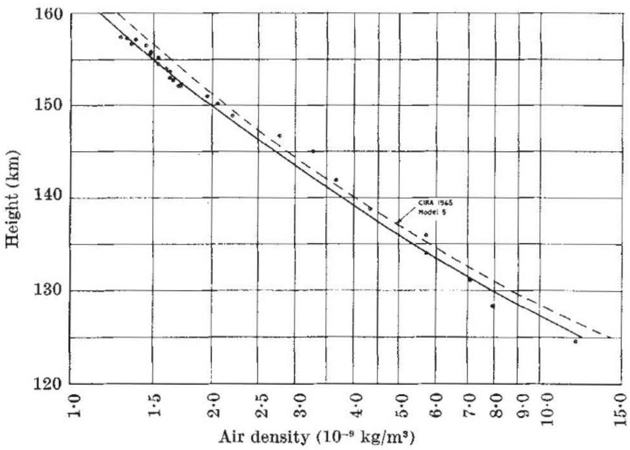

Fig. 1. Values of air density given by 1968–59*B*.

Table 1. VALUES OF AIR DENSITY DETERMINED FROM THE ORBIT OF 1968–59*B*

Height (km)	130	140	150	160
Density (10^{-9} kg m^{-3})	7·9	3·8	1·98	1·15

The values of air density from 1968–59*B* in Fig. 1 agree surprisingly well with the *CIRA 1965* values, being about 9 per cent lower than *CIRA* on average. The errors in the absolute values of density obtained are estimated as ±8 per cent (*S.D.*) at heights above 140 km, due chiefly to possible bias errors in perigee height and drag coefficient.

Any latitudinal or day-to-night variations in density were too small to be detected, although perigee travelled through a full range of latitude, from equator to north pole, and from mid-day tropical sunshine to the edge of the Earth's shadow.

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Magnetite Content of a Type I Carbonaceous Meteorite

ESTIMATES of the amount of magnetite in a Type I carbonaceous meteorite have ranged from 6 per cent by weight[1] to about 40 per cent by weight[2]. We have applied the technique of quantitative X-ray diffractometry to a sample of the Orgueil meteorite in an attempt to narrow these limits.

The technique depends on the fact that for a component in a mineral mixture the intensity of each of its X-ray reflexions is proportional, over an appreciable range, to the amount of that component which is present[3]. If this intensity is measured after successive dilutions with known amounts of the component its initial concentration can be calculated by extrapolation to zero intensity.

A half gram sample of the Orgueil meteorite from the British Museum (catalogue number 1960, 331) was ground to a particle size of approximately 10 microns and mixed with a small amount of nitrocellulose in acetone solution to act as a bonding agent. The powder was pressed gently into a 0·5 inch × 0·5 inch specimen holder and