The existence of the zinc blende structure at these three points in the triangle leads us to expect adamantine solid solution at all compositions inside the triangle. The ease with which equilibrium can be attained will, it is to be hoped, stimulate work on the many similar systems that can be postulated from known adamantine compounds.

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GEOPHYSICS

Airborne Observations of Natural Radioactivity in the Atmosphere

MANY observations of natural radioactivity in the atmosphere have been made[1], especially at ground-level. Radon and its decay products predominate[2].

This communication describes some measurements with a scintillation detector of background counting rates at altitudes up to 3·6 km. The day-to-day variations in counting rate were surprisingly large, and were found to occur mainly in the atmosphere between the ground and temperature inversion layers. The variations are due principally to changes in concentration of natural radioactivity in the atmosphere.

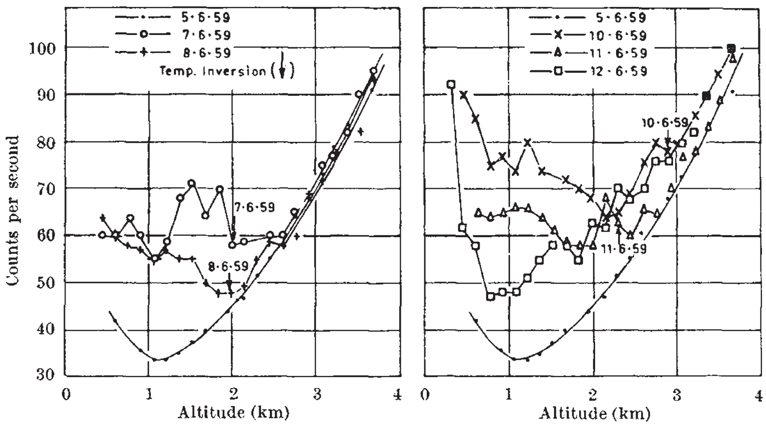

Fig. 1. Counting rate versus altitude

The detector, a scintillation unit with a cylindrical sodium iodide crystal of diameter 10 cm and height 7·5 cm, was mounted behind the tailplane of a *DC* 3 aircraft and could detect γ-rays coming from all directions. The flights were made near Gatton (elevation 100 m), Queensland, 85 km inland from the eastern coast of Australia. The airstreams were essentially from the east (maritime) for the four days immediately before the day of the first flight (June 5). Wind directions changed on June 6, and, for the subsequent days on which flights were made, the airstreams were essentially from the west (continental).

Counting rates were measured at intervals of 150 m altitude and the values obtained for the six flights are plotted against altitude (Fig. 1). The altitudes of temperature inversion are noted. The counting rates observed on June 5, in the maritime airstream, were the lowest of the series, and varied smoothly with altitude. The initial decrease in counting rate with altitude was due to absorption by air of γ-rays from radioisotopes in the ground[3]. At higher altitudes the counting rate increases with altitude due to cosmic rays[4]. Counting rates, especially at heights less than 2 km, were higher on days of continental airstream (June 7–12) and varied more abruptly with altitude. The main increases in counting rates, as compared with results on June 5, occurred below the temperature inversion layers. This indicates that the increases were due to radioactivity in the atmosphere, and that it probably originated from the ground.

Simultaneous measurements of counting rate and relative humidity were made at 1-min intervals during several flights at constant altitude. During one flight the aircraft passed through successive moist and dry air regions at about 2-min intervals, and higher counting rates were recorded in the moist air than in the dry. These observations were made in clear air about 10–15 min before cloud formation was observed. The moist air pockets, which were not found an hour earlier at this altitude, may have been carried up by convection, thereby containing more natural radioactivity than the surrounding air.

It was probably mainly radon and its decay products which were detected. The principal γ-rays originate from lead-214 and bismuth-214 (ref. 5). The scintillation detector 'sees' γ-rays emitted by these isotopes distributed in the sphere of radius approximately 300 m about the aircraft. It has been estimated that the present detector will record 8 c.p.s. as a result of a uniform concentration of 10^{-17} curies/c.c. of both lead-214 and bismuth-214 in the atmosphere at an altitude of about 2 km. The calculation[6], allowing for the build-up of γ-ray quanta in air, gives a counting rate about eight times that for calculations based on exponential absorption of γ-rays. The maximum increase in counting rate above the results of June 5 was about 46 c.p.s., that is, a concentration of about 6×10^{-17} curies/c.c. This is well within the range of concentrations found by other investigators[2].

These observations show that by using a scintillation detector mounted on an aircraft, instantaneous measurements can be made of the natural radioactivity in the atmosphere. An air mass may be identified as being of essentially continental origin when the concentration of natural radioactivity is high. Estimation of the efficiency of scouring of radioactive aerosols by rain, and the degree of mixing across a stable interface between two fluids such as at the top of stratocumulus cloud, are two problems which may merit investigation with this technique.

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