The results for the period January–June follow the slope of the lines remarkably well. Combined with the cessation of weapon tests around November 1, this seems to show that for a period of five–six months starting two–three months after the last injections in the stratosphere, and for 5 stations distributed nearly along a line 2000 miles long, the composition of the fallout corrected for the decay is very uniform.

Since the time of residence in the troposphere is much shorter and stratospheric debris from older tests would give a lower value of r , it is concluded that a considerable part of the fallout in the spring of 1959 over a large area was stratospheric, but originated from the tests in northern latitudes in the autumn of 1958.

From the increase in r as given by the vertical distance between the two lines in Fig. 1, it is inferred that 40–50 per cent of the strontium-90 fallout in the period February–June comes from these tests.

These measurements are part of work carried out for the Danish Defence Research Board, and I thank the Board for permission to publish these results.

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Measurement of Ion Beam Currents using a Hall Effect Magnetometer

ION and electron beam currents are normally measured in terms of either a collected current or the beam power dissipated in a calorimeter. Direct-current collection is complicated by secondary emission at the collector surface, and calorimeters are difficult to use when the beam power is low. For both methods the beam must be interrupted in order to measure the current. The technique described here avoids these disadvantages by measuring the magnetic field associated with the particle beam.

The magnetic field-strength in the vicinity of a beam of charged particles is given by $H = i/5r$, where i is the net current in amperes and r the radial distance in cm. from the beam axis. If $i = 1$ m.amp. and $r = 1$ cm. then $H = 2 \times 10^{-4}$ oersted. Fields of this intensity have been detected using the Hall effect in indium antimonide¹. If the magnetic field generated by the beam is concentrated on the indium antimonide crystal then currents smaller than one milliamperes may be detected.

A 'Mumetal' rod 1.3 cm. in diameter was bent into a 6.0-cm. diameter ring and annealed. An indium antimonide crystal 0.025 cm. thick was placed in a 0.040-cm. air gap built into the ring. This indium antimonide magnetometer was used in conjunction with a transistor oscillator and amplifier. In order to demonstrate the principle the ring assembly was mounted in a vacuum chamber through which passed a 1.0-cm. diameter electron beam of 1 keV. energy. Two current balancing loops, as shown in Fig. 1, were used to cancel the magnetic field due to the beam. The magnetometer was then used as a null indicating

Fig. 1. Schematic diagram of magnetometer ring assembly

device and at the null point the beam current equalled the current through the balance loops.

Two methods of applying the magnetometer were investigated. In the first method a steady electron beam was directed through the ring with the crystal excited by a 1 kc./s. alternating current. A balance was obtained by adjusting the current through the balance loops until the value of the 1 kc./s. Hall voltage equalled that for zero beam current. The smallest beam current detectable above the noise-level was about 10 μ amp. Although a balance was easily obtained for larger currents the accuracy of the device was mainly limited by the zero drift caused by small changes in temperature of the crystal unit. Displacement of the beam from the centre of the ring did not appear to alter the balance condition.

In the second method the crystal was excited by a steady direct current while the beam was modulated at 1 kc./s. Only the alternating component of the Hall voltage was fed into the amplifier. In this case zero drift was virtually eliminated and the smallest detectable current was slightly less than 10 μ amp.

The technique offers a new experimental approach to certain problems involving ion beam current measurement. Ionic processes may be studied without the complications associated with conventional detectors.

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Cavity Formation in Simple Pipes due to Rupture of the Water Column

WHEN the water-hammer surges that accompany rapid velocity changes in pipes are of such a kind as to produce a fall to vapour pressure, cavities are formed. Theory and analysis at present available rest largely on empirical evidence of changes in pressure alone. In the case of rupture, a recent publi-