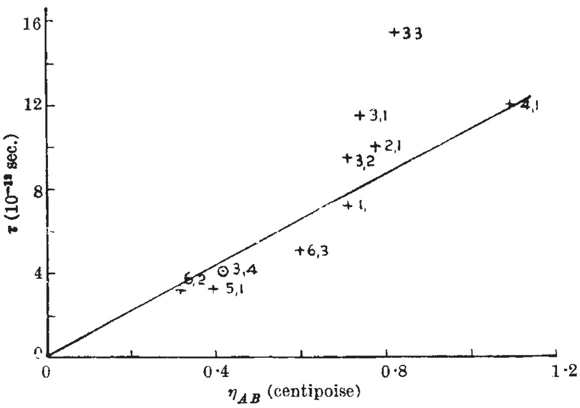

Fig. 2. Relaxation time and mutual viscosity. Numbers at points have the same significance as in Fig. 1. For the point marked by a circle both scales should be multiplied by 10

of the two substances, which can be found from the viscosity of the mixture, since

$$\eta\sigma = f_A{}^2\eta_A\sigma_A + f_B{}^2\eta_B\sigma_B + 2f_Af_B\eta_{AB}\sigma_{AB}, \quad (3)$$

where the f's are mole fractions, the σ's are intermolecular distances, and terms without suffix refer to the mixture.

Relations (2) and (3) are derived using Andrade's[2] model of a liquid.

Figs. 1 and 2 show τ plotted as a function of η_A and of η_{AB} respectively for various polar solutes in benzene (η = 0·65 c.poise), *cyclo*hexane (η = 0·97 c.poise), carbon tetrachloride (η = 0·97 c.poise) and medicinal paraffin ($\eta \sim$ 200 c.poise). The relaxation times are taken from the results of Whiffen and Thompson[3], and of Curtis, McGreer, Rathmann and Smyth[4]. The values of η_{AB} are deduced from data given in the "International Critical Tables" for solutes in benzene, and from measurements I have made in other cases.

From the graphs it can be seen that there is no simple relation between τ and η_A, as required by the Debye formula; but that the graph of τ against η_{AB} does approximate to a straight line through the origin as required by equation (2). Deviations from the linear relation may be interpreted as reflecting variations of the function A of the molecular sizes.

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A.C. Operation of Ion Chambers

Measurement of low-intensity ionization in an ion chamber involves the amplification of very small currents. D.C. operation is conventional; but it is difficult to provide stable valve amplification of a weak D.C. signal. Conversion to A.C. by a vibrating-reed gives good sensitivity and stability, but the mechanical device is elaborate. A.C. operation and amplification appears to be stable and simple, and is capable of high sensitivity.

The current produced by irradiation in the A.C. case is caused not primarily by the collection of ions but by the oscillation of a space charge within the chamber. This builds up slowly to its equilibrium density after a source of radiation is brought near the chamber, giving slow response time but high sensitivity. With the bridge circuit described for 10 c./s. operation, an irradiation sensitivity equivalent to 10^{-14} amp. D.C. may easily be obtained; the current rises to its maximum value with a time-constant of about ¼ min.

Kiehn[1] has described a single ion-chamber in a Wien bridge operated at 150 c./s. The high frequency gives rapid response times but reduced sensitivity. The apparatus developed in the present investigation was designed for high-sensitivity measurements of strontium-90 – yttrium-90 bremsstrahlung radiation.

Two T.P.A. (gamma-sensitive) ion chambers, filled with argon at 20 atmospheres pressure, are connected in opposition as two arms of an A.C. bridge; each balance arm consists of adjustable capacity and parallel resistance. The bridge is fed with 10 c./s. at 24 volts. Out-of-balance current is detected by an amplifier with electrometer triode input; the amplified signal is led to a 'gate' pentode where it is filtered for both frequency and phase, and the smoothed anode current measured on the output meter. The bridge is easily balanced to eliminate all capacitive current through the ion chambers, and much of the cosmic background current as well. Irradiation of either chamber separately causes additional resistive current to flow in the chamber; the output meter shows a change in reading proportional to the radiation intensity over a small range. The sensitivity is limited by variations in the balanced background currents to a value of about 2 microcuries radium at 100 cm. from one chamber.

This work will be reported in detail elsewhere.

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Atmospherics with Very Low-frequency Components

The low-frequency (*c.* 100–500 c./s.) or 'slow tail' component in the wave-form of an atmospheric was first studied in detail by Watson-Watt, Herd and Lutkin[1]. They defined two parameters: the delay t as the time elapsing between the start of the main oscillatory section of the atmospheric and the commencement of the slow tail, and the quarter-period τ/4 as the time occupied by the first quarter-cycle of the tail. Both t and τ/4 were found to increase in a somewhat irregular, non-linear, manner, as the distance of origin, D, of the atmospheric increased.

An extensive programme of observations of slow tails has recently been completed at the Cavendish Laboratory. Throughout the programme, the kind co-operation of the Meteorological Office "Sferics" Organization[2] has greatly enhanced the value of the work by locating the sources of individual wave-forms. Although it was noted that, for any estimated distance and any hour of the day, the individual values obtained for t and τ/4 showed considerable scatter, the results, when averaged, were found to be represented for distances up to 5,000 km. by two