observe the transit of Venus and to study atmospheric refraction in the tropics. As an incident of the latter, while at Pondichéry he observed carefully the form of the rising sun, with attendant phenomena, and noted the instants of upper and lower contacts in several cases, with the help of the telescope of his quadrant and a clock. While he does not seem to have made any further use of the durations deducible from his observations, nevertheless with the help of the *Nautical Almanac* of that year and a standard astronomical formula one may compute the duration which would have held on the assumption of constant refraction, and may compare this with the actual observations and with the accompanying descriptions of the sun's form. The subjoined table shows the results. Type A (see *Popular Astronomy*, "On Types of Sunrise and Sunset," vol. 29, p. 251, 1921; NATURE, October 13, p. 211), which is a mirage type, has an average excess of +2·3 per cent. as compared with computation; the one type B case has an excess of +5·3 per cent. These results agree with numerous observations made by the present writer at various stations in Pacific and Atlantic waters. It is as if the sun sets behind a receding horizon and rises beyond an approaching horizon.

	Duration				
Local date, 1769	Obs.	Comp.	Dif.	Per cent.	Type
	″	″	″		
I 7 A	148·5	144·6	+3·9	+2·8	A
I 9 A	147·4	144·4	+3·0	+2·1	A
I 10 A	145·0	144·1	+0·9	+0·6	A
II 1 A	145·4	139·7	+5·7	+4·1	A
VI 18 A	148·4	140·9	+7·5	+5·3	B

WILLARD J. FISHER.

The Measurement of Ionisation Currents by Three-electrode Valves.

IN view of the advantages offered by the use of valves for measuring ionisation currents, which have been pointed out in a recent paper by M. J. Malassez (*Comptes rendus*, vol. 172, p. 1093, 1921), it appears to be of some interest to describe another method of using valves for this purpose, differing in its application from that adopted by M. Malassez.

The method described by M. Malassez gives directly the mean ionisation during a certain interval of time by determining the time required to discharge a condenser from 40 volts to a small potential indicated sharply by the valve. It is intended to measure ionisation currents, of the order of 10^{-8} amperes, produced by X-rays when conditions are such that the leakage through the valve can be neglected.

In the method to be described the ionisation is measured by the steady deflection of a galvanometer. It permits changes of ionisation within short intervals of time to be followed, and can readily be adapted to a balance method.

The arrangement is given by the accompanying sketch (Fig. 1).

The plates of the valves V_1, V_2 are connected through equal resistances r_1, r_2. One terminal of each of these resistances is connected to the positive pole of the battery, the other terminals are connected through the galvanometer g. The resistances R_1, R_2 regulate the heating currents through the filaments. Each grid can be connected to the positive plate of an ionisation chamber through the leads C_1 or C_2.

The heating currents are set so as to give equal plate currents through both valves when the grids are insulated. When, owing to the action of the ionisation current, one of the grids receives a charge, the plate current through the corresponding valve is altered and the galvanometer is deflected. An ionisation current acting on the other filament causes a galvanometer deflection in the opposite direction.

The sensitiveness is, in general, different for ionisation currents acting on each of the grids, but for each one the deflections of the galvanometer are fairly proportional to the ionisation currents. If required, inequalities in the valves can be corrected by interposing an E.M.F. in one of the valve circuits by means of a battery and suitable resistances.

When two valves are used in this way, fluctuations in the heating currents and in the plate potentials are reduced owing to the fact that the heating currents for the filaments and the plate voltage are supplied from the same sources for both valves.

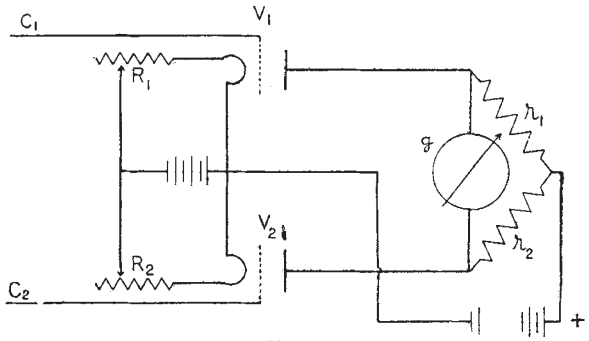

FIG. 1.

A fuller discussion of the method and more details of the experiments carried out will be given elsewhere.

When some radio-active deposit emitting α-rays is gradually brought near to an ionisation chamber of suitable shape it is easy to show the amount of ionisation for different distances (Bragg's curve) by the deflections of a unipivot galvanometer. When a more sensitive galvanometer is substituted for the unipivot instrument, in a set of observations the sensitivity for current was 3×10^{-13} amperes with a sensitivity for voltage of $1{\cdot}2 \times 10^{-4}$ volts, although the valves used were rather soft and not suitable for high current sensitivity, and no amplification device was used.

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Manchester University, Manchester, December 10.

Simple Sensitive Flames.

IT does not seem to be well known that it is quite easy to make a very simple flame sensitive to sounds of short wave-length for working with gas at ordinary supply pressure.

Such a sensitive jet is obtained from a glass tube, of diameter about 1 cm., simply by rotating the end of the tube in a blow-pipe flame, so that it takes the shape of a dome with an orifice. This shape provides the sudden change of pressure on which sensitiveness depends. While the glass is still soft it is slightly flattened so as to make the orifice noticeably elliptical. As with high-pressure jets, the flame loses sensitiveness if the orifice be too nearly circular, or if its ellipticity be too great. The best condition is attained by trial. If the orifice be too large the flame is easily disturbed by draughts or by slight variations in the pressure of the gas. If it be too small the normal gas pressure is too low to give a flame on the point of flaring, a well-known condition of sensitiveness. These low-pressure flames are sensitive to lower pitched sounds than is usual with high-pressure flames. Like the latter, they are most sensitive to sounds in a particular direction, viz., the direction of the major axis of the elliptical orifice.

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University College, W.C.1, December 6.