

only when the oscillation has reached its maximum. Perhaps they provide a means of limiting the amplitude of oscillation. But when the body of the fly with its halteres oscillating is rotated in yaw or roll, the pattern of impulses in the haltere nerve changes—probably as the result of the campaniform sensilla of the 'basal plate' being excited by the gyroscopic forces. These sense organs have a much higher sensitivity.

Diptera and other insects have campaniform and chordotonal sensilla around the base of their wings. These will presumably detect strains in the wing, and Pringle writes, "one can imagine an evolutionary process, involving a gradual reduction of the wing area and increase of the wing mass, in which the effect of the inertia forces gradually became more important than the aerodynamic forces".

¹ Hollick, F. S. J., *Phil. Trans. Roy. Soc.*, B, **230**, 356 (1940).

² Fraenkel, G., and Pringle, J. W. S., *Nature*, **141**, 919 (1938).

³ Nageotte, J., *C.R. Acad. Sci., Paris*, **215**, 509 (1942).

⁴ Nageotte, J., *Arch. Zoo. exp. gén.*, **83**, Notes et Rev. 99 (1944).

⁵ Pringle, J. W. S., *Phil. Trans. Roy. Soc.*, B, **233**, 347 (1948).

LOCATION OF THUNDERSTORMS BY RADIO

12/6
 THE study of atmospheric disturbances in radio reception began ^{at or} before the time when electromagnetic waves were being applied to practical communication; and from the beginning of the present century, various investigators were exploring the possibility of using radio methods for forecasting the arrival of thunderstorm conditions. For more than twenty years, the radio direction-finder with cathode-ray tube indication, first described by R. A. Watson-Watt and J. F. Herd¹, has been used in the study of the direction of arrival of atmospherics. By the use of a number of such direction-finding stations suitably situated, simultaneous observations can be made on individual atmospherics, and from the bearings obtained the source of the disturbance can be determined. Such a storm-location network has been built up by the Meteorological Office in the British Isles during the past few years, and the regular daily information obtained therefrom has for a long time formed a substantial contribution to the knowledge used in weather forecasting. The general organisation and arrangement of this 'Sferics' service, as it is called, have been described by C. V. Ockenden²; and in a paper read before Section A of the British Association at Dundee, a general review of the present and possible future techniques for the location of thunderstorms by radio was given by R. L. Smith-Rose³.

To meet the demands of the meteorologist for radio direction-finding equipment of the greatest reliability and accuracy, an improved form of the instrument was developed at the National Physical Laboratory, and has been described by F. Adcock and C. Clarke⁴. The equipment follows the same basic principles described by Watson-Watt and his colleagues, using a pair of crossed-loop receiving aeriels connected to twin balanced amplifiers, the outputs from which are connected to the two pairs of plates of the cathode-ray tube. The arrival of an atmospheric causes a line or narrow ellipse to be traced on the screen of this tube in a direction corresponding to that of the source of disturbance at which the atmospheric originated. Various modern

improvements in radio and electronic techniques have been incorporated in the present instruments to secure greater reliability, and ease and accuracy of observation. A tube with a long after-glow fluorescent screen is used to enable the observer to make accurate readings on flashes of very short duration. In addition, a brilliance modulator is provided, by means of which only flashes with amplitudes greater than a predetermined value are shown on the tube. This allows the observer to concentrate on the more important flashes. The direction of the disturbances can either be read visually with the aid of a scale and cursor on the tube, or the traces may be photographed as required. In this manner, a thunderstorm area can be located with a high degree of accuracy at ranges up to about 2,500 km.

Following the experimental development described above, the apparatus now in use by the Meteorological Office at four stations in the British Isles has been made by the Plessey Co., Ltd., Ilford, which has given brief details of the sets in a recent Press notice. The receivers operate on a frequency of 12.5 kc./s. (wave-length 24,000 m.), this being the region of the radio spectrum in which the maximum energy is radiated by a lightning discharge, and also where there is the least likelihood of disturbance from radio transmitting stations. Three observing stations, in Cornwall, Fifeshire and Northern Ireland, are controlled from the fourth at Dunstable, which is the central forecasting station and communication centre of the Meteorological Office. Observations are made twelve times daily, and the resulting information is broadcast over the teleprinter network and by radio to enable aircraft pilots to avoid storm areas, and thus reduce the risk of accidents. The information is also of great importance to the synoptic meteorologist in the preparation and study of daily weather charts.

¹ Watson-Watt, R. A., and Herd, J. F., *J. Inst. Elec. Eng.*, **64**, 611 (1926).

² Ockenden, C. V., *Met. Mag.*, **76**, 898 (1947).

³ Smith-Rose, R. L., *Advancement of Science*, **5**, 149 (1948).

⁴ Adcock, F., and Clarke, C., *J. Inst. Elec. Eng.*, **94**, part 3, 118 (1947).

FORTHCOMING EVENTS

(Meetings marked with an asterisk * are open to the public)

Saturday, January 8

INSTITUTION OF MECHANICAL ENGINEERS, GRADUATES' SECTION (at Storey's Gate, St. James's Park, London, S.W.1), at 3 p.m.—Sir F. Ewart Smith: "Industrial Research and its Relation to Design and Production".

Monday, January 10

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5.30 p.m.—"How Radar is Used in Navigation" (Sound Films with Introduction by Mr. R. F. Hansford).

TEXTILE INSTITUTE, OLDHAM BRANCH (at the Technical College, Ascroft Street, Oldham), at 7.30 p.m.—Mr. Higgins: "Plastics for Textiles".

Tuesday, January 11

INSTITUTION OF CHEMICAL ENGINEERS (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 10.15 a.m.—Conference on "Drying".

BRITISH PSYCHOLOGICAL SOCIETY, INDUSTRIAL SECTION (in Room 105, London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 1.10 p.m.—Dr. Philip E. Vernon: "The Structure of Practical Abilities".

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 5 p.m.—Mr. R. G. Lienhardt: "Totemism among the Western Dinka".

INSTITUTION OF ELECTRICAL ENGINEERS (joint meeting of the MEASUREMENTS and RADIO SECTIONS, at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Scientific Papers.

INSTITUTION OF NAVAL ARCHITECTS (joint meeting with the INSTITUTE OF MARINE ENGINEERS, at 85-88 The Minories, London, E.C.3), at 5.30 p.m.—Messrs. J. Rhodes, T. H. Arnold and J. R. Rait: "Methods of Non-Destructive Testing of Large Marine Forgings and Castings".