The Association's physics laboratories are equipped with an electron microscope, an electron-diffraction apparatus and an X-ray generator, with a wide range of cameras. The techniques thus available are applied as required throughout the Association's work both in its internal research programme and as *ad hoc* service to assist member firms in dealing with current technical problems. The electron microscope is proving of special value in the study of grain-boundary structures, which have been found to be of great importance in the technical properties of alloys. Electron-diffraction has been applied usefully to the study of the adhesion of electrodeposits on aluminium alloys and to the examination of the oxide films formed on liquid and solid metals, while the X-ray equipment is in constant use for the identification of chemical compounds and for studies of the constitution and texture of materials. In the physics section also, measurements of surface energy and surface tension are throwing light on soldering, brazing and hot-dip metal coatings; while multiplier photocells are being applied to the direct measurement of the intensities of spectral lines, in further development of the Association's well-known investigations on the spectrographic analysis of metals.

CHEMICAL ATTRACTANTS FOR INSECTS: SEX- AND FOOD-ODOURS OF THE COTTON LEAF WORM AND THE CUT WORM

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We have been investigating the cotton leaf worm (*Prodenia litura*, Fab.) and the cut worm (*Agrotis ypsilon*, Rott.), the most harmful pests of cotton in Egypt[1-3]. Female moths are found to attract the male moth and not vice versa, as with the gypsy moths[4]. If the females are separated in a glass chamber from the males, no attraction occurs. The odour of the female appears an hour after hatching and is restricted to the last two abdominal segments. The sex-odour disappears from the cut abdominal segments in a vacuum, but reappears again after 15 min. under normal pressure. It disappears totally after one and a half hours. It can be extracted from the abdominal segments with purified ether, and the ethereal residue shows the same power of attraction as the living moth. This proves that the female attracts the male by one or more chemical substances and not by sound or radiation.

We have developed an apparatus (an odour-analyser) which enables us to study sex- and food-odours chemically and biologically simultaneously. It consists of three parts: an odour-developer containing the females or the food, the odour-receiver with which we investigate the physical and chemical properties of the odours, and the odour-tester in which the males are able to migrate against the odour-stream and not the reverse. With this apparatus the sex-odour of the cotton leaf worm was found to be a volatile, neutral substance or mixture; it could be frozen out at −20° C. It was stable against dilute sulphuric acid and dilute sodium hydroxide. With concentrated sodium hydrogen sulphite we were able to extract the sex-odour from the air-stream. This suggested the presence of an oxo-group in the molecule.

We found that fermenting 'bouza', the Egyptian wheat-beer[5] which is used in the Andree–Maire trap to attract the moths of cotton pests[1,2], contains a volatile mixture, consisting mainly of ethanol and acetic acid. However, pure ethanol attracts very few moths, and acetic acid does not attract any moth; but a mixture of the two attracts many more. The bouza odour is volatile with steam and can be frozen out. It is stable with dilute sulphuric acid and 1 per cent formalin, but is partially destroyed by dilute sodium hydroxide. Concentrated sodium hydrogen sulphite had no effect on bouza-odour, in contrast to its effect on the female sex-odour.

The extraordinary sensitivity of the sense organs of insects enables us to investigate with our apparatus some of the chemical properties of sex- and food-odours, in order to find the best way of enriching them and also to test the fractions of extracts.

Reports on this work were given on September 29, 1948, at Frankfurt before the Deutsche Physiologische-Chemische Gesellschaft (*Angew. Chem.*, **61**, 252; 1949), and on November 30, 1948, at the Faculty of Science, Farouk I University, Alexandria.

[1] Bishara, I., *Bull. Soc. Roy. Entomol.*, **18**, 288 (1943); *Tech. and Sci. Service Bull.*, **114**, 1 (1932) (Ministry of Agriculture, Cairo: Government Press).
[2] Willcocks, F., "The Insects and Related Pests in Egypt", **1**, Pt. 2 (Cairo, 1937).
[3] Kamal, M., *Proc. VI. Internat. Congress Entomol., Madrid, 1935*, **2**, 567 (1940).
[4] Haller, H. L., Potts, S. F., and Acree, F., *J. Amer. Chem. Soc.*, **66**, 1659 (1944).
[5] Monib, M., Fac. of Agriculture (Cairo, 1948).
[6] See also Dithier, A. M., "Chemical Attractants and Repellents" (London, 1947). Wigglesworth, V. B., "The Principles of Insect Physiology" (3rd. edit., London, 1947). Moncrieff, R. M., "Chemical Senses" (London, 1944). Frisch, v. K., "Duftgelenkte Bienen im Dienste der Landwirtschaft und Imkerei" (Wien, 1947).

PERCEPTION AND MEASUREMENT OF ODOUR

A LECTURE in Esperanto on "The Perception and Measurement of Odour" was given by Dr. D. R. Duncan on January 17 at University College, London, at the conclusion of the annual general meeting of the British Esperanto Scientific Association. Dr. Duncan first reviewed the attempts which have been made by Linnæus[1], Zwaardemaker[2], Henning[3], Crocker[4] and others to evolve systematic classifications of the known types of odour, mainly on the basis of subjective judgments of similarity and dissimilarity. He felt that Zwaardemaker's was by far the best attempt; but that the real solution of the problem demands attack by other methods, including a quantitative approach. Dr. Duncan described the *p*O scale of odour intensity and various instruments which have been used for estimating odour intensities, including the Fair–Wells osmoscope[5] (which is now an article of commerce) and an improved apparatus designed by Dr. G. H. Cheesman and himself. He gave reasons for assuming that there is a limited, though large, number of primary odours, other odours being produced by simultaneous stimulation of more than one type of receptor.

He then described unpublished work carried out by himself in a preliminary attempt to analyse

odours. Of various methods employed, he has found the method of odour 'fatigue' most helpful. Prolonged exposure to one odour reduces the sensitivity of the nose to other similar odours and often leads to striking changes in the apparent odours of other substances. In cases where no change in intensity or character of odour occurs, it may be assumed that there is no primary odour in common, and the converse should also be true. By quantitative measurements of loss of sensitivity under standard conditions of fatigue, it may even be possible to effect a quantitative analysis of odour stimuli, a line which is being pursued by Dr. Cheesman.

Dr. Duncan has concentrated on the study of the qualitative changes, supported by rough estimates of sensitivity changes due to fatigue and by more accurate odour-mixing experiments. Dr. C. M. Bean has independently carried out qualitative work on odour fatigue on much the same lines. In broad terms, the results confirm that Zwaardemaker's classification has a considerable element of truth in it.

The main difficulty in such work is to make an intelligible written record of the subjective observations; but by concentrating on a small group of odours (Zwaardemaker's classes 1 and 2), it has been possible to reach some definite results. In illustration, evidence was presented which suggests that the odour of *cyclo*hexanol differs from that of *cyclo*hexanone in that the former contains about 1 per cent of a component not present in that of *cyclo*hexanone but present as a major component in the odour of tertiary butyl alcohol, while the odour of *cyclo*hexanone contains instead about 6 per cent of a component also present as the major component in the odours of acetone, methyl ethyl ketone and tetrahydrofuran. The primary stimuli common to *cyclo*hexanol and *cyclo*hexanone, producing an overall minty effect, include: (1) an 'aromatic' component present in the odours of menthol, camphor, eucalyptus oil, weakly in the odour of *iso*butyl alcohol and very weakly in those of *cyclo*hexane and *cyclo*hexylamine; (2) a sweet sensation (probably stronger in *cyclo*hexanone than in *cyclo*hexanol), present also in menthol and more powerfully in *cyclo*hexane and many chlorinated hydrocarbons, particularly chloroform—this sensation is stated by Henning to be due to stimulation of taste buds present in the nose; (3) possibly, but very weakly in comparison with menthol, a component stimulating the temperature-sensitive nerves in the nose.

[1] Linné, K. von, *Amœnitates Academicæ*, **3**, 195 (1756).
[2] Zwaardemaker, H., "Die Physiologie des Geruchs" (Leipzig, 1895).
[3] Henning, H., "Der Geruch" (Leipzig, 1916).
[4] Crocker, E. C., and Henderson, L. F., *Amer. Perfumer*, **22**, 325 (1927).
[5] E. and A. Bull. No. 524 from Messrs. Eimer and Amend, New York. Fair, G. M., and Wells, W. F., *J. Amer. Water Works Assoc.*, **26**, 1674 (1934).

STUDY OF METEOR VELOCITIES

ON October 26, Dr. J. G. Porter, president of the British Astronomical Association, delivered his presidential address, taking as his subject "The Study of Meteor Velocities"*. As a result of the Harvard–Cornell Meteor Expedition in Arizona during 1931–33, it was believed that most meteors were moving with highly hyperbolic velocities—a conclusion which Dr. Porter never accepted. He spent some years in investigating the subject with the utmost care, and showed that the methods adopted in the Harvard–Cornell Expedition were unsound, and he found no real evidence that any meteors were hyperbolic. It is significant that none of the meteors doubly photographed by members of the Expedition showed hyperbolic velocities, and it is now generally accepted that meteors are members of the solar system. Dr. Porter's analysis of about three thousand meteor observations*, from which there were sufficient doubly observed to give the real paths of 778, showed in addition that, contrary to the opinion of a number of experienced workers in meteoric astronomy, there was no essential difference between the heights of appearance and disappearance of the shower and sporadic meteors.

Dealing with the relation between a number of well-known meteor showers and the comets usually associated with them, Dr. Porter pointed out in his address that the usually accepted view that these meteors are the debris of the comets is open to considerable doubt. In support of the contrary view, he referred to the Leonids and Perseids which have been active for a thousand years and to the Lyrids which have been active for about two thousand years, but the comets with which they are associated were not discovered until the nineteenth century. A more convincing case is found in Comet Giacobini–Zimmer; in 1926 the meteors associated with this comet came from particles in front of it, not from the debris following behind. Dr. Porter considers it more simple to assume that this and other comets are moving along in orbits with the dust that is responsible for the meteoric showers, such dust being quite independent of the comet, though it is just possible that in the remote past both may have been derived from a common source—perhaps from a great comet which disintegrated. Further corroboration for this view is found in the work of the Computing Section of the British Astronomical Association (of which the president is director), which was carried out during the Second World War. Of all known comets, it was shown that only sixty approached the orbit of the earth within 0·1 astronomical unit, while thirty-five came within 0·05 unit. There did not appear to be any connexion between these (with the exception of six) and any meteor showers—a result which is very significant if meteor showers are formed from the debris of comets.

Many other points were discussed by Dr. Porter; but it is impossible to deal with all of these in this article. One important development in meteoric work referred to in the address, however, may be mentioned, namely, the application of radar to determine radiants and also speeds of meteors. Very useful work has been accomplished already, and we may confidently look forward to great strides in the near future. The discovery by radar of the great daylight streams in 1946 was a new departure in meteoric astronomy, and one can scarcely predict what further important developments will take place in the next few years. It is interesting to notice that in the past very few radiants seemed to be active in September, and this has been confirmed by radar.

In the course of the address, Dr. Porter appealed for more observers of meteors and also for more computers who would use the observational results to determine real paths. He mentioned a mechanical apparatus under construction which will facilitate such computations and will, in fact, give the heights and path-lengths of meteors directly.

* *J. Brit. Astro. Assoc.*, **60**, 1 (1949).

* The results appeared under the title, "An Analysis of British Meteor Data" (*Mon. Not. Roy. Astro. Soc.*, **103**, 3; 1943, and **104**, 257; 1945). See also *Nature*, **152**, 420 (1943); **155**, 761 (1945).