OLFACTORY STRUCTURES IN INSECTS.

THERE is no doubt that many insects have a sense of smell, but there is great variety of opinion as to the precise location of the sense. Dr. N. E. McIndoo,[1] of the Washington Bureau of Entomology, has summed up the discrepant views in forty pages, and also in one word—"chaos." Lehmann seems to have been the first to experiment (1799), and he was led to the conclusion that the seat of smell is in the spiracles. Most of the older naturalists reached their conclusion without experimenting, and the sense of smell has been referred to at least a dozen different parts, such as the mouth, the epipharynx, the palps, the caudal styles. Of recent years, as the result of experiment on one hand and histological analysis on the other, there has been a tendency to conclude that the antennæ are the olfactory organs. The antennæ are rich in sensory structures, and their removal is sometimes followed by a negative reaction to an odour which is attractive to the intact insect. Dr. McIndoo thinks that the arguments are very inconclusive.

There are certainly many structures on the antennæ which might be olfactory—pore-plates (Lubbock's pits), pegs (Lubbock's cones), Forel's flasks, pit-pegs, and end-rods; and each of these has been claimed by some investigator as the true and only seat of smell. But in all these structures the nerve-ending is shut in by the chitinous cuticle, through which, therefore, the odour would have to pass. Another difficulty emphasised by Dr. McIndoo is in regard to the distribution of the structures above-mentioned: thus the pore-plates cannot be the exclusive olfactory structures, for they are absent in all Lepidoptera; the pegs cannot be the exclusive olfactory structures, for they are absent in many male bees, and so on. The distribution of the various antennary structures in different types does not correspond with the varied rates of response to odours as shown by these types under experimental conditions. Moreover, spiders can smell, and they have no antennæ. The author concludes that for ants, bees, and wasps, the antennæ can no longer be regarded even as a possible seat of the sense of smell. It is possible, however, that what is true of one order of insects may not hold for another.

What, then, is to be made of the experiment repeatedly performed of removing the antennæ and observing that the usual response to odours did not occur? The author's numerous experiments on Hymenoptera have shown him that if the antennæ of these insects are mutilated even a little, the behaviour becomes abnormal, and the slow reaction to odours may be due to the actual injury, not to the removal of some of the olfactory structures. Amputation of the antennæ is often fatal, and the insect is so much disorganised that its failure to respond to attractive odours does not prove that the olfactory structures are on the antennæ. Details are given in support of this useful criticism.

Where, then, is the seat of smell? Dr. McIndoo takes us back to the work of Hicks (1857), who discovered vesicles or pores on the bases of the wings and on the legs, and suggested that they were olfactory. The structures have been studied by Janet and others, as well as by Dr. McIndoo. Each is like an inverted flask imbedded in the chitin, but with a minute external pore. A fibre from a sensory cell near the inner end of the flask rises to the pore, and its cytoplasm comes into direct contact with the air and its odorous particles. These pores correspond to the lyriform organs or slits discovered by Bertkau on the legs of spiders, and subsequently studied by Dr. McIndoo. When the pores on insects' wings are covered with glue or vaseline the reaction times are greatly increased, and the rates of response in particular insects correspond with the number of pores. A drone hive bee has 2600 pores, and responds in 2·9 seconds; a worker has 2200 pores, and responds in 3·4 seconds; and a queen has 1800 pores and responds in 4·9 seconds. The author is to be congratulated on his introduction of some order into the chaos of discrepant opinions concerning the seat of the sense of smell in insects.

[1] "The Olfactory Sense of Insects." By Dr. N. E. McIndoo. Smithsonian Miscellaneous Collections. Vol. lxiii (1914), number 9. Pp. 1—63, 6 figs.

SIR A. H. CHURCH, K.C.V.O., F.R.S.

THE announcement in NATURE of June 3 of the death of Sir Arthur Herbert Church, in his eighty-first year, has been received with great regret among men of science. Sir Arthur Church was educated at King's College, London, the Royal College of Chemistry, and Lincoln College, Oxford, where he took a First in the Natural Science School. He afterwards became Professor of Chemisty in the Royal Agricultural College, Cirencester. This appointment naturally led him to devote special attention to agricultural chemistry, on which he became an authority, and at the same time to direct his attention to the chemistry of plants. He contributed memoirs on vegetable albinism; colein or erythrophyll; and aluminium in vascular cryptogams, etc., and also investigated the remarkable animal pigment known as Turacin, which contains 7 per cent. of metallic copper.

Sir Arthur Church also directed his attention to mineralogical chemistry, being the first to discover Churchite, a native cerium phosphate, and several other new minerals; and he was at one time president of the Mineralogical Society. His researches in other departments of applied chemistry seem, however, to have been influenced by his strong interest in art in every form. Perhaps few chemists know that Sir Arthur Church once exhibited at the Royal Academy, besides

having very fine private collections of Japanese metalwork, Oriental and English pottery, precious stones, and Italian and Oriental embroideries. This interest in art led him to take up the study of precious stones, on which he was a recognised authority, and on which he wrote a standard work, besides publishing valuable books on English earthenware and English porcelain.

Sir Arthur Church will, however, probably best be remembered by his work on the subject of artists' pigments. In connection with the Royal Academy of Arts there is an appointment—the only one of its kind in Europe—of a professor of chemistry, whose duty it is to deliver certain lectures to the art students in training. Sir Arthur Church was appointed to this professorship in 1879, and held the post until 1911, when he decided to retire. His professorship at the Royal Academy brought him into close connection with the many chemical problems involved in painting, and led to his carrying out a large number of investigations, the results of which are summed up in his book on "The Chemistry of Paints and Painting," which has passed through several editions. This book, which is the standard work on the subject, contains—very often in a few lines—the results of long and careful inquiry and research, and has done a great deal to redeem the artist from the unfortunate position in which he was placed by the dying out of the old studio traditions, and by the flood of pigments and preparations which were due to modern chemistry, and were somewhat recklessly introduced into the artist's palette.

These researches naturally led Sir Arthur Church to make a special study of the old masters and their methods, and he was also asked to inquire into the condition of the frescoes in the Houses of Parliament, and report on the preservation of the decaying stone in Westminster Abbey. For many years he worked at these problems as a labour of love, either with his own hand, or under his personal direction, restoring and preserving the frescoes, and carrying out special researches with the view of stopping stone decay in such national monuments as Westminster Abbey. In all these problems his interest in artistic and archæological questions made him devote his special knowledge of chemistry to subjects which the ordinary chemist seldom regards as of sufficient interest to attract his attention.

Of late years he prepared for the Royal Society a classified list of papers and letters in the Society's archives, this classification being the result of much labour and research and of great value as a reference to the older work which was done in the early days.

Sir Arthur Church will be missed by all men of science who knew him, and also by his many friends, on account of his personal charm and kindness and his wide culture, which touched upon so many subjects outside the realms of chemistry.

A. P. L.

NOTES.

AMONG the recipients of honours conferred on the occasion of the celebration of the King's birthday on June 3, we notice the following names of men of science and others associated with scientific work:—*Knights*—Mr. C. E. Fryer, Superintending Inspector of Fisheries Division of the Board of Agriculture and Fisheries since 1903; Mr. R. R. Gales, Indian Public Works Department, Engineer-in-Chief, Hardinge Bridge, Sara, Bengal; Dr. J. Mackenzie, F.R.S., lecturer on cardiac research at the London Hospital, and author of many works on the diseases of the heart; Dr. T. Muir, F.R.S., Superintendent-General of Education, Province of the Cape of Good Hope, Union of South Africa; Mr. W. Pearce, director of William Pearce and Sons (Limited) and Spencer, Chapman, and Mensel (Limited), chemical manufacturers; Mr. E. Rigg, since 1898 Superintendent of the Operative Department of the Royal Mint; Dr. W. N. Shaw, F.R.S., director of the Meteorological Office since 1905 and reader in meteorology in the University of London since 1907; Mr. W. Slingo, Engineer-in-Chief of the General Post Office. *Knight Commander of the Most Honourable Order of the Bath* (K.C.B.)—The Right Hon. Sir John Fletcher, Baron Moulton, F.R.S. *Companions of the Most Honourable Order of the Bath* (C.B.)—Surgeon-General T. M. Corker; Mr. E. H. Tennyson-d'Eyncourt, Director of Naval Construction, Admiralty; Mr. E. J. Cheney, Chief Agricultural Adviser, Board of Agriculture and Fisheries. *Knight Commander of the Most Distinguished Order of St. Michael and St. George* (K.C.M.G.)—Dr. W. Peterson, Principal and Vice-Chancellor of McGill University, Montreal. *Companions of the Most Distinguished Order of St. Michael and St. George* (C.M.G.)—Mr. A. W. G. Bagshawe, Director of the Tropical Diseases Bureau; Dr. D. M. Gordon, Principal and Vice-Chancellor of Queen's University, Kingston, Ontario. *Knight Commander of the Most Eminent Order of the Indian Empire* (K.C.I.E.)—Mr. W. Maxwell, Director-General of Posts and Telegraphs, India; Lieut.-Col. Percy Molesworth Sykes. *Companions of the Most Eminent Order of the Indian Empire* (C.I.E.)—Mr. A. W. Lushington, Imperial Forest Service, Conservator of Forests, Northern Circle, Madras; Mr. G. P. Millet, Indian Forest Service, Senior Conservator of Forests, Bombay Presidency; Lieut.-Col. C. H. D. Ryder, Deputy Superintendent of Survey of India. *Companion of the Imperial Service Order* (I.S.O.)—Rai Chuni Lal Basu Bahadur, First Assistant Chemical Examiner of the Government of India, Teacher of Physics and Chemistry, Campbell Medical School.

WE regret to announce the death on June 5, in his sixty-eighth year, of Mr. F. H. Neville, F.R.S., late lecturer on physics and chemistry in Sidney Sussex College, Cambridge.

ON account of the unfavourable state of the finances of the country, due mostly to the European war, the Peruvian Government has, says *Science*, ordered the closing of the Museum of National History and Archæology at Lima.