

comparative study of behaviour, including the comparison of animal and human behaviour, as possible and useful. In 1951 Dr. Tinbergen wrote of "the almost universal misconception that the causes of man's behaviour are qualitatively different from the causes of animal behaviour", and no doubt this belief still has its adherents; but psychologists, no less than zoologists, may now be taken to accept the view that the comparative method is as appropriate in the study of behaviour as in anatomy, embryology, physiology or biochemistry. Again, both psychologists and ethologists proceed on the principle that behaviour, in Dr. Hinde's words, "is mediated by the nervous system, and every particular pattern of behaviour is mediated by a particular nervous mechanism or pattern of nervous activity".

The main differences, Prof. Knight suggested, between ethologists and many psychologists, especially American psychologists, relate to theory. Some of the difficulties that psychologists see in Lorenz's theoretical system have been expressed by D. O. Hebb and (though he is not himself a psychologist) by D. S. Lehrman, of the American Museum of Natural History.

Three of these difficulties may be put in the form of questions. First: Is the ethologists' use of the comparative method sufficiently strict? It would appear that Lorenz and Dr. Tinbergen do not always confine their comparisons to what is truly homologous, but are sometimes apt to assume that functionally similar behaviour patterns must be caused by fundamentally similar mechanisms; whereas in fact there is plenty of evidence that, at different evolutionary levels, functionally similar behaviour patterns often depend on mechanisms that are very different in origin and fundamental structure.

Second: Are the ethologists' criteria of innateness satisfactory? They ascribe innateness to all behaviour that appears without previous specific practice, and, in particular, to any behaviour pattern that appears in animals that have been raised in isolation from fellow-members of their species and prevented from performing the particular pattern in question. But, as Lehrman has pointed out, an animal isolated from others and prevented from practising a particular behaviour pattern is "not necessarily isolated from the effects of processes and events which contribute to the development of the particular behaviour pattern"; and cases (for example, the nest-building of pregnant rats) can be given of behaviour which satisfies the ethologists' criteria of innateness but is demonstrably dependent on the animals' previous experience.

Third: Are the ethologists on the wrong tack in looking for unitary, autonomously developing behaviour patterns? For heuristic and other reasons, many psychologists are averse from an approach which regards the development of behaviour as involving the maturation of specific behaviour patterns and of specific mechanisms underlying them. They prefer an approach which, while acknowledging the importance of the physical growth of various structures, regards the development of behaviour as a process in which at each stage new patterns of nervous activity, and consequently new patterns of behaviour, emerge from interaction within the organism and between the organism and its environment.

In the subsequent discussion, Dr. W. H. Thorpe (Department of Zoology, University of Cambridge)

said that, in his view, Lorenz's theoretical scheme has greatly stimulated, clarified and simplified the study of behaviour. He referred particularly to its concept of the 'innate releasing mechanism', to its division of behaviour into flexible appetitive behaviour and the relatively rigid consummatory act, and to its distinction between 'directing' and 'releasing' stimuli. He also said that, although Lorenz's theory does take considerable account of innate or inborn behaviour, it is not anti-learning; indeed, it not only accepts the usual kinds of learning but also adds another—'imprinting'. Prof. C. W. Valentine (formerly of the Department of Education, University of Birmingham) said he wished to make it clear that not all psychologists, particularly in Great Britain, are unsympathetic to the idea of instinctive drives and inborn patterns of behaviour. Although the word 'instinct' has for many years been under a ban in American psychology, it is now beginning to reappear, and innate impulses and actions, as well as other constitutional factors, are receiving increasing attention in recent American work in educational and developmental psychology. Prof. T. H. Pear (formerly of the Department of Psychology, University of Manchester) welcomed ethology and its experimental field-studies of birds and a variety of other animals as helping to "break the domination of psychology by American laboratory studies of the rat"; but, while psychologists are right, he said, to be interested in animal behaviour, they must not let this interest so obsess them that they neglect the study of "civilized and sophisticated men and women".

REX KNIGHT

PAUL SABATIER, 1854–1941

By PROF. J. R. PARTINGTON, M.B.E.

PAUL SABATIER, the centenary of whose birth fell on November 5, was born of a modest family in Carcassonne in 1854. In 1874 he passed high on the lists in the entrance examinations for the École Polytechnique and the École Normale Supérieure. His place (fourth) on the list of the Normale was higher and he chose to go there. In 1877 he was top of the list of graduates in his class. After a year as professor at the Lycée at Nîmes, he had the good fortune to become assistant to Berthelot at the Collège de France, where he took his doctorate in 1880 with a thesis on the metallic sulphides. After a year at Bordeaux, he became assistant professor of physics, and in 1883 of chemistry, at Toulouse, becoming professor of chemistry there in 1884 at the early age of thirty. In Toulouse, in spite of an offer to succeed Moissan at the Sorbonne in 1908, Sabatier stayed for the rest of his life, and died there on August 14, 1941, aged eighty-seven*. He became dean of the faculty of science in 1905. He was an excellent and very popular teacher, and long after his retirement, in fact nearly to the end of his life, he continued to lecture. He became *correspondant* of the Academy of Sciences in 1901 and the first non-resident member in 1913. He was Nobel laureate in chemistry in 1912, Davy medallist of the Royal Society in 1912 and foreign member of the Society in 1918, doctor *honoris causa* of the University of

* *C.R. Acad. Sci., Paris*, 213, 281 (1941); *Obituary Notices of Fellows of the Royal Society*, 4, 63 (1942–44); *J. Amer. Chem. Soc.*, 66, 1615 (1944).

Pennsylvania in 1926, and Franklin medallist in 1933.

Sabatier's early work was in physical and inorganic chemistry, some of it in collaboration with his pupil, Jean Baptist Senderens. He first obtained pure hydrogen disulphide by vacuum distillation in 1886, discovered new metallic nitrides, and studied nitroso-disulphonic acid. He also made thermochemical measurements. His most famous work, begun in 1897 and occupying him for thirty years, was a study of the applications of heterogeneous catalysis in organic chemistry, of which he published a summary in his book, "La Catalyse en Chimie Organique", 1912. Although platinum had long been used as a contact mass, and the associated Dutch chemists in 1796 had found that alcohol vapour when passed over heated alumina is decomposed into ethylene and steam, little or no application of catalysis in organic reactions had been made. Sabatier became interested in this field by Mond's work on nickel carbonyl, and he used nickel, as well as other finely divided metals such as copper, as catalysts.

At that time there were two theories of heterogeneous catalysis. Faraday in 1833 had suggested a physical theory that one or more of the reacting gases was condensed by attraction on the surface of the metal. William Charles Henry in 1836 and de la Rive in 1838 had proposed a chemical theory that intermediate compounds, for example, oxides of metals, were formed and decomposed. Sabatier soon proved that the specific action of catalysts strongly supports the chemical theory. He showed that different contact masses produce different reactions. Formic acid vapour passed over heated zinc oxide gives only hydrogen and carbon dioxide, but when passed over heated titanium oxide it gives only steam and carbon monoxide. Chromic oxide can act both in oxidation and in dehydrogenation and dehydration reactions. Heated alumina decomposes alcohol into ethylene and steam, metallic molybdenum and zinc oxide decompose it into acetaldehyde and hydrogen. Sabatier postulated the formation of different intermediate compounds, each with its own mode of decomposition, and he also clearly recognized that some organic reactions are reversible; and in cases where intermediate compounds cannot be isolated, there may be a production of surface compounds (chemisorption), thus linking the two theories of catalysis, the physical and chemical. Recent work has largely confirmed his views.

Sabatier's catalytic hydrogenation technique, carried out with relatively simple apparatus, was applied to the preparation of a large number of organic compounds. He clearly saw the technical importance of his work and took out several patents; but for some reason he did not extend the method to hydrogenation in the liquid phase. This was first studied by Ipatiev and led to a revolution in the fat industry by the hydrogenation of oils with a nickel catalyst.

Sabatier was responsible for opening out a new field in organic chemistry, and his clear appreciation of the importance of physical and inorganic chemistry in that branch of the science was most fruitful. The influence of his great master, Berthelot, with his wide interests, was clearly apparent in all Sabatier's work, and infused new life into organic chemistry at a time when it was becoming stereotyped.

Sabatier's personal qualities were greatly appreciated by his colleagues. Although able to lecture only in French, he was always welcome abroad. He was

one of the great school of French chemists, and his contributions to the science were both extensive and important. The centenary of his birth was marked by commemorative meetings held in Toulouse during November 4-5.

OBITUARIES

Mr. J. P. Bushe-Fox, C.B.E.

JOCELYN PLUNKET BUSHE-FOX died on October 15 at the age of seventy-four, having been ailing for some time and unable to take part in archaeological affairs. Archaeology had been his great interest in life and the subject of his life-work. His education at St. Paul's School, with its fine classical tradition, influenced his choice of field, and it was to Romano-British archaeology that he turned, after a brief interlude in Egypt.

He was one of the ablest of the young men whom Haverfield gathered about him for the initial exploration of the Roman site at Corbridge, Northumberland, and, strongly influenced by the then recent work of James Curle at Newstead, he began the study of stratified pottery of all kinds as a criterion for dating the sites upon which it was found. His Corbridge contribution was not so weighty as those which came later, but it still remains of value to students of the site and subject.

Under the ægis of the Society of Antiquaries, his excavation of two Iron-Age sites, at Swarling and Hengistbury Head, and of the Roman town at Wroxeter (*Viroconium*), laid foundations which have often been obscured by the important superstructures built upon them and have never failed. His work has stood the test of time and the challenge of later developments remarkably well.

His largest task, however, was undertaken after the First World War, in which he served with the distinction and ability of one who came of Irish military stock. He entered the Ancient Monuments Department of H.M. Office of Works (now the Ministry of Works) and undertook on behalf of the Society of Antiquaries the excavation of the Roman site at Richborough. This was a task of unprecedented complication, involving many levels often heavily robbed. The main lines of the history of the place were sorted out in four brilliant reports, in which the most notable feature, in what may appropriately be called the Bushe-Fox tradition, was the meticulous care devoted to the stratified pottery and small objects. Structurally, the most notable achievements were the definition of the great triumphal monument and of the supply-base which preceded it and occupied the Claudian invasion bridge-head.

No other worker has nine research reports of the Society of Antiquaries to his credit; no other perhaps the genial patience and scholarly perseverance to produce their like. They mark an age, and a standard of individual effort which deserves record, admiration and respect. I. A. RICHMOND

Dr. Anthony L. Levy

ANTHONY LEWIS LEVY lost his life on August 21, in a mountaineering accident on Mt. Olympus in the State of Washington, after he had successfully rescued an injured companion from a glacial crevasse.

Born in Romford, Essex, in 1924, Levy attended Brentwood Grammar School, Essex, and the Imperial College of Science and Technology, London, receivin