

"According to the account he gave in my hearing," said Lord Rayleigh, "he had definitely found previously unopened boxes of plates in his laboratory to be fogged for no assignable reason, and, acting I suppose in accordance with the usual human instinct of blaming someone else when things go wrong, he complained to the makers, who naturally had no satisfactory explanation to offer. I believe it was only after Röntgen's discovery that he connected this with the use of highly exhausted vacuum tubes in the neighbourhood. He had, at least, less to reproach himself for than another English man of science, who, it is said, knew that high vacuum discharge tubes were apt to fog photographic plates anywhere near them, and only drew the moral that the plates should be stored elsewhere".

In conclusion, Lord Rayleigh spoke of Sir Arthur Schuster, until recently one of the now fast diminishing band who derived personal inspiration from Clerk Maxwell. Schuster showed complete indifference to the practical applications of science and the plaudits of the gallery. He always retained an open mind to scientific 'heresy'. His reserve and sensitiveness received a great shock at the treatment he met with in the early days of the Great War. He narrowly missed the discovery of the Zeeman effect, and was diverted by Röntgen's discovery from provisional conclusions on his measurements of the deflection of cathode rays in a magnetic field, in both of which problems "he had the root of the matter".

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Animal Intelligence

TWO lectures on animal intelligence were recently given at the Royal Society of Arts* by Dr. David Katz, formerly professor of psychology and education at the University of Rostock, Mecklenburg. Although addressed to a juvenile audience, the matter and form of Dr. Katz's lectures raise serious issues regarding the scientific study of animal behaviour, and for that reason no less than for their attractive quality, the lectures merit close consideration. Their substance and sequence were briefly as follows.

Intelligence is defined as the capacity to adapt to new conditions. In estimating its manifestations in animals, we can easily be misled by spurious performances—as is amply shown in the history of the Elberfeld counting horses, whose activities were such as to persuade the gullible that horses are able to solve even the cube roots of numbers running into millions. The study of animal behaviour has, therefore, to be approached with circumspection, and no simple answer can be given to the question of the comparative merits of animal and human intelligence. The worlds in which animals live are often so different from our own—mainly because of differences in sensory capacities—that it is frequently impossible to find any means of explaining their activities. For example, the manner in which some animals accurately find their way from one place to another, often hundreds of miles distant, remains, in spite of much investigation, a complete mystery.

An analysis of animal intelligence demands a recognition of three forms of behaviour. The first is instinctive behaviour, which is perhaps best

manifested in the insect world. "Instinct," stated Dr. Katz, "is what a whole species has learned to do, as distinct from what an individual member of the species learns for itself." What an animal learns for itself is a higher form of adaptation, and learning through 'trial and error' thus constitutes the second form of behaviour. It is manifested, so far as is known, by most living creatures. The third and highest form of animal intelligence is adaptation, through insight, by the exercise of reason. Behaviour which merits such description occurs only amongst the larger apes, and is exemplified by the well-known instance of the chimpanzee who, in order to reach a banana suspended from a ceiling, climbed on to boxes which it stacked for the purpose.

In appraising Dr. Katz's lectures, it has to be remembered that they were addressed to a juvenile audience, for that fact probably explains why it was that the discourse followed the classical lines laid down for such discussions towards the end of the last century. The question arises, however, whether or not the scheme still provides an adequate framework for the numerous facts about animal behaviour which have been gathered experimentally during the past fifty years, and whether the time has not been reached when even popular reviews of the subject should expand less on its traditional issues, such as instinct, about whose inner nature little or nothing is known, and concentrate more on forms of behaviour the scientific analysis of which has added a little light to the general mystery by which much of the subject is encompassed.

The shortcoming of the classical approach

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results mainly from its too rigid adherence to concepts which have little scientific value. For example, the definition of instinct as something that a species, as opposed to one of its individual members, has learned to do, is eminently sound as a broad description of a type of behaviour. As a hypothesis in the scientific sense of the term, it is valueless. The term 'instinct' covers a multitude of complex activities, each compounded of distinct units, each of which in turn may comprise a number of separate physiological reactions. How these separate reactions are linked, and become linked in the course of evolution, is a problem about which almost nothing is known as yet. Instinct, in short, is a broad term by which we cover our ignorance of a very complex question. The same, in no less degree, is true of the concept of 'insight', which we discover is a term used to designate certain rapid complex adaptive reactions, the essential steps of which are no less obscure than those of 'instinct'.

Dr. Katz told a story of two dogs, the larger of which had a bone which the smaller wished to get. When the smaller animal approached, it was frightened away by the menacing attitude of the other. After a time, the big dog ran out of the house, unnoticed by the smaller one, who, after hearing barks coming from the direction of the garden, immediately went and secured the bone. The original describer of the incident apparently interpreted this as a manifestation of reasoning in the little dog, which, when it heard the big dog barking in the garden, argued that it was now safe to steal the bone. There can be little doubt that a child behaving in the same way would also be regarded as having exercised a certain amount of reason. Dr. Katz, however, suggests that it would be better to suppose that growling at close quarters was a more effective inhibiting factor to the small dog than barking from a distance, and that the smaller animal's final response represented, not the product of a reasoning process, but a release from inhibition. In the circumstances, it is difficult to escape the feeling that were someone to uncover the hidden steps through which an ape solved a problem by so-called insight, there would be many who would cease to see in the performance any attributes of a higher reasoning power—in the same way that Dr. Katz's explanation seems to remove from the behaviour of the little dog any similar quality. The estimation of what constitutes reason in animals is clearly far too arbitrary a process.

The shortcoming of the concept of insight in the study of animal behaviour does not, however, end here. Insight may have been of use when it was a concept designating the highest and most complex stage in an evolutionary scale of

behaviour, but behaviour which by definition cannot be denied similar description has recently been encountered not only among monkeys as well as apes, but also in cats, and even in rats. However humble the organisms in which it has been found, behaviour with insight still remains an altogether mysterious and complex phenomenon. It is well known that the peculiarities of a particular animal may be such as to transform an experimental problem with which it is presented into a meaningless situation, or into something completely different from what was intended; in consequence, most students of behaviour to-day recognise the fact that problems which animals are set in experiments must be carefully arranged with regard to the animal's known sensorimotor capacities. What does not appear to be sufficiently well emphasised is that a successful performance of an animal in an experiment may give the appearance of brilliant reasoning as much because of our own incapacity to understand what is happening as because of the animal's inherent genius. We only shelve our problems by using terms like insight and instinct as if they added anything to our original knowledge of the situations to which they refer, and we only confuse ourselves by adhering to traditional concepts which, for all their antiquity, may be barren of any promise.

Were the spurious issues of the classical approach to animal psychology laid aside, there would remain a vast choice of true scientific material for popular expositions of the subject; and by so doing it would be possible to put before the uninitiated points of view which would be in close sympathy with those that prevail in places where the subject is vigorously pursued by experiment. For example, although the conditioned reflex is primarily a physiological concept, some recent investigations of animal behaviour have shown that its laws have a wider bearing as characteristics of many forms of learning. The statistical study of delayed reactions and delayed alternations, again, has provided much useful and exact information about memory in animals. Discrimination experiments using visual, auditory, temporal and tactile stimuli have given extremely interesting data about perceptual capacities—a topic considered by Dr. Katz. Specific issues such as these are the ones that form an inner nucleus of knowledge from which a fruitful expansion of the study of animal behaviour could be expected. Observations of normal behaviour, or an experimental method which shows qualitatively what an animal can do, and what it cannot do, provide the subject with much of its material, and are undoubtedly necessary for its well-being, but in themselves they cannot provide the necessary data for the integration of a real scientific system of animal psychology.