

# HOW THE BRAINS OF ANIMALS WORK

By Sir E. Ray Lankester.

IN THE NEW YORK TIMES of Sunday, Jan. 22, Sir Ray Lankester, K. C. B., F. R. S., the famous English scientist, discussed various aspects of recent investigation. In to-day's issue he concludes his series of selections from the advance proof sheets of the forthcoming new Encyclopaedia Britannica.

**A**MONG the most interesting of the articles which, in the first installment of my casual pickings from the new book, lack of space prevented my citing are two by Prof. Lloyd Morgan on "The Intelligence of Animals and on Instinct."

The young chicken in the performance of its truly instinctive activities pecks at all sorts of small objects. In doing so it gains a certain amount of initial experience. Very soon it may be observed that some grubs and caterpillars are seized with avidity whenever occasion offers; while others are after a few trials let alone. Broadly speaking, we have here intelligent selection and rejection. Psychologically interpreted what is believed to take place is somewhat as follows: Each grub or caterpillar affords through eyesight an impression or sensation; merely something presented to vision—what psychologists call a visual presentation—and nothing more. But in virtue of previous experience it suggests what was formerly presented to consciousness in that experience. It has meaning. An impression which carries meaning begotten of previous experience is fully perceived, and is raised to the level of a percept in the true sense of that word. Behavior which is influenced and guided by such percepts, that is to say by impressions coupled with a recognition of their indicating a particular line of conduct, is the outcome of perceptual process.

If a dog learns to open a gate by lifting the latch, this may be due to perceptual process. Through previous experience the sight of the latch may suggest meaning for practical behavior. His action may be simply due to the fact that the visual presentation has been directly associated with the appropriate bodily activities, and now by suggestion reinstates similar activities; he may not, though on the other hand he may, exercise conceptual thought. Conception and perception bear to one another the relation of general and particular. Let us suppose that the chick which selects certain caterpillars and rejects others does form concepts. The idea of the general relations of certain phenomena is conceptual, while the recognition of cause and effect in any of the particular cases examined is a percept. The question arises, has the chick any power of thinking in general laws,

or is it unable to go beyond the particular case? If, then, the chick apprehends the idea of "good-for-eating" as exemplified in the particular maggot, and sees the maggot as a concrete case of the abstract and universal "good-for-eating," it has a capacity for conceptual thought. The general, or in technical phraseology, the universal, characteristic "good-for-eating" is present in all that the chick practically finds to be edible; but the chick may just eat the nice caterpillars without thinking for a moment of edibility.

A good deal for human behavior may be interpreted in terms of perceptual intelligence, and a far larger proportion of animal behavior may be so interpreted. But some human conduct cannot be explained save as the outcome of conceptual intelligence. The question is, whether any carefully observed and well-authenticated cases of animal procedure are inexplicable in the absence of conceptual thought, and if so, what concepts are necessarily involved? It is now conceded that the mere collection of anecdotes which result from casual as opposed to systematic observation, can afford no satisfactory basis for an answer to this question. A solution can only be obtained by well-planned observations conducted by those who have an adequate psychological training. Even under these conditions a criterion of the presence or absence of conceptual factors is needed; and such a criterion is not easy to formulate or to apply.

If we institute inquiries with a view to ascertaining how the conceptual factor originates, it appears to be the result of analysis and abstraction, and to be reached by a process of comparison, which becomes intentional and deliberate. If, for example, in educational procedure, we seek to assist children in forming concepts of color, shape, and material, we place before them a number of objects, some round, some square, some triangular; some red, some yellow, some blue, some made of paper, some of wood, some of flannel. Any given object is both red and square and made of flannel, blue and round and made of wood, and so on.

We teach the child to group the objects, to put the blues, yellows and reds together irrespective of shape or material; then all the rounds, squares and triangles together; then all which are made of like material. We thus help the children to grasp that though shape, color and material are combined in each object, yet for the immediate purpose in hand one matters and the others do not matter. That which does matter is abstracted from the

rest. The child has to analyze his experience and fix his attention on some given factor therein. He has to compare the objects intentionally, that is, for a definite end. He reaches, for example, the concept "blue" and realizes that the word may be applied to a number of particular objects differing in other respects, and that each is an example of what he understands by the word blue. Whether he could reach the concept without words is a question on which opinions differ.

Locke held that animals are incapable of the abstraction which is implied in such procedure. Dr. Stout considers that observation of their behavior shows little if any evidence of intentional comparison. And it is open to discussion whether they are able to analyze the situations opened up by their perceptual behavior. The matter cannot be fully considered here. It must suffice if enough has been said to show the nature of the distinction between perceptual and conceptual process.

An example may, however, be given of the kind of observation which, since it was carefully planned and carried out, is of evidential value. Dr. Alexander Hill's fox terrier was "taught" to open the side door of a large box by lifting a projecting latch. When the door swung open he was never allowed to find anything in the box, but was given a piece of biscuit from the hand. Then a warm chop-bone was put inside the box, which was placed in a courtyard so that the dog would pass it when no one was near, though he could be watched from the window. The net result was that the dog failed to apply at once his quite familiar experience of lifting the latch in the usual way. Here two situations were presented: first, the box with people around and a piece of biscuit to be obtained from one of them by lifting the latch; secondly, the box with no one near and a redolent chop-bone inside. To us it is obvious enough that the lifted latch is the key to the development of both situations; we analyze them so as to get the essential factor which matters. The dog apparently did not do so. He seemingly was incapable of this modest amount of analysis and abstraction.

We can now see more clearly what was meant by saying that Romanes's phrase (that intelligence "implies a conscious knowledge of the relation between means employed and ends attained") is ambiguous. The dog which lifts the latch of a gate and goes out when the gate swings open undoubtedly employs means to reach an end; he need not analytically think the means as conducive to the end and the end as reached by the means; he need not conceive this relationship as

exemplified in a number of particular cases; he need not recognize the universal as distinguished from the particular. Perceptual experience, therefore, does not imply what Romanes states if his words are interpreted in terms of conception; it does, however, imply that the relationship is contained within the unanalyzed whole of experience and is a factor contributing to an acquired mode of behavior.

Opinions differ as to how far, if at all, animals show what we are bound to interpret as the rudiments of conceptual thinking. It is perhaps best to regard the question as still unsettled. The evolutionist school, but not without exception, inclines to the view that we find in animals the beginnings of conceptual experience; some are, however, of opinion that, in the absence of language, conceptual analysis is well-nigh impossible, and in any case cannot be carried far. To an evolutionist the assertion that conceptual intelligence could not conceivably have had a natural genesis from perceptual experience, appears to be made on grounds other than scientific. Conscious experience is, indeed, unique, and is distinct in kind from the energy with which the physicist or the physiologist has to deal, but within conscious experience from its earliest manifestation to its latest development scientific psychology only recognizes differences of mode.

In another article in the new Encyclopaedia Britannica Prof. Morgan discusses the interesting question of "Instinct."

A good example of the methods of recent investigation is to be found in Dr. G. W. and Mrs. Peckham's minute observations on the habits and instincts of the solitary wasps. They enumerate the following primary types of instinctive behavior; the manner of attacking and capturing a particular kind of prey which alone affords the requisite presentation to sense; the manner of conveying the prey to the nest; the general style and locality of the nest; the method and order of procedure in stocking the nest with food for the unseen young. It is noteworthy, however, that although the manner in which the prey is stung (for example) is on the whole similar in the case of the members of any given species—that is to say, all the wasps of the species behave in very much the same manner—yet there are minor variations in detail.

The outcome of prolonged and careful observation is of importance. It affords a point of departure for the interpretation of the genesis of existing instincts. Furthermore, the observations on American wasps render it probable that the

earlier accounts of the instinctive behavior of such wasps are exaggerated. Romanes thought that the manner of stinging and paralyzing their prey might be justly deemed the most remarkable instinct in the world. Spiders, caterpillars, and grasshoppers are, he said, stung in their chief nerve centres, in consequence of which the victims are not killed outright, but rendered motionless, and continue to live in this paralyzed condition for several weeks, being thus available as food for the larvae when these are hatched. Of course, he adds, the extraordinary fact which stands to be explained is that of the precise anatomical, not to say the physiological, knowledge which appears to be displayed by the insect in stinging only the nerve centres of its prey.

But the Peckhams' careful observations and experiments show that, with the American wasps, the victims stored in the nests are quite as often dead as alive; that those which are only paralyzed live for a varying number of days, some more, some less; that wasp larvae thrive just as well on dead victims, sometimes dried up, sometimes undergoing decomposition, as on living and paralyzed prey; that the nerve centres are not stung with the supposed uniformity, and that in some cases paralysis, in others death, follows when the victims are stung in parts far removed from any nerve centre. It would seem that by the stinging of insects or spiders their powers of resistance are overcome and their escape prevented; that some are killed outright and some paralyzed is merely an incidental result.

Granted that instinctive modes of behavior are hereditary and definite within the limits of congenital variation, the question of their manner of genesis is narrowed to a clear issue. Do they originate through the natural selection of those variations which are the more adaptive, or do they originate through the inheritance of those acquired modifications which are impressed on the nervous system in the course of individual and intelligent use?

Romanes, taking up the inquiry where Darwin left it, came to the conclusion that some instinctive modes of behavior which he termed "primary" are due to the operation of natural selection alone; that others, which he termed "secondary," and of which he could give few examples, were due to the inheritance of acquired modifications from which, in the phrase of G. H. Lewes, the intelligence had lapsed; while others, which he termed "blended," were partly due to natural selection and partly resulted from the inheritance of acquired habit.