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THE INTERNATIONAL SCIENTIFIC SERIES.

ANIMAL INTELLIGENCE.

BY

John
GEORGE J. ROMANES, M. A., LL. D., F. R. S.,

ZOOLOGICAL SECRETARY OF THE LINNEAN SOCIETY.

^{5^x}NEW YORK:

D. APPLETON AND COMPANY,

1, 3, AND 5 BOND STREET.

1883.

INTRODUCTION.

BEFORE we begin to consider the phenomena of mind throughout the animal kingdom it is desirable that we should understand, as far as possible, what it is that we exactly mean by mind. Now, by mind we may mean two very different things, according as we contemplate it in our own individual selves, or in other organisms. For if we contemplate our own mind, we have an immediate cognizance of a certain flow of thoughts or feelings, which are the most ultimate things, and indeed the only things, of which we are cognisant. But if we contemplate mind in other persons or organisms, we have no such immediate cognizance of thoughts or feelings. In such cases we can only *infer* the existence and the nature of thoughts and feelings from the activities of the organisms which appear to exhibit them. Thus it is that we may have a subjective analysis of mind and an objective analysis of mind—the difference between the two consisting in this, that in our subjective analysis we are restricted to the limits of a single isolated mind which we call our own, and within the territory of which we have immediate cognizance of all the processes that are going on, or at any rate of all the processes that fall within the scope of our introspection. But in our objective analysis of other or foreign minds we have no such immediate cognizance; all our knowledge of their operations is derived, as it were, through the medium of ambassadors—these ambassadors being the activities of the organism. Hence it is evident that in our study of animal intelligence we are wholly restricted to the objective method. Starting from what I know subjectively

of the operations of my own individual mind, and the activities which in my own organism they prompt, I proceed by analogy to infer from the observable activities of other organisms what are the mental operations that underlie them.

Now, in this mode of procedure what is the kind of activities which may be regarded as indicative of mind? I certainly do not so regard the flowing of a river or the blowing of the wind. Why? First, because the objects are too remote in kind from my own organism to admit of my drawing any reasonable analogy between them and it; and, secondly, because the activities which they present are of invariably the same kind under the same circumstances; they afford no evidence of feeling or purpose. In other words, two conditions require to be satisfied before we even begin to imagine that observable activities are indicative of mind: first, the activities must be displayed by a living organism; and secondly, they must be of a kind to suggest the presence of two elements which we recognise as the distinctive characteristics of mind as such—consciousness and choice.

So far, then, the case seems simple enough. Wherever we see a living organism apparently exerting intentional choice, we might infer that it is conscious choice, and therefore that the organism has a mind. But further reflection shows us that this is just what we cannot do; for although it is true that there is no mind without the power of conscious choice, it is not true that all apparent choice is due to mind. In our own organisms, for instance, we find a great many adaptive movements performed without choice or even consciousness coming into play at all—such, for instance, as in the beating of our hearts. And not only so, but physiological experiments and pathological lesions prove that in our own and in other organisms the mechanism of the nervous system is sufficient, without the intervention of consciousness, to produce muscular movements of a highly co-ordinate and apparently intentional character. Thus, for instance, if a man has his back broken in such a way as to sever the nervous connection between his brain and lower extremi-

ties, on pinching or tickling his feet they are drawn suddenly away from the irritation, although the man is quite unconscious of the adaptive movement of his muscles; the lower nerve-centres of the spinal cord are competent to bring about this movement of adaptive response without requiring to be directed by the brain. This non-mental operation of the lower nerve-centres in the production of apparently intentional movements is called Reflex Action, and the cases of its occurrence, even within the limits of our own organism, are literally numberless. Therefore, in view of such non-mental nervous adjustment, leading to movements which are only in appearance intentional, it clearly becomes a matter of great difficulty to say in the case of the lower animals whether any action which appears to indicate intelligent choice is not really action of the reflex kind.

On this whole subject of mind-like and yet not truly mental action I shall have much to say in my subsequent treatise, where I shall be concerned among other things with tracing the probable genesis of mind from non-mental antecedents. But here it is sufficient merely to make this general statement of the fact, that even within the experience supplied by our own organisms adaptive movements of a highly complex and therefore apparently purposive character may be performed without any real purpose, or even consciousness of their performance. It thus becomes evident that before we can predicate the bare existence of mind in the lower animals, we need some yet more definite criterion of mind than that which is supplied by the adaptive actions of a living organism, howsoever apparently intentional such actions may be. Such a criterion I have now to lay down, and I think it is one that is as practically adequate as it is theoretically legitimate.

Objectively considered, the only distinction between adaptive movements due to reflex action and adaptive movements due to mental perception, consists in the former depending on inherited mechanisms within the nervous system being so constructed as to effect *particular* adaptive movements in response to *particular* stimula-

tions, while the latter are independent of any such inherited adjustment of special mechanisms to the exigencies of special circumstances. Reflex actions under the influence of their appropriate stimuli may be compared to the actions of a machine under the manipulations of an operator; when certain springs of action are touched by certain stimuli, the whole machine is thrown into appropriate movement; there is no room for choice, there is no room for uncertainty; but as surely as any of these inherited mechanisms are affected by the stimulus with reference to which it has been constructed to act, so surely will it act in precisely the same way as it always has acted. But the case with conscious mental adjustment is quite different. For, without at present going into the question concerning the relation of body and mind, or waiting to ask whether cases of mental adjustment are not really quite as *mechanical* in the sense of being the necessary result or correlative of a chain of physical sequences due to a physical stimulation, it is enough to point to the variable and incalculable character of mental adjustments as distinguished from the constant and foreseeable character of reflex adjustments. All, in fact, that in an objective sense we can mean by a mental adjustment is an adjustment of a kind that has not been definitely fixed by heredity as the only adjustment possible in the given circumstances of stimulation. For were there no alternative of adjustment, the case, in an animal at least, would be indistinguishable from one of reflex action.

It is, then, adaptive action by a living organism in cases where the inherited machinery of the nervous system does not furnish data for our prevision of what the adaptive action must necessarily be—it is only here that we recognise the objective evidence of mind. The criterion of mind, therefore, which I propose, and to which I shall adhere throughout the present volume, is as follows:—Does the organism learn to make new adjustments, or to modify old ones, in accordance with the results of its own individual experience? If it does so, the fact cannot be due merely to reflex action in the sense above described,

for it is impossible that heredity can have provided in advance for innovations upon, or alterations of, its machinery during the lifetime of a particular individual.

In my next work I shall have occasion to consider this criterion of mind more carefully, and then it will be shown that as here stated the criterion is not rigidly exclusive, either, on the one hand, of a possibly mental element in apparently non-mental adjustments, or, conversely, of a possibly non-mental element in apparently mental adjustments. But, nevertheless, the criterion is the best that is available, and, as it will be found sufficient for all the purposes of the present work, its more minute analysis had better be deferred till I shall have to treat of the probable evolution of mind from non-mental antecedents. I may, however, here explain that in my use of this criterion I shall always regard it as fixing only the upper limit of non-mental action; I shall never regard it as fixing the lower limit of mental action. For it is clear that long before mind has advanced sufficiently far in the scale of development to become amenable to the test in question, it has probably begun to dawn as nascent subjectivity. In other words, because a lowly organised animal does *not* learn by its own individual experience, we may not therefore conclude that in performing its natural or ancestral adaptations to appropriate stimuli consciousness, or the mind-element, is wholly absent; we can only say that this element, if present, reveals no evidence of the fact. But, on the other hand, if a lowly organised animal *does* learn by its own individual experience, we are in possession of the best available evidence of conscious memory leading to intentional adaptation. Therefore our criterion applies to the upper limit of non-mental action, not to the lower limit of mental.

Of course to the sceptic this criterion may appear unsatisfactory, since it depends, not on direct knowledge, but on inference. Here, however, it seems enough to point out, as already observed, that it is the best criterion available; and further, that scepticism of this kind is logically bound to deny evidence of mind, not only in the case of the lower animals, but also in that of the

higher, and even in that of men other than the sceptic himself. For all objections which could apply to the use of this criterion of mind in the animal kingdom would apply with equal force to the evidence of any mind other than that of the individual objector. This is obvious, because, as I have already observed, the only evidence we can have of objective mind is that which is furnished by objective activities ; and as the subjective mind can never become assimilated with the objective so as to learn by direct feeling the mental processes which there accompany the objective activities, it is clearly impossible to satisfy any one who may choose to doubt the validity of inference, that in any case other than his own mental processes ever do accompany objective activities. Thus it is that philosophy can supply no demonstrative refutation of idealism, even of the most extravagant form. Common sense, however, universally feels that analogy is here a safer guide to truth than the sceptical demand for impossible evidence ; so that if the objective existence of other organisms and their activities is granted—without which postulate comparative psychology, like all the other sciences, would be an unsubstantial dream—common sense will always and without question conclude that the activities of organisms other than our own, when analogous to those activities of our own which we know to be accompanied by certain mental states, are in them accompanied by analogous mental states.

The theory of animal automatism, therefore, which is usually attributed to Descartes (although it is not quite clear how far this great philosopher really entertained the theory), can never be accepted by common sense ; and even as a philosophical speculation it will be seen, from what has just been said, that by no feat of logic is it possible to make the theory apply to animals to the exclusion of man. The expression of fear or affection by a dog involves quite as distinctive and complex a series of neuromuscular actions as does the expression of similar emotions by a human being ; and therefore, if the evidence of corresponding mental states is held to be inadequate in the one case, it must in consistency be held similarly

inadequate in the other. And likewise, of course, with all other exhibitions of mental life.

It is quite true, however, that since the days of Descartes—or rather, we might say, since the days of Joule—the question of animal automatism has assumed a new or more defined aspect, seeing that it now runs straight into the most profound and insoluble problem that has ever been presented to human thought—viz. the relation of body to mind in view of the doctrine of the conservation of energy. I shall subsequently have occasion to consider this problem with the close attention that it demands; but in the present volume, which has to deal only with the phenomena of mind as such, I expressly pass the problem aside as one reserved for separate treatment. Here I desire only to make it plain that the mind of animals must be placed in the same category, with reference to this problem, as the mind of man; and that we cannot without gross inconsistency ignore or question the evidence of mind in the former, while we accept precisely the same kind of evidence as sufficient proof of mind in the latter.

And this proof, as I have endeavoured to show, is in all cases and in its last analysis the fact of a living organism showing itself able to learn by its own individual experience. Wherever we find an animal able to do this, we have the same right to predicate mind as existing in such an animal that we have to predicate it as existing in any human being other than ourselves. For instance, a dog has always been accustomed to eat a piece of meat when his organism requires nourishment, and when his olfactory nerves respond to the particular stimulus occasioned by the proximity of the food. So far, it may be said, there is no evidence of mind; the whole series of events comprised in the stimulations and muscular movements may be due to reflex action alone. But now suppose that by a number of lessons the dog has been taught not to eat the meat when he is hungry until he receives a certain verbal signal: then we have exactly the same kind of evidence that the dog's actions are prompted by mind as we have that the actions of a man are so prompted.¹ Now we find

¹ Of course it may be said that we have no evidence of *prompting*

that the lower down we go in the animal kingdom, the more we observe reflex action, or non-mental adjustment, to predominate over volitional action, or mental adjustment. That is to say, the lower down we go in the animal kingdom, the less capacity do we find for changing adjustive movements in correspondence with changed conditions; it becomes more and more hopeless to *teach* animals—that is, to establish associations of ideas; and the reason of this, of course, is that ideas or mental units become fewer and less definite the lower we descend through the structure of mind.

It is not my object in the present work to enter upon any analysis of the operations of mind, as this will require to be done as fully as possible in my next work. Nevertheless, a few words must here be said with regard to the main divisions of mental operation, in order to define closely the meanings which I shall attach to certain terms relating to these divisions, and the use of which I cannot avoid.

The terms sensation, perception, emotion, and volition need not here be considered. I shall use them in their ordinary psychological significations; and although I shall subsequently have to analyse each of the organic or mental states which they respectively denote, there will be no occasion in the present volume to enter upon this subject. I may, however, point out one general consideration to which I shall throughout adhere. Taking it for granted that the external indications of mental processes which we observe in animals are trustworthy, so that we are justified in inferring particular mental states from particular bodily actions, it follows that in consistency we must everywhere apply the same criteria.

For instance, if we find a dog or a monkey exhibiting marked expressions of affection, sympathy, jealousy, rage, &c., few persons are sceptical enough to doubt that the complete analogy which these expressions afford with

in either case; but this is the side issue which concerns the general relation of body and mind, and has nothing to do with the guarantee of inferring the presence of mind in particular cases.

those which are manifested by man, sufficiently prove the existence of mental states analogous to those in man of which these expressions are the outward and visible signs. But when we find an ant or a bee apparently exhibiting by its actions these same emotions, few persons are sufficiently non-sceptical not to doubt whether the outward and visible signs are here trustworthy as evidence of analogous or corresponding inward and mental states. The whole organisation of such a creature is so different from that of a man that it becomes questionable how far analogy drawn from the activities of the insect is a safe guide to the inferring of mental states—particularly in view of the fact that in many respects, such as in the great preponderance of ‘instinct’ over ‘reason,’ the psychology of an insect is demonstrably a widely different thing from that of a man. Now it is, of course, perfectly true that the less the resemblance the less is the value of any analogy built upon the resemblance, and therefore that the inference of an ant or a bee feeling sympathy or rage is not so valid as is the similar inference in the case of a dog or a monkey. Still it is an inference, and, so far as it goes, a valid one—being, in fact, the only inference available. That is to say, if we observe an ant or a bee apparently exhibiting sympathy or rage, we must either conclude that some psychological state resembling that of sympathy or rage is present, or else refuse to think about the subject at all; from the observable facts there is no other inference open. Therefore, having full regard to the progressive weakening of the analogy from human to brute psychology as we recede through the animal kingdom downwards from man, still, as it is the only analogy available, I shall follow it throughout the animal series.

It may not, however, be superfluous to point out that if we have full regard to this progressive weakening of the analogy, we must feel less and less certain of the real similarity of the mental states compared; so that when we get down as low as the insects, I think the most we can confidently assert is that the known facts of human psychology furnish the best avail-

able pattern of the probable facts of insect psychology. Just as the theologians tell us—and logically enough—that if there is a Divine Mind, the best, and indeed only, conception we can form of it is that which is formed on the analogy, however imperfect, supplied by the human mind; so with ‘inverted anthropomorphism’ we must apply a similar consideration with a similar conclusion to the animal mind. The mental states of an insect may be widely different from those of a man, and yet most probably the nearest conception that we can form of their true nature is that which we form by assimilating them to the pattern of the only mental states with which we are actually acquainted. And this consideration, it is needless to point out, has a special validity to the evolutionist, inasmuch as upon his theory there must be a psychological, no less than a physiological, continuity extending throughout the length and breadth of the animal kingdom.

In these preliminary remarks only one other point requires brief consideration, and this has reference to the distinction between what in popular phraseology is called ‘Instinct’ and ‘Reason.’ I shall not here enter upon any elaborate analysis of a distinction which is undoubtedly valid, but shall confine my remarks to explaining the sense in which I shall everywhere use these terms.

Few words in our language have been subject to a greater variety of meanings than the word instinct. In popular phraseology, descended from the Middle Ages, all the mental faculties of the animal are termed instinctive, in contradistinction to those of man, which are termed rational. But unless we commit ourselves to an obvious reasoning in a circle, we must avoid assuming that all actions of animals are instinctive, and then arguing that because they are instinctive, therefore they differ from the rational actions of man. The question really lies in what is here assumed, and we can only answer it by examining in what essential respect instinct differs from reason.

Again, Addison says:—

I look upon instinct as upon the principle of gravitation in bodies, which is not to be explained by any known qualities inherent in the bodies themselves, nor from any laws of mechanism, but as an immediate impression from the first Mover, and the Divine energy acting in the creatures.

This mode of ‘looking upon instinct’ is merely to exclude the subject from the sphere of inquiry, and so to abstain from any attempt at definition.

Innumerable other opinions might be quoted from well-known writers, ‘looking upon instinct’ in widely different ways; but as this is not an historical work, I shall pass on at once to the manner in which science looks upon it, or, at least, the manner in which it will always be looked upon throughout the present work.

Without concerning ourselves with the origin of instincts, and so without reference to the theory of evolution, we have to consider the most conspicuous and distinctive features of instinct as it now exists. The most important point to observe in the first instance is that instinct involves *mental* operations; for this is the only point that serves to distinguish instinctive action from reflex. Reflex action, as already explained, is non-mental neuro-muscular adaptation to appropriate stimuli; but instinctive action is this and something more; there is in it the element of mind. Such, at least, is instinctive action in the sense that I shall always allude to it. I am, of course, aware that the limitation which I thus impose is one which is ignored, or not recognised, by many writers even among psychologists; but I am persuaded that if we are to have any approach to definiteness in the terms which we employ—not to say of clearness in our ideas concerning the things of which we speak—it is most desirable to restrict the word instinct to mental as distinguished from non-mental activity. No doubt it is often difficult, or even impossible, to decide whether or not a given action implies the presence of the mind-element—*i.e.*, conscious as distinguished from unconscious adaptation; but this is altogether a separate matter, and has nothing to do with the question of

defining instinct in a manner which shall be formally exclusive, on the one hand of reflex action, and on the other of reason. As Virchow truly observes, 'it is difficult or impossible to draw the line between instinctive and reflex action;' but at least the difficulty may be narrowed down to deciding in particular cases whether or not an action falls into this or that category of definition; there is no reason why the difficulty should arise on account of any ambiguity of the definitions themselves. Therefore I endeavour to draw as sharply as possible the line which *in theory* should be taken to separate instinctive from reflex action; and this line, as I have already said, is constituted by the boundary of non-mental or unconscious adjustment, with adjustment in which there is concerned consciousness or mind.

Having thus, I hope, made it clear that the difficulty of drawing a distinction between reflex and instinctive actions as a class is one thing, and that the difficulty of assigning particular actions to one or the other of our categories is another thing, we may next perceive that the former difficulty is obviated by the distinction which I have imposed, and that the latter only arises from the fact that on the objective side there is no distinction impossible. The former difficulty is obviated by the distinction which I have drawn, simply because the distinction is itself a definite one. In particular cases of adjustive action we may not always be able to affirm whether consciousness of their performance is present or absent; but, as I have already said, this does not affect the validity of our definition; all we can say of such cases is that if the performance in question is attended with consciousness it is instinctive, and if not it is reflex.

And the difficulty of assigning particular actions to one or other of these two categories arises, as I have said, merely because on the objective side, or the side of the nervous system, there is no distinction to be drawn. Whether or not a neural process is accompanied by a mental process, it is in itself the same. The advent and development of consciousness, although progressively converting reflex action into instinctive, and instinctive into

rational, does this exclusively in the sphere of subjectivity; the nervous processes engaged are throughout the same in kind, and differ only in the relative degrees of their complexity. Therefore, as the dawn of consciousness or the rise of the mind-element is gradual and undefined, both in the animal kingdom and in the growing child, it is but necessary that in the early morning, as it were, of consciousness any distinction between the mental and the non-mental should be obscure, and generally impossible to determine. Thus, for instance, a child at birth does not close its eyes upon the near approach of a threatening body, and it only learns to do so by degrees as the result of experience; at first, therefore, the action of closing the eyelids in order to protect the eyes may be said to be instinctive, in that it involves the mind-element:¹ yet it afterwards becomes a reflex which asserts itself even in opposition to the will. And, conversely, sucking in a new-born child, or a child *in utero*, is, in accordance with my definition, a reflex action; yet in later life, when consciousness becomes more developed and the child *seeks* the breast, sucking may properly be called an instinctive action. Therefore it is that, as in the ascending scale of objective complexity the mind-element arises and advances gradually, many particular cases which occupy the undefined boundary between reflex action and instinct cannot be assigned with confidence either to the one region or to the other.

We see then the point, and the only point, wherein instinct can be consistently separated from reflex action; viz., in presenting a mental constituent. Next we must consider wherein instinct may be separated from reason. And for this purpose we may best begin by considering what we mean by reason.

The term 'reason' is used in significations almost as various as those which are applied to 'instinct.' Some-

¹ *I.e.*, ancestral as well as individual. If the race had not always had occasion to close the eyelids to protect the eyes, it is certain that the young child would not so quickly learn to do so in virtue of its own individual experience alone; and as the action cannot be attributed to any process of conscious inference, it is not rational; but we have seen that it is not originally reflex; therefore it is instinctive.

times it stands for all the distinctively human faculties taken collectively, and in antithesis to the mental faculties of the brute; while at other times it is taken to mean the distinctively human faculties of intellect.

Dr. Johnson defines it as 'the power by which man deduces one proposition from another, and proceeds from premises to consequences.' This definition presupposes language, and therefore ignores all cases of inference not thrown into the formal shape of predication. Yet even in man the majority of inferences drawn by the mind never emerge as articulate propositions; so that although, as we shall have occasion fully to observe in my subsequent work, there is much profound philosophy in identifying reason with speech as they were identified in the term *Logos*, yet for purposes of careful definition so to identify intellect with language is clearly a mistake.

More correctly, the word reason is used to signify the power of perceiving analogies or ratios, and is in this sense equivalent to the term 'ratiocination,' or the faculty of deducing inferences from a perceived equivalency of relations. Such is the only use of the word that is strictly legitimate, and it is thus that I shall use it throughout the present treatise. This faculty, however, of balancing relations, drawing inferences, and so of forecasting probabilities, admits of numberless degrees; and as in the designation of its lower manifestations it sounds somewhat unusual to employ the word reason, I shall in these cases frequently substitute the word intelligence. Where we find, for instance, that an oyster profits by individual experience, or is able to perceive new relations and suitably to act upon the result of its perceptions, I think it sounds less unusual to speak of the oyster as displaying intelligence than as displaying reason. On this account I shall use the former term to signify the lower degrees of the ratiocinative faculty; and thus in my usage it will be opposed to such terms as instinct, reflex action, &c., in the same manner as the term reason is so opposed. This is a point which, for the sake of clearness, I desire the reader to retain in his memory. I shall always speak of intelligence and intellect in antithesis to instinct, emo-

tion, and the rest, as implying mental faculties the same in kind as those which in ourselves we call rational.

Now it is notorious that no distinct line can be drawn between instinct and reason. Whether we look to the growing child or to the ascending scale of animal life, we find that instinct shades into reason by imperceptible degrees, or, as Pope expresses it, that these principles are 'for ever separate, yet for ever near.' Nor is this other than the principles of evolution would lead us to expect, as I shall afterwards have abundant occasion to show. Here, however, we are only concerned with drawing what distinction we can between instinct and reason as these faculties are actually presented to our observation. And this in a general way it is not difficult to do.

We have seen that instinct involves 'mental operations,' and that by this feature it is distinguished from reflex action; we have now to consider the features by which it is distinguished from reason. These are accurately, though not completely, conveyed by Sir Benjamin Brodie, who defines instinct as 'a principle by which animals are induced, independently of experience and reasoning, to the performances of certain voluntary acts, which are necessary to their preservation as individuals, or to the continuance of the species, or in some other way convenient to them.'¹ This definition, as I have said, is accurate as far as it goes, but it does not state with sufficient generality and terseness that all instinctive action is adaptive; nor does it clearly bring out the distinction between instinct and reason which is thus well conveyed by the definition of Hartmann, who says in his 'Philosophy of the Unconscious,' that 'instinct is action taken in pursuance of an end, but without conscious perception of what the end is.' This definition, however, is likewise defective in that it omits another of the important differentia of instinct—namely, the uniformity of instinctive action as performed by different individuals of the same species. Including this feature, therefore, we may more accurately and completely define instinct as mental action (whether in animals or human beings),

¹ *Psychological Researches*, p. 187.

directed towards the accomplishing of adaptive movement, antecedent to individual experience, without necessary knowledge of the relation between the means employed and the ends attained, but similarly performed under the same appropriate circumstances by all the individuals of the same species. Now in every one of these respects, with the exception of containing a mental constituent and in being concerned in adaptive action, instinct differs from reason. For reason, besides involving a mental constituent, and besides being concerned in adaptive action, is always subsequent to individual experience, never acts but upon a definite and often laboriously acquired knowledge of the relation between means and ends, and is very far from being always similarly performed under the same appropriate circumstances by all the individuals of the same species.

Thus the distinction between instinct and reason is both more definite and more manifold than is that between instinct and reflex action. Nevertheless, in particular cases there is as much difficulty in classifying certain actions as instinctive or rational, as there is in cases where the question lies between instinct and reflex action. And the explanation of this is, as already observed, that instinct passes into reason by imperceptible degrees; so that actions in the main instinctive are very commonly tempered with what Pierre Huber calls 'a little dose of judgment or reason,' and *vice versâ*. But here, again, the difficulty which attaches to the classification of particular actions has no reference to the validity of the distinctions between the two classes of actions; these are definite and precise, whatever difficulty there may be in applying them to particular cases.

Another point of difference between instinct and reason may be noticed which, although not of invariable, is of very general applicability. It will have been observed, from what has already been said, that the essential respect in which instinct differs from reason consists in the amount of conscious deliberation which the two processes respectively involve. Instinctive actions are actions which, owing to their frequent repetition, become

so habitual in the course of generations that all the individuals of the same species automatically perform the same actions under the stimulus supplied by the same appropriate circumstances. Rational actions, on the other hand, are actions which are required to meet circumstances of comparatively rare occurrence in the life-history of the species, and which therefore can only be performed by an intentional effort of adaptation. Consequently there arises the subordinate distinction to which I allude, viz., that instinctive actions are only performed under particular circumstances which have been frequently experienced during the life-history of the species; whereas rational actions are performed under varied circumstances, and serve to meet novel exigencies which may never before have occurred even in the life-history of the individual.

Thus, then, upon the whole, we may lay down our several definitions in their most complete form.

Reflex action is non-mental neuro-muscular adjustment, due to the inherited mechanism of the nervous system, which is formed to respond to particular and often recurring stimuli, by giving rise to particular movements of an adaptive though not of an intentional kind.

Instinct is reflex action into which there is imported the element of consciousness. The term is therefore a generic one, comprising all those faculties of mind which are concerned in conscious and adaptive action, antecedent to individual experience, without necessary knowledge of the relation between means employed and ends attained, but similarly performed under similar and frequently recurring circumstances by all the individuals of the same species.

Reason or intelligence is the faculty which is concerned in the intentional adaptation of means to ends. It therefore implies the conscious knowledge of the relation between means employed and ends attained, and may be exercised in adaptation to circumstances novel alike to the experience of the individual and to that of the species.