



*ANIMAL INTELLIGENCE.*¹

ANIMAL INTELLIGENCE is a subject which has always been of considerable interest to philosophical minds ; but, as most of you are probably aware, the interest attaching to this subject has of late years been greatly increased by the significance which it has acquired in relation to the theory of Descent. The study of Animal Intelligence being thus, without question, fraught with high importance to the science of our time, in adducing before this illustrious assembly some of the results which that study has yielded, I shall endeavour to treat them in a manner purely scientific. I shall try, as much as possible, to avoid mere anecdote, except in so far as it is desirable that I should put you in possession of a few typical facts to illustrate the various principles which I shall have occasion to expound. I shall seek to render apparent the more important of the issues which the subject, as a whole, involves, as well as the considerations by which alone these issues can be legitimately settled. I shall attempt to state my own views with the utmost candour ; and if I shall appear to ignore any arguments opposed to the conclusions at which I shall arrive, it will only be because I believe those arguments to admit of easy refutation. And, in order that my exposition may be sufficiently comprehensive, I shall endeavour to point out the relations that subsist between the intelligence of animals and the intelligence of man. The aim and scope of the present lecture will therefore be to discuss, as fully as time permits, the facts and the principles of Comparative Psychology.

As human intelligence is the only order of intelligence with which we are directly acquainted, and as it is, moreover, the highest order of intelligence known to science, we may most conveniently adopt it as our standard of comparison. I shall therefore begin by very briefly detailing those principles of human psychology which we shall afterwards find to be of the most essential importance in their bearings on the subject which I have undertaken to discuss.

When I allow my eyes to travel over this vast assembly, my mind receives, through their instrumentality, a countless number of im-

¹ An evening lecture delivered before the British Association at Dublin, August 16, 1878.

pressions. So far as these impressions enter into the general stream of my consciousness, they constitute what are called perceptions. Suppose, now, that I were to close my eyes, and to fix my attention on the memory of some particular perception which I had just experienced—say the memory of some particular face. This mental image of a previous perception would be what is called an idea. Lastly, suppose that I were to analyse a number of the faces which I had perceived, I should find that, although no two of them are exactly alike, they all bear a certain general resemblance to one another. Thus from the multitude of faces which I now perceive it becomes possible for my mind to abstract from them all the essential qualities of a face as a face; and such a mental abstraction of qualities would then constitute what I might call my abstract idea of a face in general, as distinguished from my concrete idea, or memory, of any face in particular.

Thus, then, we have three stages:—1st, that of immediate perception; 2nd, that of ideal representation of particular objects; and, 3rd, that of a generalised conception, or abstract idea, of a number of qualities which a whole class of objects agree in possessing. It will be convenient to split the latter division into two subdivisions, viz. abstract ideas which are sufficiently simple to be developed without the aid of language, and abstract ideas which are so complex as not to admit of development without the aid of language. As an instance of the former class of abstract ideas we may take the idea of food. This is aroused in our minds by the feeling of hunger; and while the idea when thus aroused is clearly quite independent of language, it is no less clearly what is called an abstract idea. For it is by no means necessary that the idea of food which is present to the mind should be the idea of some special kind of food; on the contrary, the idea is usually that of food in *general*, and this idea it is which usually prompts us to seek for any kind of food in *particular*. Simple abstract ideas, therefore, may be formed without the assistance of language; and for this reason they are comprised within what has been called the Logic of Feelings. But abstract ideas of a more elaborated type can only be formed by the help of words, and are therefore comprised within what has been called the Logic of Signs. The manner in which language thus operates in the formation of highly abstract ideas is easily explained. Because we see that a great many objects present a certain quality in common, such as redness, we find it convenient to give this quality a name; and having done this we speak of redness in the abstract, or as standing apart from any particular object. Our word 'redness' then serves as a sign or symbol of a quality as apart from any particular object of which it may happen to be a quality; and having made this symbolical abstraction in the case of a simple quality, such as redness, we can afterwards compound it with other symbolical abstractions, and so on till we

arrive at verbal symbols of more and more complex qualities, as well as qualities further and further removed from immediate perception. By the help of these symbols, therefore, we climb into higher and higher regions of abstraction; by thinking in verbal signs, we think, as it were, with the semblance of thoughts, and by combining these signs in various ways, and giving the resulting compounds distinctive names, we are able to condense into single words, or signs, an enormous amount of meaning. So that, just as in mathematics the symbols which are employed contain, in an easily manipulated form, the whole meaning of a long calculation, so in all other kinds of reasoning the symbols which we call words contain, in an abbreviated form, vast bodies of signification. Indeed any one who investigates this subject cannot fail to become convinced that it is wholly impossible to overestimate the value of language as thus the handmaid of thought; for, as we have seen, in the absence of language it would be impossible for thought to rise above the very simplest of abstract ideas, while in the presence of language it becomes possible for us consciously to predicate qualities, and so at last to feel that we are conscious of our own consciousness.

So much, then, for our classification of ideas. We have, first, simple ideas, or ideas of particular perceptions; and, secondly, abstract ideas, or ideas of general qualities; and the latter class I have subdivided into those which may be developed by simple feelings, and those which can only be developed by the aid of signs.

Now, with regard to ideas themselves, I need only add that they are the psychological units which compose the whole structure intellectual. They constitute, as it were, the raw material of thought, which may be elaborated by the reflective faculty into various products of thought. Once formed they present an essential property of occurring in concatenated series; so that the occurrence of one idea determines that of another with which it has been previously joined. This principle of the association of ideas, manifested as it is by the ultimate units of intellectual structure, is by far the most important principle in psychology: it is the principle which renders possible all the faculties of mind—memory, instinct, judgment, reason, emotion, conscience, and volition.

We are now in a position to investigate the facts of Comparative Psychology; and, in order to do so thoroughly, I shall begin by considering what I may term the physiological basis of mind. There is no reasonable doubt that all mental processes are accompanied by nervous processes; or, to adopt the convenient terms of Professor Huxley, that psychosis is invariably associated with neurosis. The nature of this association, according to the best lights of our present knowledge, is probably as follows. Nerve-tissue consists of two elementary parts, viz. nerve-cells and nerve-fibres. The nerve-cells are usually collected into aggregates, which are called nerve-centres,

and to these nerve-centres bundles of nerve-fibres come and go. The incoming nerve-fibres serve to conduct stimuli or impressions to the cells in the nerve-centre; and when the cells thus receive a stimulus or impression, they liberate a discharge of nervous energy, which then courses down the outgoing nerve-fibres to be distributed either to other nerve-centres or else to muscles. It is in this way that nerve-centres are able to act in harmony with one another, and so to co-ordinate the action of the muscles over which they preside. This fundamental principle of neurosis is what physiologists call the principle of reflex action; and you will perceive that all it requires for its manifestation is an incoming nerve, a nerve-centre, and an outgoing nerve, which together constitute what has been called a nervous arc. Now there can be no reasonable doubt that in the complex structure of the brain one nervous arc is connected with another nervous arc, and this with another almost *ad infinitum*; and there can be equally little doubt that processes of thought are accompanied by nervous discharges taking place now in this arc and now in that one, according as the nerve-centre in each arc is excited to discharge its influence by receiving a discharge from some of the other nerve-arcs with which it is connected. Again, it is almost certain that the more frequently a nervous discharge takes place through a given group of nervous arcs, the more easy will it be for subsequent discharges to take place along the same routes—these routes having been thus rendered more permeable to the passage of subsequent discharges. So that in this physiological principle of reflex action we no doubt have the objective side of the psychological principle of the association of ideas. For it may be granted that a series of discharges taking place through the same group of nervous arcs will always be attended with the occurrence of the same series of ideas; and it may be further granted that the previous passage of a series of discharges through any group of nervous arcs, by making the route more permeable, will have the effect of making subsequent discharges pursue the same course when started from the same origin. And if these two propositions be granted, it follows that the tendency of ideas to *recur* in the same order as that in which they have previously occurred, is merely a psychological expression of the physiological fact that lines of reflex discharge become more and more permeable by use. We thus see that the most fundamental of psychological principles—the association of ideas—is merely an obverse expression of the most fundamental neurological principles—reflex action. But here we have an important qualification to take into account. All reflex action, or neurosis, is not attended with ideation, or psychosis. In our own organisation, for instance, it is only cerebral reflexes which are so attended; and even among cerebral reflexes there is good reason to believe that the greater number of them are not accompanied by conscious ideation; for analysis shows that it is only those

cerebral discharges which have taken place comparatively seldom, and the passage of which is therefore comparatively slow, that are accompanied by any ideas, or changes of consciousness. The more habitual any action becomes, the less conscious do we require to be of its performance; it is, as we say, performed automatically, or without thought. Now it is of great importance thus to observe that consciousness only emerges when cerebral reflexes are flowing along comparatively unaccustomed channels, and therefore that cerebral discharges which at first were accompanied by definite ideas may, by frequent repetition, cease to be accompanied by any ideas. It is of importance to observe this fact, because it serves to explain the origin of a number of animal instincts. These instincts must originally have been of an intelligent nature; but the actions which they prompted, having through successive generations been frequently repeated, became at last organised into a purely mechanical reflex, and therefore now appear as actions which we call purely automatic or blindly instinctive. Thus, for instance, the scraping of graminivorous birds in earth and stones was no doubt originally an intelligent action, performed with the conscious purpose of uncovering seeds; but by frequent repetition through successive generations the action has now become blindly instinctive. This is shown by the following experiment. Dr. Allen Thomson tells me that he hatched out some chickens on a carpet, where he kept them for several days. They showed no inclination to scrape, because the stimulus supplied by the carpet to the soles of their feet was of too novel a character to call into action the hereditary instinct; but when Dr. Thomson sprinkled a little gravel on the carpet, and so supplied the appropriate or customary stimulus, the chickens immediately began their scraping movements. Yet, for aught that these chickens can have known to the contrary, there was as good a chance of finding seeds in the carpet as in the thin layer of gravel. And numberless other cases might be given to prove that animals acquire instincts by frequently repeating intelligent actions, just as we ourselves acquire, even in our individual lifetime, an instinct to adjust our night-caps—an instinct which may become so pronounced as to assert itself even when a man is in the profound unconsciousness of apoplectic coma.

Thus we are able to explain all the more complicated among animal instincts as cases of 'lapsed intelligence.' But, on the other hand, a great many of the more simple instincts were probably evolved in a more simple way. That is to say, they have probably never been of an intelligent character, but have begun as merely accidental adjustments of the organism to its surroundings, and have then been laid hold upon by natural selection and developed into automatic reflexes. Take, for instance, the action of so-called 'shamming dead,' which is performed by certain insects and allied animals when in the presence of danger. That this is not a case of intelligent action we

may feel quite sure, not only because it would be absurd to suppose that insects could have any such highly abstract ideas as those of death and its conscious simulation, but also because Mr. Darwin tells me that he once made a number of observations on this subject, and in no case did he find that the attitude in which the animal shammed dead resembled that in which the animal really died. All, therefore, that 'shamming dead' amounts to is an instinct to remain motionless, and therefore inconspicuous, in the presence of enemies; and it is easy to see that this instinct may have been developed by natural selection without ever having been of an intelligent nature—those individuals which were least inclined to run away from enemies being preserved rather than those which rendered themselves conspicuous by movement.

So that we thus see how animal instincts may arise in either of two different ways; for, on the one hand, they may arise from the performance of actions which were originally intelligent, but which by frequent repetition have become automatic; and, on the other hand, they may arise from survival of the fittest, preserving actions which, although never intelligent, yet happen to have been of benefit to the animals which first chanced to perform them. But now let it be observed that although there is a great difference between these two kinds of instincts if regarded psychologically, there is no difference between them if regarded physiologically; for, regarded physiologically, both kinds of instincts are merely expressions of the fact that particular nerve-cells and fibres have been set apart to perform their reflexes automatically—that is, without being accompanied by intelligence.

So much, then, for what I have called the physiological basis of mind; and in now taking leave of this part of my subject, I should like to point out that in recognising the indisputable fact of mind having such a basis, we are not necessarily committing ourselves to the doctrine of Materialism. That psychical phenomena are very intimately associated with physical phenomena is a fact which does not admit of one moment's dispute; but concerning the nature of this association science must declare, not merely that it is at present unknown, but that, so far as she is at present able to discern, it must for ever remain unknowable. The restless tide of intellect for centuries has onwards rolled, submerging in its every arm those strong and rugged shores whose name is Why; but at the line where mind and matter meet there rises, like a frowning cliff, a mighty mystery, and in the darkness of the place we hear the voice of true Philosophy proclaim:—Hitherto shalt thou come, but no further, and here shall thy proud waves be stayed.

Passing on now to our review of Comparative Psychology, the first animals in which, so far as I can ascertain, we may be quite sure that reflex action is accompanied by ideation, are the insects. For

Mr. Darwin has observed that bees remember the position of flowers which they have *only several times* visited, even though the flowers be concealed by intervening houses, &c. Sir John Lubbock also has shown that, *after a very few individual experiences*, bees are able to establish a definite association between particular colours on paper and food; and further that, *after a very few lessons*, a bee may be taught to find its way out of a glass jar. These observations would seem to prove that the grade of intelligence is higher in some Articulata than it is among the lower Vertebrata. For many of you will probably remember the experiment of Professor Möbius, which proved that a pike requires three months to establish an association of ideas between particular kinds of prey and the fact of their being protected by an invisible wall. This fact was proved by the pike repeatedly dashing its nose against a glass partition in its tank in fruitless efforts to catch minnows which were confined on the other side of the partition. At the end of three months, however, the requisite association was established, and the pike, having learned that its efforts were of no use, ceased to continue them. The sheet of glass was then removed; but the now firmly established association of ideas never seems to have become disestablished, for the pike never afterwards attacked the minnows, though it fed voraciously on all other kinds of fish. From which we see that a pike is very slow in forming his ideas, and no less slow in again unforming them—thus resembling many respectable members of a higher community, who spend one half of their lives in assimilating the obsolete ideas of their forefathers, and through the other half of their lives stick to these ideas as to the only possible truths; they can never learn when the hand of science has removed a glass partition.

As regards the association of ideas by the higher vertebrated animals, it is only necessary to say that in all these animals, as in ourselves, this principle of association is the fundamental principle of their psychology; that in the more intelligent animals associations are quickly formed, and when once formed are very persistent; and, in general, that so far as animal ideation goes, the laws to which it is subject are identical with those under which our own ideation is performed.

Let us, then, next ask, How far does animal ideation go? The answer is most simple, although it is usually given in most erroneous form. It is usually said that animals do not possess the faculty of abstraction, and therefore that the distinction between animal intelligence and human intelligence consists in this—that animals are not able to form abstract ideas. But this statement is most erroneous. You will remember the distinction which I previously laid down between abstract ideas that may be developed by simple feelings, such as hunger, and abstract ideas that can only be developed by the aid of language. Well, remembering this dis-

inction, we shall find that the only difference between animal intelligence and human intelligence consists in this—that animal intelligence is unable to elaborate that class of abstract ideas, the formation of which depends on the faculty of speech. In other words, animals are quite as able to form abstract ideas as we are, if under abstract ideas we include general ideas of qualities which are so far simple as not to require to be fixed in our thoughts by names. For instance, if I see a fox prowling about a farmyard, I cannot doubt that he has been led by hunger to visit a place where he has a general idea that a number of good things are to be fallen in with, just as I myself am led by a similar impulse to visit a restaurant. And, to take only one other instance, there can be no question that animals have a generalised conception of cause and effect. For example, I had a setter dog which was greatly afraid of thunder. One day a number of apples were being shot upon the wooden floor of an apple-room, and as each bag of apples was shot it produced through the rest of the house a noise resembling that of distant thunder. My dog became terror-stricken at the sound; but as soon as I brought him to the apple-room and showed him the true *cause* of the noise, he became again buoyant and cheerful as usual. Another dog I had used to play at tossing dry bones to give them the appearance of life. As an experiment, I one day attached a fine thread to a dry bone before giving him the latter to play with; and after he had tossed the bone about for a while as usual, I stood a long way off and slowly began to draw it away from him. So soon as he perceived that the bone was really moving on its own account, his whole demeanour changed, and rushing under a sofa he waited horror-stricken to watch the uncanny spectacle of a dry bone coming to life. I have also greatly frightened this dog by blowing soap-bubbles along the floor; one of these he summoned courage enough to touch with his paw, but as soon as it vanished he ran out of the room, terrified at so mysterious a disappearance. Lastly, I have put this dog into a paroxysm of fear by taking him into a room alone and silently making a series of horrible grimaces. Although I had never in my life hurt this dog, he became greatly frightened at my unusual behaviour, which so seriously conflicted with his general idea of uniformity in matters psychological. But I have tried this experiment with less intelligent dogs without any other result than that of causing them to bark at me.

Of course in thus claiming for animals the power of forming general conceptions, I mean only such general conceptions as can be arrived at by the logic of feelings. So far, then, as the logic of feelings can carry them, I maintain that the intellectual operations of animals are indistinguishable from those of ourselves. For having thus shown that animals possess the faculty of abstraction, I shall now go on to show that they possess the faculties both of judgment and of

reason. My friend Dr. Rae, the well-known traveller and naturalist, knew a dog in Orkney which used to accompany his master to church on alternate Sundays. To do so he had to swim a channel about a mile wide; and before taking to the water he used to run about a mile to the north when the tide was flowing, and a nearly equal distance to the south when the tide was ebbing, 'almost invariably calculating his distance so well that he landed at the nearest point to the church.' In his letter to me Dr. Rae continues: 'How the dog managed to calculate the strength of the spring and neap tides at their various rates of speed, and always to swim at the proper angle, is most surprising.'

So much, then, for judgment. For some good instances of reasoning in animals I am also indebted to Dr. Rae. Desiring to obtain some Arctic foxes, he set various kinds of traps; but, as the foxes knew these traps from previous experience, he was unsuccessful. Accordingly he set a kind of trap with which the foxes in that part of the country were not acquainted. This consisted of a loaded gun set upon a stand pointing at the bait. A string connected the trigger of the gun with the bait, so that when the fox seized the bait he discharged the gun, and thus committed suicide. In this arrangement the gun was separated from the bait by a distance of about twenty yards, and the string which connected the trigger with the bait was concealed throughout nearly its whole distance in the snow. The gun-trap thus set was successful in killing one fox, but not in killing a second; for the foxes afterwards adopted either of two devices whereby to secure the bait without injuring themselves. One of these devices was to bite through the string at its exposed part near the trigger, and the other device was to burrow up to the bait through the snow at right angles to the line of fire, so that, although in this way they discharged the gun, they escaped without injury—the bait being pulled below the line of fire before the string was drawn sufficiently tight to discharge the gun. Now both of these devices exhibited a wonderful degree of what I think must fairly be called power of reasoning. I have carefully interrogated Dr. Rae on all the circumstances of the case, and he tells me that in that part of the world traps are never set with strings, so that there can have been no special association in the foxes' minds between strings and traps. Moreover, after the death of fox number one, the track on the snow showed that fox number two, notwithstanding the temptation offered by the bait, had expended a great deal of scientific observation on the gun before he undertook to sever the cord. Lastly, with regard to burrowing at right angles to the line of fire, Dr. Rae and a friend in whom he has confidence observed the fact a sufficient number of times to satisfy themselves that the direction of the burrowing was really to be attributed to thought and not to chance.

I could give several other unequivocal instances of reasoning

on the part of animals which I have myself observed ; but time does not permit of my stating them. Passing on, therefore, to the emotional life of animals, we find that this is very slightly, if at all, developed in the lower orders, but remarkably well developed in the higher ; that is to say, the emotions are vivid and easily excited although they are shallow and evanescent. They thus differ from those of most civilised men in being more readily aroused and more impetuous while they last, though leaving behind them but little trace of their occurrence. As regards the particular emotions which occur among the higher animals, I can affirm from my own observations that all the following give unmistakable tokens of their presence :—Fear, Affection, Passionateness, Pugnacity, Jealousy, Sympathy, Pride, Reverence, Emulation, Shame, Hate, Curiosity, Revenge, Cruelty, Emotion of the Ludicrous, and Emotion of the Beautiful. Now this list includes nearly all the human emotions, except those which refer to religion and to the perception of the sublime. These of course are necessarily absent in animals, because they depend upon ideas of too abstract a nature to be reached by the mind when unaided by the logic of signs. Time prevents me from here detailing any of my observations or experiments with regard to the emotional life of animals, so I will pass on at once to the faculty of Conscience. Of course the moral sense as it occurs in ourselves involves ideas of high abstraction, so that in animals we can only expect to meet with a moral sense in a very rudimentary form ; and, therefore, even if it is true that no indications of such a sense are to be met with in animals, the fact would not establish any difference in kind between animal intelligence and human. But I am inclined to believe that in highly intelligent, highly sympathetic, and tolerably well-treated animals, the germs of a moral sense become apparent. To give two instances. I once shut up a Skye terrier in a room by himself while I went to a friend's house. The dog must have been thrown into a violent passion at being left behind, for when I returned I found that he had torn the window-curtains to shreds. He was in great joy at seeing me ; but as soon as I picked up one of the torn shreds of the curtains the animal gave a howl and ran screaming up the staircase. Now this dog was never chastised in his life, so that I can only explain his conduct as an expression of the remorse which he suffered at having done in a passion what he knew would cause me annoyance. So far as I can interpret the facts, his sympathetic affection for me, coupled with the memory of his misdeeds, created in his mind a genuine feeling of *repentance*.

The other instance I have to narrate occurred with the same terrier. Only once in his life was he ever known to steal ; and on this occasion, when very hungry, he took a cutlet from a table and carried it under a sofa. I saw him perform this act of larceny, but pretended not to have done so, and for a number of minutes he remained under

the sofa with his feelings of hunger struggling against his feelings of duty. At last the latter triumphed; for he brought the stolen cutlet and laid it at my feet. Immediately after doing so he again ran under the sofa, and from this retreat no coaxing could draw him. Moreover, when I patted his head he turned away his face in a ludicrously conscience-stricken manner. Now I regard this instance as particularly valuable from the fact that the terrier in question had never been beaten, and hence that it cannot have been fear of bodily pain which prompted these actions. On the whole, therefore, I can only suppose that we have in these actions evidence of as high a development of the ethical faculty as is attainable by the logic of feelings when unassisted by the logic of signs—that is to say, a grade very nearly, if not quite, as high as that with which we meet in low savages, young children, many idiots, and uneducated deaf-mutes.

This allusion to savages, children, idiots, and deaf-mutes, leads me to the next division of my subject.

Professor St. George Mivart has said that an interesting book might be written on the stupidity of animals. I am inclined to think that a still more interesting book might be written on the stupidity of savages. For it is a matter of not the least interest how much stupidity any number of animals may present, so long as some animals present sufficient sagacity to supply data for the general theory of evolution; while, on the other hand, it is of the utmost importance for the science of this century to ascertain the lowest depths in which the mind of man is known to exist as human. Now there is no doubt that the interval which separates the most degraded savage from the most intelligent animal is, psychologically considered, enormous; but, enormous as it is, I cannot see any evidence to show that the gulf may not have been bridged over during the countless ages of the past. Abstract ideas among savages are mostly confined to such as may be formed by the logic of the feelings; so that, for instance, according to the observations and the judgment of Mr. Francis Galton, the ideas of number which are presented by the lowest savages are certainly in no degree superior to those which are presented by the higher animals. Such ideas as savages possess seem to be mainly those which, as in animals, are due to special associations. On this account there is in them, as in animals, a remarkable tendency to act in accordance with preformed habits, rather than to strike out improved modes of action. On this account, also, there is, as in animals, a strong tendency to imitation as distinguished from origination. Again, as in animals, so in savages, the reflective power is of an extremely undeveloped character, and quite incapable of sustained application. And, lastly, the emotions of savages, as of animals, are vivid, although, as contrasted with the emotions of civilised man, they are in a marked degree more fitful, impetuous, shallow, and transitory. So that, altogether, I think the lowest

savages supply us with a most valuable transition stage between mind as we know it in ourselves, and mind as we see it manifested by the higher animals.

With regard to children, it is to be expected, on the general theory of evolution by inheritance, that if we were attentively to study the order in which their mental faculties develop, we should find that the historical sequence is, as it were, a condensed epitome of the order in which these faculties were developed during the evolution of the human species. And this expectation is fairly well realised. Very young children present only those lower faculties of mind which in animals we call instincts. With advancing age, the first indication of true intelligence seems to consist in the power of forming special associations. Memory thus appears early in life; and long before a child is able to speak, it links together in thought ideas of objects which it finds to be associated in fact. Again, the emotions begin to assert their presence at a very early period, and attain a high degree of development before any of the characteristically human faculties can be said to have appeared. Moreover, in young children we meet with nearly all the emotions which I have named as occurring in animals, and their general character is much of the same kind. In more advanced childhood the emotional life of children more resembles that of savages. With regard to the more purely intellectual faculties, language is largely intelligible to a child long before it is itself able to articulate; but soon after it is able to articulate, the faculty of abstracting qualities and classifying objects by the aid of signs begins its course of development. Thus, for instance, I have lately seen a child who belongs to one of the best of living observers, and who is just beginning to speak. This child called a duck 'quack,' and by special association it also called water 'quack.' By an appreciation of the resemblance of qualities, it next extended the term 'quack' to denote all birds and insects on the one hand, and all fluid substances on the other. Lastly, by a still more delicate appreciation of resemblance, the child eventually called all coins 'quack,' because on the back of a French sou it had once seen the representation of an eagle. Hence to this child the sign 'quack,' from having originally had a very specialised meaning, became more and more extended in its signification, until it now serves to designate such apparently different objects as 'fly,' 'wine,' and 'shilling.' And as in this process we have the initiation of the logic of signs, so we have in it the potentiality of the most abstract thought. Accordingly, soon after a child begins to speak, we find that reason of a properly human kind begins to be developed.

Upon the whole, then, the study of infant psychology yields just the kind of results which the general theory of evolution would lead us to expect. But in comparing the intelligence of a young child with that of an adult animal we are met with this difficulty—that as

the bodily powers of children at so immature an age are so insufficiently developed, the mind is not able, as in the case of animals, to accumulate experiences of life. In order, therefore, to obtain a fair parallel, we should require a human being whose mental powers have become arrested in their development at an early age, while the bodily powers have continued to develop to mature age, so serving to supply the aborted human intelligence with full experiences of life. Now the nearest approach that we have to these conditions is to be found in the case of idiots. Accordingly, in anticipation of this lecture, I have sent a table of questions to all the leading authorities on idiocy, and the answers which I have obtained display a very substantial agreement. Through the kindness of these gentlemen I have also been enabled to examine personally a number of the patients who are under their charge. In particular I have to express my obligations to Drs. Beech, Crichton Browne, Langdon Down, Ireland, Maudsley, Savage, and Shuttleworth. On the present occasion I can only pause to state the leading facts which have been elicited by this inquiry.

As there are all degrees of idiocy, the object of my inquiry was to determine the order in which the various mental faculties become enfeebled and disappear as we descend from the higher to the lower grades of imbecility. On the general theory of evolution we should expect that in such a descending scale the characteristically human, or the more recently developed, faculties should be the first to disappear, while those faculties which man shares with the lower animals should be the most persistent. And this expectation I have found to be fairly well realised. Beginning from below, the first dawn of intelligence in the ascending scale of idiots, as in the ascending scale of animals, is invariably to be found in the power of associating simple concrete ideas. Thus, there are very few idiots so destitute of intelligence that the appearance of food does not arouse in their minds the idea of eating; and, as we ascend in the scale idiotic, we find the principle of association progressively extending its influence, so that the mind is able, not only to establish a greater and greater number of special associations, but also to retain these associations with an ever increasing power of memory. In the case of the higher idiots, as in the case of the higher animals, it is surprising in how considerable a degree the faculty of special association is developed, notwithstanding the dwarfed condition of all the higher faculties. Thus, for instance, it is not a difficult matter to teach a clever idiot to play dominos, in the same way as a clever dog has been taught to play dominos, viz. by teaching special associations between the optical appearances of the facets which the game requires to be brought together. But the idiot may be quite as unable as the dog to play at any game which involves the understanding of a simple *rationale*, such, for instance, as draughts. And, similarly, many of the higher idiots

have been taught to recognise, by special association, the time on a watch; but it is remarkable that the high power of forming special associations which this fact implies occurs in the same minds which are unable to perform so simple a calculation as this—If it is ten minutes to three, how many minutes is it past two? Thus it will be seen that among idiots, as among animals, the faculty of forming special associations between concrete ideas attains a comparatively high degree of development. Let us then next turn to the faculties of abstraction and reason. Prepared as I was to expect these faculties to be the most deficient, I have been greatly surprised at the degree in which they are so. As regards the power of forming abstract ideas which depend on the logic of signs, it is only among the very highest class of idiots that any such power is apparent at all; and even here it is astonishing in how very small a degree this power is exhibited. There seems, for instance, to be an almost total absence of the idea of right and wrong as such; so that the faculty of conscience, properly so called, can rarely be said to be present. Most of the higher idiots, indeed, experience a feeling of remorse on offending the sympathies of those whom they love, just as did my dog on tearing the window curtains; but I have been able to obtain very little evidence of any true idiot whose action is prompted by any idea of right and wrong in the abstract, or as apart from the idea of approbation and disapprobation of those whose good feeling he values.

Again, the faculty of reason is dwarfed to the utmost—so much so that the investigator is most of all astonished at the poverty of rational power which may be displayed by a human mind that in most other respects seems well developed. I can only wait to give you one example, but it may be taken as typical. A boy fourteen years of age, belonging to the highest class of undoubted idiots, could scarcely be called feeble-minded as regarded many of his faculties. Thus, for instance, his powers of memory were above the average, so that he had no difficulty in learning Latin, French, &c. Moreover, he could tell you by mental calculation the product of two numbers into two numbers, such as 35 by 35, or of one number into three numbers, such as number of days in nine years. His powers of mental calculation were therefore quite equal to those of any average boy of his age. Yet he was not able to answer any question that involved the simplest act of reason. Thus, when I asked him how many sixpences there are in a sovereign, he was quite unable to answer. Although he knew that there are two sixpences in a shilling, and twenty shillings in a sovereign, and could immediately have said that twice twenty are forty, yet he could not perform the simple act of inference which the question involved. Again, I asked him, if he could buy oranges at a farthing each, how many could he buy for twopence? He thought long and hard, saying, 'I know that four farthings make a penny, and the oranges cost a

farthing each ; then how many could I buy for twopence ? Ah ! that's the question, and there's just the puzzle.' Nor was he able by the utmost effort to solve the puzzle. This boy had a very just appreciation of his own psychological character. Alluding to his power of forming special associations and retaining them in his excellent memory, he observed, 'Once put anything into my head and you don't get it out again very easily ; but there's no use in asking me to do puzzles.'

Lastly, the emotional life of all the higher idiots, as of all the higher animals, is remarkably vivid as compared with their intellectual life. All the emotions are present (except, perhaps, that of the sublime and the religious emotions), and they occur for the most part in the same order as to strength as that which I have already named in the case of animals. But, more than this, just as in animals, children, and savages, so in idiots, the emotions, although vivid and keen, are not profound. A trivial event will make the higher idiots laugh or cry, and it is easy to hurt their feelings with a slight offence ; but the death of a dear relative is very soon forgotten, while the stronger passions, such as Love, Hate, Ambition, &c., do not occur with that force and persistency which properly entitle them to be called by these names.

Upon the whole, then, with regard to idiots, it may be said that we have in them a natural experiment wherein the development of a human mind is arrested at some particular stage, while the body is allowed to continue its growth. Therefore, by arranging idiots in a descending grade, we obtain, as it were, an inclined plane of human intelligence, which indicates the probable order in which the human faculties have appeared during the history of their development ; and on examining this inclined plane of human intelligence, we find that it runs suggestively parallel with the inclined plane of animal intelligence, as we descend from the higher to the lower forms of psychical life.

I have only time to treat of one other branch of my subject. Believing, as I have said, that language, or the logic of signs, plays so essential a part in developing the higher intellectual life of man, it occurred to me that a valuable test of the truth of this view was to be found in the mental condition of uneducated deaf-mutes. It often happens that deaf and dumb children of poor parents are so far neglected that they are never taught finger language, or any other system of signs, whereby to converse with their fellow-creatures. The consequence, of course, is that these unfortunate children grow up in a state of intellectual isolation, which is almost as complete as that of any of the lower animals. Now when such a child grows up and falls into the hands of some competent teacher, it may of course be educated, and is then in a position to record its experiences when in its state of intellectual isolation. I have therefore obtained all

the evidence I can as to the mental condition of such persons, and I find that their testimony is perfectly uniform. In the absence of language, the mind is able to think in the logic of feelings, but can never rise to any ideas of higher abstraction than those which the logic of feelings supplies. The uneducated deaf-mutes have the same notions of right and wrong, cause and effect, and so on, as we have already seen that animals and idiots possess. They always think in the most concrete forms, as shown by their telling us when educated that so long as they were uneducated they always thought in pictures. Moreover, that they cannot attain to ideas of even the lowest degree of abstraction, is shown by the fact that in no one instance have I been able to find evidence of a deaf-mute who, prior to education, had evolved for himself any form of supernaturalism. And this, I think, is remarkable, not only because we might fairly suppose that some rude form of fetishism, or ghost-worship, would not be too abstract a system for the unaided mind of a civilised man to elaborate, but also because the mind in this case is not wholly unaided.² On the contrary, the friends of the deaf-mute usually do their utmost to communicate to his mind some idea of whatever form of religion they may happen to possess. Yet it is uniformly found that, in the absence of language, no idea of this kind can be communicated. For instance, the Rev. Mr. S. Smith tells me that one of his pupils, previous to education, supposed the Bible to have been printed by a printing-press in the sky, which was worked by printers of enormous strength—this being the only interpretation the deaf-mute could assign to the gestures whereby his parents sought to make him understand that they believed the Bible to contain a revelation from a God of power who lives in heaven. Similarly, Mr. Graham Bell informs me of another, though similar case, in which the deaf-mute supposed the object of going to church to be that of doing obeisance to the clergy.

On the whole, then, from the mental condition of uneducated deaf-mutes we learn the important lesson that, in the absence of language, the mind of a man is almost on a level with the mind of a brute in respect of its power of forming abstract ideas. So that all our lines of evidence converge to one conclusion:—the only difference which analysis can show to obtain between the mind of man and the mind of the lower animals consists in this—that the mind of man has been able to develop the germ of rational thought which is undeveloped in the mind of animals, and that the development of this

² Were it not for certain criticisms which have appeared on my lecture as originally delivered, I should have thought it unnecessary to point out that an uneducated deaf-mute inherits the cerebral structure of a man. The fact, therefore, of his having human feelings and expressions of face, as well as the capacity for education, is no proof that language is not necessary for the formation of abstract ideas, unless it could be proved that the human brain might have been what it is, even if the human race had never evolved any system of language.

germ has been due to the power of abstraction which is rendered possible by the faculty of speech. I have, therefore, no hesitation in giving it as my opinion that the faculty of speech is alone the ultimate source of that enormous difference which now obtains between the mind of man and the mind of the lower animals. • Is this source of difference adequate to distinguish the mind of man from the mind of the lower animals in kind? I leave you all to answer this question for yourselves. I am satisfied with my work if I have made it clear to you that the question whether human intelligence differs from animal intelligence in kind or in degree, hinges entirely on the question whether the faculty of speech has been of an origin natural or supernatural. Still, to be candid, when the question occurs to me:—Seeing that language is of such prodigious importance as a psychological instrument, does not the presence of language serve to distinguish us in kind from all other forms of life? How is it that no mere brute has ever learned to communicate with its fellows by words? Why has man alone of animals been gifted with the Logos? I say, when this question occurs to me, I feel that, although from the absence of pre-historical knowledge I am not able to answer it, still, when I reflect on the delicacy of the conditions which, on the naturalistic hypotheses, must first have led to the beginning of articulate language—conditions not only anatomical and physiological, but also psychological and sociological—when I thus reflect, I cease to wonder that the complicated faculty of speech should only have become developed in *Homo sapiens*.

Ladies and Gentlemen, I have now given you an organised epitome of the leading results which have been obtained by a study of the facts and the principles of Comparative Psychology; and as in doing so I have chiefly sought to address those among you who are interested in science, I fear that to some of you I must in many places have been very hard to follow. But as a general outcome of the whole lecture—as the great and vivifying principle by which all the facts are more or less connected, and made to spring into a living body of philosophic truth—I will ask you to retain in your memories one cardinal conclusion. We are living in a generation which has witnessed a revolution of thought unparalleled in the history of our race. I do not merely allude to the fact that this is a generation in which all the sciences, without exception, have made a leap of progress such as widely to surpass all previous eras of intellectual activity; but I allude to the fact that in the special science of Biology it has been reserved for us to see the first rational enunciation, the first practical demonstration, and the first general acceptance of the doctrine of Evolution. And I allude to this fact as to a fact of unparalleled importance in the history of thought, not only because I know how completely it has transformed the study of Life from a mere grouping of disconnected observations to a rational tracing of

fundamental principles, but also because it is now plainly to be foreseen that what the Philosophy of Evolution has already accomplished is but an earnest of what it is destined to achieve. We know the results which have followed in the science of Astronomy by the mathematical proof of the law of gravitation; and can we doubt that even more important results will follow in the much more complex science of Biology from the practical proof of the law of Evolution? I at least can entertain no doubt on this head; and forasmuch as this enormous change in our means of knowledge and our modes of thought has been so largely due to the almost unaided labours of a single man, I do not hesitate to say, even before so critical an audience as this, that in all the history of science there is no single name worthy of a veneration more profound than the now immortal name of Charles Darwin.

Do you ask me why I close this lecture with such a panegyric on the Philosophy of Evolution? My answer is—If we have found that in the study of Life the theory of Descent is the keynote by which all the facts of our science are brought into harmonious relation, we cannot doubt that in our study of Mind the theory of Descent must be of an importance no less fundamental. And, indeed, even in this our time, which is marked by the first opening dawn of the science of Psychology, we have but to look with eyes unprejudiced to see that the Philosophy of Evolution is here like a rising Sun of Truth, eclipsing all the lesser lights of previous philosophies, dispelling superstitions like vapours born of darkness, and revealing to our gladdened gaze the wonders of a world till now unseen. So that the cardinal conclusion which I desire you to take away, and to retain in your memories long after all the lesser features of this discourse shall have faded from your thoughts, is the conclusion that Mind is everywhere one; and that the study of Comparative Psychology, no less than the study of Comparative Anatomy, has hitherto yielded results in full agreement with that great transformation in our view of things, which, as I have said, is without a parallel in the history of thought, and which it has been the great, the individual glory of this age and nation to achieve.

G. J. ROMANES.

POSTSCRIPT.

Many and various have been the criticisms to which this lecture has already given rise, so that, in now submitting it to the readers of the *Nineteenth Century*, I am impelled to make one additional remark. Within the time at my disposal in a lecture it was not possible to give more than a carefully balanced epitome of what I conceive to be the leading principles of Comparative Psychology, and

the directions in which it seems to me of most importance that these principles should be applied. Naturally, therefore, no one division of my subject has here been treated with any attempt at completeness, and thus the unsympathetic critic has an easy task to perform when he indicates the apparent disproportion between my premisses and my conclusions. Of such criticisms I have neither the right nor the desire to complain; they were clearly to be foreseen as the result of first publishing my work in so condensed a form. But I do desire to address this one remark to my critics as a body. Let it not be supposed that by pointing out sins of omission in this *résumé* you have proved negligence or one-sidedness against the labour of which it is the result. It is needless to say that I gladly welcome all criticisms, even such as give me credit for being myself so far an idiot as not to have observed that a parrot can talk, or that a deaf-mute has a human kind of look about the face, together with 'latent' (*inherited?*) capacities of which animals are destitute. But, while gladly welcoming criticisms from every quarter, I would suggest that, at least when rendering the more superficial and the more hackneyed of ideas, they might be conveyed in a form which recognises the possibility of my having met with these ideas before.

It seems desirable, however, to add a few explanatory statements with regard to the Arctic foxes; for in my oral exposition of the circumstances as communicated to me by Dr. Rae, I somewhat unduly sacrificed lucidity to compression. The only supplementary matter which it seems desirable to add I will quote from Dr. Rae's letter to me:—

'In the cases seen by myself and by a friend of greater experience, the trench was always scraped at right angles, or nearly so, to the line of fire.' This fact Dr. Rae explains by the hypothesis:—'If the trench is to be a shelter one—thinking, as the fox must, that the gun, or something coming from it, was the danger to be protected from or guarded against—it must be made across the line of fire, for if scratched in direction of the gun, it would afford little or no protection or concealment, and the reasoning power or intelligence of the fox would be at fault.

'My belief is that one of these knowing foxes had seen his or her companion shot, or found it dead shortly after it had been killed (paired foxes do not necessarily always keep close together, because they have a better chance of finding food if separated some distance from each other), and not unnaturally attributed the cause of the mishap to the only strange thing it saw near, namely, the gun. It was evident that in all cases they had studied the situation carefully, as was sufficiently shown by their tracks in the snow, which indicated their extremely cautious approach when either the string-cutting or trench-digging dodge was resorted to.'

Lastly, I should like to take this opportunity of requesting the

readers of the *Nineteenth Century* to favour me by sending to the undermentioned addressers brief accounts of any well-marked instances of the display of animal intelligence which may have fallen within their own notice or that of their friends. None of these instances will be published by me without permission ; but I desire to accumulate as many of such instances as possible, in order that I may obtain a wide basis of suggestion as to the directions in which experiment may be most profitably employed.

G. J. R.

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