

THE
DARWINIAN THEORY OF INSTINCT.

‘GAVEST thou the goodly wings unto the peacocks? or wings and feathers unto the ostrich? which leaveth her eggs in the earth, and warmeth them in dust, and forgetteth that the foot may crush them, or that the wild beast may break them. . . . Because God hath deprived her of wisdom, neither hath He imparted to her understanding.’

This is the oldest theory of instinct. The writer of that sublime monument of literary power in which it occurs observed a failure of instinct on the part of the ostrich, and forthwith attributed the fact to neglect on the part of the Deity; the implication plainly being that in all cases where instinct is perfect, or completely suited to the needs of the animal presenting it, the fact is to be attributed to a God-given faculty of wisdom. This, I say, is the oldest theory of instinct, and I may add that until within the past twenty-five years it has been the only theory of instinct. I think, therefore, I ought to begin by explaining that this venerable and time-honoured theory is a purely theological explanation of the ultimate source of instinct, and therefore cannot be affected by any scientific theory as to the proximate causes of instinct. It is with such a theory alone that we shall here be concerned. ‘When giants build, men must bring the stones.’ For the past eight or ten years I have been engaged in elaborating Mr. Darwin’s theories in the domain of psychology, and I cannot allude to my own work in this connection without expressing the deep obligations under which I lie to his ever ready and ever generous assistance—assistance rendered not only in the way of conversation and correspondence, but also by his kindness in making over to me all his unpublished manuscripts, together with the notes and clippings which he had been making for the past forty years in psychological matters. I have now gone carefully through all this material, and have published most of it in my work on ‘Mutual Evolution in Animals.’ I allude to this work on the present occasion in order to observe that, as it has so recently come out, I shall feel myself entitled to assume that few have read it; and therefore I shall not cramp my remarks by seeking to avoid any of the facts or arguments therein contained.

As there are not many words within the compass of our language which have had their meanings less definitely fixed than the word 'instinct,' it is necessary that I should begin by clearly defining the sense in which I shall use it.

In general literature and conversation we usually find that instinct is antithetically opposed to reason, and this in such wise that the mental operations of the lower animals are termed instinctive; those of man are termed rational. This rough and ready attempt at psychological classification has descended to us from remote antiquity, and, like kindred attempts at zoological classification, is not a bad one so far as it goes. To divide the animal kingdom into beasts, fowls, fish, and creeping things, is a truly scientific classification as far as it goes, only it does not go far enough for the requirements of more careful observation; that is to say, it only recognises the more obvious and sometimes only superficial differences, while it neglects the more hidden and usually more important resemblances. And to classify all the mental phenomena of animal life under the term 'instinct,' while reserving the term 'reason' to designate a mental peculiarity distinctive of man, is to follow a similarly archaic method. It is quite true that instinct preponderates in animals, while reason preponderates in man. This obvious fact is what the world has always seen, just as it saw that flying appeared to be distinctive of birds, and creeping of reptiles. Nevertheless, a bat was all the while a mammal and a pterodactyl was not a bird; and it admits of proof as definite that what we call instinct in animals occurs in man, and that what we call reason in man occurs in animals. This, I mean, is the case if we wait to attach any definition to the words which we employ. It is quite evident that there is some difference between the mind of a man and the mind of a brute, and if without waiting to ascertain what this difference is, we say that it consists in the presence or absence of the faculty of reason, we are making the same kind of mistake as when we say that the difference between a bird and a mammal consists in the presence or absence of the faculty of flying. Of course, if we choose, we may employ the word 'reason' to signify all the differences taken together, whatever they may be; and so, if we like, we may use the word 'flying.' But in either case we shall be talking nonsense, because we should be divesting the words of their meaning, or proper sense. The meaning of the word 'reason' is the faculty of ratiocination—the faculty of drawing inferences from a perceived equivalency of relations, no matter whether the relations involve the simplest mental perceptions, or the most abstruse mathematical calculations. And in this, the only real and proper sense of the word, reason is not the special prerogative of man, but occurs through the zoological scale at least as far down as the articulata.

What then is to be our definition of instinct?

First of all, instinct involves *mental* operation, and therefore implies consciousness. This is the point which distinguishes instinct from reflex action. Unless we assume that a new-born infant, for example, is conscious of sucking, it is as great a misnomer to term its adaptive movements in the performance of this act instinctive, as it would be similarly to term the adaptive movements of its stomach subsequently performing the act of digestion.

Next, instinct implies hereditary knowledge of the objects and relations with respect to which it is exercised; it may therefore operate in full perfection prior to any experience on the part of the individual. When the pupa of a bee, for instance, changes into an imago, it passes suddenly from one set of experiences to another, the difference between its previous life as a larva and its new life as an imago being as great as the difference between the lives of two animals belonging to two different sub-kingdoms; yet as soon as its wings are dry it exhibits all the complex instincts of the mature insect in full perfection. And the same is true of the instincts of vertebrated animals, as we know from the researches of the late Mr. Douglas Spalding and others.

Again, instinct does not imply any necessary knowledge of the relations between means employed and ends attained. Such knowledge may be present in any degree of distinctness, or it may not be present at all; but in any case it is immaterial to the exercise of the instinct. Take, for example, the instinct of the *Banbex*. This insect brings from time to time fresh food to her young, and remembers very exactly the entrance to her cell, although she has covered it with sand, so as not to be distinguishable from the surrounding surface. Yet M. Fabre found that if he brushed away the earth and the underground passage leading to the nursery, thus exposing the contained larva, the parent insect 'was quite at a loss, and did not even recognise her own offspring. It seemed as if she knew the doors, nursery, and the passage, but not her child.'

Lastly, instinct is always similarly manifested under similar circumstances by all the individuals of the same species. And, it may be added, these circumstances are always such as have been of frequent occurrence in the life-history of the species.

Now in all these respects instinct differs conspicuously from every other faculty of mind, and especially from reason. Therefore, to gather up all these *differentiæ* into one definition, we may say that instinct is the name given to those faculties of mind which are concerned in consciously adaptive action, prior 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.

Such being my definition of instinct, I shall now pass on to

consider Mr. Darwin's theory of the origin and development of instincts.

Now, to begin with, Mr. Darwin's theory does not, as many suppose that it does, ascribe the origin and development of all instincts to natural selection. This theory does, indeed, suppose that natural selection is an important factor in the process; but it neither supposes that it is the only factor, nor even that in the case of numberless instincts it has had anything at all to do with their formation. Take, for example, the instinct of wildness, or of hereditary fear as directed towards any particular enemy—say man. It has been the experience of travellers who have first visited oceanic islands without human inhabitants and previously unvisited by man, that the animals are destitute of any fear of man. Under such circumstances the birds have been known to alight on the heads and shoulders of the newcomers, and wolves to come and eat meat held in one hand while a knife was held ready to slay them with the other. But this primitive fearlessness of man gradually passes into an hereditary instinct of wildness, as the special experiences of man's proclivities accumulate; and as this instinct is of too rapid a growth to admit of our attributing it to natural selection (not one per cent. of the animals having been destroyed before the instinct is developed), we can only attribute its growth to the effects of inherited observation. In other words, just as in the lifetime of the individual, adjustive actions which were originally intelligent may by frequent repetition become automatic, so in the lifetime of the species, actions originally intelligent may, by frequent repetition and heredity, so unite their efforts on the nervous system that the latter is prepared, even before individual experience, to perform adjustive actions mechanically which, in previous generations, were performed intelligently. This mode of origin of instincts has been appropriately called the 'lapsing of intelligence,' and it was fully recognised by Mr. Darwin as a factor in the formation of instinct.

The Darwinian theory of instinct, then, attributes the evolution of instincts to these two causes acting either singly or in combination—natural selection and lapsing intelligence. I shall now proceed to adduce some of the more important facts and considerations which, to the best of my judgment, support this theory, and show it to be by far the most comprehensive and satisfactory explanation of the phenomena which has hitherto been propounded.

That many instincts must have owed their origin and development to natural selection exclusively is, I think, rendered evident by the following general considerations:—

(1) Considering the great importance of instincts to species, we are prepared to expect that they must be in large part subject to the influence of natural selection. (2) Many instinctive actions are performed by animals too low in the scale to admit of our supposing that the adjustments which are now instinctive can ever have been

intelligent. (3) Among the higher animals instinctive actions are performed at an age before intelligence, or the power of learning by individual experience, has begun to assert itself. (4) Many instincts, as we now find them, are of a kind which, although performed by intelligent animals at a matured age, yet can obviously never have been originated by intelligent observation. Take, for instance, the instinct of incubation. It is quite impossible that any animal can ever have kept its eggs warm with the intelligent purpose of developing their contents; so we can only suppose that the incubating instinct began in some such form as we now see it in the spider, where the object of the process is protection, as distinguished from the imparting of heat. But incidental to such protection is the imparting of heat, and as animals gradually became warm-blooded, no doubt this latter function became of more and more importance to incubation. Consequently, those individuals which most constantly cuddled their eggs would develop most progeny, and so the incubating instinct would be developed by natural selection without there ever having been any intelligence in the matter.

From these four general considerations, therefore, we may conclude (without waiting to give special illustrations of each) that one mode of origin of instincts consists in natural selection, or survival of the fittest, continuously preserving actions which, although never intelligent, yet happen to have been of benefit to the animals which first chanced to perform them. Among animals, both in a state of nature and domestication, we constantly meet with individual peculiarities of disposition and of habit, which in themselves are utterly meaningless, and therefore quite useless. But it is easy to see that if among a number of such meaningless or fortuitous psychological variations, any one arises which happens to be of use, this variation would be seized upon, intensified, and forced by natural selection, just as in the analogous case of structures. Moreover there is evidence that such fortuitous variations in the psychology of animals (whether useless or accidentally useful) are frequently inherited, so as to become distinctive not merely of individuals, but of races or strains. Thus, among Mr. Darwin's manuscripts I find a letter from Mr. Thwait's under the date 1860, saying that all his domestic ducks in Ceylon had quite lost their natural instincts with regard to water, which they would never enter unless driven, and that when the young birds were thus compelled to enter the water they had to be quickly taken out again to prevent them from drowning. Mr. Thwait's adds that this peculiarity only occurs in one particular breed. Tumbler-pigeons instinctively tumbling, pouter-pigeons instinctively pouting, &c., are further illustrations of the same general fact.

Coming now to instincts developed by lapsing intelligence, I have already alluded to the acquisition of an hereditary fear of man as an instance of this class. Now not only may the hereditary fear of man

be thus acquired through the observation of ancestors—and this even to the extent of knowing by instinct what constitutes safe distance from fire-arms; but, conversely, when fully formed it may again be lost by disuse. Thus there is no animal more wild, or difficult to tame, than the young of the wild rabbit; while there is no animal more tame than the young of the domestic rabbit. And the same remark applies, though in a somewhat lesser degree, to the young of the wild and of the domestic duck. For, according to Dr. Rae, ‘If the eggs of a wild duck are placed with those of a tame duck under a hen to be hatched, the ducklings from the former, on the very day they leave the egg, will immediately endeavour to hide themselves, or take to the water, if there be any water, should anyone approach, whilst the young from the tame duck’s eggs will show little or no alarm.’ Now, as neither rabbits nor ducks are likely to have been selected by man to breed from on account of tameness, we may set down the loss of wildness in the domestic breeds to the uncompounded effects of hereditary memory of man as a harmless animal, just as we attributed the original acquisition of instinctive wildness to the hereditary memory of man as a dangerous animal; in neither case can we suppose that the principle of selection has operated in any considerable degree.

Thus far, for the sake of clearness, I have dealt separately with these two factors in the formation of instinct—natural selection and lapsing intelligence—and have sought to show that either of them working singly is sufficient to develop some instincts. But, no doubt, in the case of most instincts intelligence and natural selection have gone hand-in-hand, or co-operated, in producing the observed results—natural selection always securing and rendering permanent any advances which intelligence may have made. Thus, to take one case as an illustration. Dr. Rae tells me that the grouse of North America have the curious instinct of burrowing a tunnel just below the surface of the snow. In the end of this tunnel they sleep securely, for when any four-footed enemy approaches the mouth of the tunnel, the bird, in order to escape, has only to fly up through the thin covering of snow. Now in this case the grouse probably began to burrow in the snow for the sake of warmth, or concealment, or both; and, if so, thus far the burrowing was an act of intelligence. But the longer the tunnel the better would it serve in the above-described means of escape; therefore natural selection would tend to preserve the birds which made the longest tunnels, until the utmost benefit that length of tunnel could give had been attained.

And similarly, I believe, all the host of animal instincts may be fully explained by the joint operation of these two causes—intelligent adjustment and survival of the fittest. For now, I may draw attention to another fact which is of great importance, viz., that instincts admit of being modified as modifying circumstances may

require. In other words, instincts are not rigidly fixed, but are plastic, and their plasticity renders them capable of improvement or of alteration, according as intelligent observation requires. The assistance which is thus rendered by intelligence to natural selection must obviously be very great, for under any change in the surrounding conditions of life which calls for a corresponding change in the ancestral instincts of the animal, natural selection is not left to wait, as it were, for the required variations to arise fortuitously; but is from the first furnished by the intelligence of the animal with the particular variations which are needed.

In order to demonstrate this principle of the variation of instinct under the guidance of intelligence, I may here introduce a few examples.

Huber observes, 'How ductile is the instinct of bees, and how readily it adapts itself to the place, the circumstances, and the needs of the community.' Thus, by means of contrivances, which I need not here explain, he forced the bees either to cease building combs, to change their instinctive mode of building from above downwards, to building in the reverse direction, and also horizontally. The bees in each case changed their mode of building accordingly. Again, an irregular piece of comb, when placed by Huber on a smooth table, tottered so much that the bumble bees could not work on so unsteady a basis. To prevent the tottering, two or three bees held the comb by fixing their front feet on the table, and their hind feet on the comb. This they continued to do, relieving guard, for three days, until they had built supporting pillars of wax. Some other bumble bees, when shut up, and so prevented from getting moss wherewith to cover their nests, tore threads from a piece of cloth, and 'carded them with their feet into a fretted mass,' which they used as moss. Lastly, Andrew Knight observed that his bees availed themselves of a kind of cement made of iron and turpentine, with which he had covered some decorticated trees—using this ready-made material instead of their own propolis, the manufacture of which they discontinued; and more recently it has been observed that bees, 'instead of searching for pollen, will gladly avail themselves of a very different substance, namely, oatmeal.' Now in all these cases it is evident that if, from any change of environment, such accidental conditions were to occur in a state of nature, the bees would be ready at any time to meet them by intelligent adjustment, which, if continued sufficiently long and aided by selection, would pass into true instincts of building combs in new directions, of supporting combs during their construction, of carding threads of cloth, of substituting cement for propolis, and of oatmeal for pollen.

Turning to higher animals, Andrew Knight tells us of a bird which, having built her nest upon a forcing-house, ceased to visit it during the day when the heat of the house was sufficient to incubate

the eggs; but always returned to sit upon the eggs at night when the temperature of the house fell. Again, thread and worsted are now habitually used by sundry species of birds in building their nests, instead of wool and horse-hair, which in turn were no doubt originally substitutes for vegetable fibres and grasses. This is especially noticeable in the case of the tailor-bird, which finds thread the best material wherewith to sew. The common house-sparrow furnishes another instance of intelligent adaptation of nest-building to circumstances; for in trees it builds a domed nest (presumably, therefore, the ancestral type), but in towns avails itself by preference of sheltered holes in buildings, where it can afford to save time and trouble by constructing a loosely formed nest. Moreover, the chimney- and house-swallows have similarly changed their instincts of nidification, and in America this change has taken place within the last two or three hundred years. Indeed, according to Captain Elliott Coues, all the species of swallow on that continent (with one possible exception) have thus modified the sites and structures of their nests in accordance with the novel facilities afforded by the settlement of the country.

Another instructive case of an intelligent change of instinct in connection with nest-building is given from a letter by Mr. Haust, dated New Zealand, 1862, which I find among Mr. Darwin's manuscripts. Mr. Haust says that the Paradise duck, which naturally or usually builds its nest along the rivers on the ground, has been observed by him on the east of the island, when disturbed in their nests upon the ground, to build 'new ones on the tops of high trees, afterwards bringing their young ones down on their backs to the water;' and exactly the same thing has been recorded by another observer of the wild ducks of Guiana. Now if intelligent adjustment to peculiar circumstances is thus adequate, not only to make a whole breed or species of bird transport their young upon their backs—or, as in the case of the woodcock, between their legs—but even to make web-footed water-fowl build their nests in high trees, I think we can have no doubt that if the need of such adjustment were of sufficiently long continuance, the intelligence which leads to it would eventually produce a new and remarkable modification of their ancestral instinct of nest-building.

Turning now from the instinct of modification to that of incubation, I may give one example to show the plasticity of the instinct in relation to the observed requirements of progeny. Several years ago I placed in the nest of a sitting Brahma hen, four newly-born ferrets. She took to them almost immediately, and remained with them for rather more than a fortnight, when I made a separation. During the whole of the time the hen had to sit upon the nest, for the young ferrets were not able to follow her about, as young chickens would have done. The hen was very much puzzled by the lethargy of her

offspring, and two or three times a day she used to fly off the nest calling on her brood to follow; but, on hearing their cries of distress from cold, she always returned immediately, and sat with patience for six or seven hours more. I found that it only took the hen one day to learn the meaning of their cries of distress; for after the first day she would always run in an agitated manner to any place where I concealed the ferrets, provided that this place was not too far away from the nest to prevent her from hearing the cries of distress. Yet I do not think it would be possible to imagine a greater contrast between two cries than the shrill piping note of a young chicken, and the hoarse growling noise of a young ferret. At times the hen used to fly off the nest with a loud scream, which was doubtless due to the unaccustomed sensation of being gripped by the young ferrets in their search for the teats. It is further worthy of remark that the hen showed so much anxiety when the ferrets were taken from the nest to be fed, that I adopted the plan of giving them the milk in their nest, and with this arrangement the hen seemed quite satisfied; at any rate she used to chuck when she saw the milk coming, and surveyed the feeding with evident satisfaction.

Thus we see that even the oldest and most important of instincts in bees and birds admit of being greatly modified, both in the individual and in the race, by intelligent adaptation to changed conditions of life; and therefore we can scarcely doubt that the principle of lapsing intelligence must be of much assistance to that of natural selection in the origination and development of instincts.

I shall now turn to another branch of the subject. From the nature of the case it is not to be expected that we should obtain a great variety of instances among wild animals of new instincts acquired under human observation, seeing that the conditions of their life, as a rule, remain pretty uniform for any periods over which human observation can extend. But from a time before the beginning of history, mankind, in the practice of domesticating animals, has been making what we may deem a gigantic experiment upon the topic before us.

The influences of domestication upon the psychology of animals may be broadly considered as both negative and positive—negative in the obliteration of natural instincts; positive in the creation of artificial instincts. We will consider these two branches separately. Here we may again revert to the obliteration of natural wildness. We all know that the horse is an easily breakable animal, but his nearest allies in a state of nature, the zebra and the quagga, are the most obstinately unbreakable of animals. Similar remarks apply to the natural wildness of all wild species of kine, as contrasted with the innate tameness of our domesticated breeds. Consider again the case of the cat. The domesticated animal is sufficiently tame, even from kittenhood, whereas its nearest cousin in a state of nature, the wild cat, is perhaps of all animals the most untameable. But of course it is

in the case of the dog that we meet with the strongest evidence on this point. The most general and characteristic features in the psychology of all the domesticated varieties are faithfulness, docility, and sense of dependence upon a master; whereas the most usual and characteristic features in the psychology of all the wild species are fierceness, treachery, and self-reliance. But, not further to pursue the negative side of this subject, let us now turn to the positive, or to the power which man has shown himself to possess of implanting new instincts in the mental constitution of animals. For the sake of brevity I shall here confine myself to the most conspicuous instance, which is of course furnished by the dog, seeing that the dog has always been selected and trained with more or less express reference to his mental qualities. And here I may observe that in the process of modifying psychology by domestication exactly the same principles have been brought into operation as those to which we attribute the modification of instincts in general; for the processes of artificial selection and training in successive generations are precisely analogous to the processes of natural selection and lapsing of intelligence in a state of nature.

Touching what Mr. Darwin calls the artificial instincts of the dog, I may first mention those which he has himself dilated upon—I mean the instincts of pointing, retrieving, and sheep-tending; but as Mr. Darwin has already fully treated of these instincts, I shall not go over the ground which he has traversed, but shall confine myself to the consideration of another artificial instinct, which, although not mentioned by him, seems to me of no less significance—I mean the instinct of guarding property. This is a purely artificial instinct, created by man expressly for his own purposes: and it is now so strongly ingrained in the intelligence of the dog that it is unusual to find any individual animal in which it is wholly absent. Thus, we all know, that without any training a dog will allow a stranger to pass by his master's gate without molestation, but that as soon as the stranger passes within the gate, and so trespasses upon what the dog knows to be his master's territory, the animal immediately begins to bark in order to give his master notice of the invasion. And this leads me to observe that barking is itself an artificial instinct, developed, I believe, as an offshoot from the more general instinct of guarding property. None of the wild species of dog are known to bark, and therefore we must conclude that barking is an artificial instinct, acquired for the purpose of notifying to his master the presence of thieves or enemies. I may further observe that this instinct of guarding property extends to the formation of an instinctive idea on the part of the animal, of itself constituting part of that property. If, for instance, a friend gives you temporary charge of his dog, even although the dog may never have seen you before, observing that you are his master's friend and that his master intends

you to take charge of him, he immediately transfers his allegiance from his master to you, as to a deputed owner, and will then follow you through any number of crowded streets with the utmost confidence. Thus, whether we look to the negative or to the positive influences of domestication upon the psychology of the dog, we must conclude that a change has been wrought, so profound that the whole mental constitution of the animal now presents a more express reference to the needs of another, and his enslaving animal, than it does to his own. Indeed, we may say that there is no one feature in the whole psychology of the dog which has been left unaltered by the influence of man, excepting only those instincts which being neither useful nor harmful to man have never been subject to his operation—such, for instance, as the instinct of burying food, turning round to make a bed before lying down, &c.

I will now turn to another branch of the subject, and one which, although in my opinion of the greatest importance, has never before been alluded to; I mean the local and specific variations of instinct. By a local variation of instinct, I mean a variation presented by a species in a state of nature over some particular area of geographical distribution. It is easy to see the importance of such local variations of instinct as evidence of the transmutation of instinct, if we reflect that such a local variation is obviously on its way to becoming a new instinct. For example, the beavers in California have ceased to make dams, the hyenas in South Africa have ceased to make burrows, and there is a squirrel in the neighbourhood of Mount Airy which has developed carnivorous tastes—running about the trees, not to search for nuts, but to search for birds, the blood of which it sucks. In Ohinitabi there is a mountain parrot which before the settlement of the place was a honey eater, but when sheep were introduced the birds found that mutton was more palatable to them than honey, and quickly abandoned their ancestral habits, exchanging their simple tastes of honey eaters for the savageness of tearers of flesh. For the birds come in flocks, single out a sheep, tear out the wool, and when the sheep, exhausted by running about, falls upon its side, they bore into the abdominal cavity to get at the fat which surrounds the kidneys.

These, I think, are sufficient instances to show what I mean by local variations of instinct. Turning now to the specific variations, I think they constitute even stronger evidence of the transmutation of instinct; for where we find an instinct peculiar to a species, or not occurring in any other species of the genus, we have the strongest possible evidence of that particular instinct having been specially developed in that particular species. And this evidence is of particular cogency when, as sometimes happens, the change of instinct is associated with structures pointing to the state of the instincts before the change. Thus, for example, the dipper belongs to a non-aquatic

family of birds, but has developed the instinct, peculiar to its species, of diving under water and running along the bottoms of streams. The species, however, has not had time, since the acquisition of this instinct, to develop any of the structures which in all aquatic families of birds are correlated with their aquatic instincts, such as webbed feet, &c. That is to say, the bird retains all its structural affinities, while departing from the family type as regards its instincts. A precisely converse case occurs in certain species of birds belonging to families which are aquatic in their affinities, these species, however, having lost their aquatic instincts. Such is the case, for example, with the upland geese. These are true geese in all their affinities, retaining the webbed feet, and all the structures suited to the display of aquatic instincts; yet they never visit the water. Similarly, there are species of parrots and tree frogs, which, while still retaining the structures adapted to climbing trees, have entirely lost their arboreal habits. Now, short of actual historical or palæontological information—which of course in the case of instincts is unattainable, seeing that instincts, unlike structures, never occur in a fossil state—short, I say, of actual historical or palæontological information, we could have no stronger testimony to the fact of transmutation of instincts than is furnished by such cases, wherein a particular species, while departing from the instinctive habits of its nearest allies, still retains the structures which are only suited to the instincts now obsolete.

Now this last head of evidence—that, namely, as to local and specific variations of instincts—differs in one important respect from all the other heads of evidence which I have previously adduced. For while these other heads of evidence had reference to the theory concerning the *causes* of transmutation, this head of evidence has reference to the *fact* of transmutation. Whatever, therefore, we may think concerning the evidence of the causes, this evidence is quite distinct from that on which I now rely as conclusive proof of the fact.

I shall now, for the sake of fairness, briefly allude to the more important cases of special difficulty which lie against Mr. Darwin's theory of the origin and development of instincts. For the sake of brevity, however, I shall not allude to those cases of special difficulty which he has himself treated in the 'Origin of Species,' but shall confine myself to considering the other and most formidable cases which, after surveying all the known instincts presented by animals, I have felt to be such.

First, we have the alleged instinct of the scorpion committing suicide when surrounded by fire. This instinct, if it really exists, would no doubt present a difficulty, because it is clearly an instinct which, being not only of no use, but actually detrimental both to the individual and the species, could never have been developed either by natural selection or by lapsing intelligence. I may, however, dismiss

this case with a mere mention, because as yet the evidence of the fact is not sufficiently precise to admit of our definitely accepting it as a fact.

There can be no such doubt, however, attaching to another instinct largely prevalent among insects, and which is unquestionably detrimental, both to the individual and to the species. I allude to the instinct of flying through flame. This is unquestionably a true instinct, because it is manifested by all individuals of the same species. How then are we to explain its occurrence? I think we may do so by considering, in the first place, that flame is not a sufficiently common object in nature to lead to any express instinct for its avoidance; and in the next place by considering that insects unquestionably manifest a disposition to approach and examine shining objects. Whether this disposition is due to mere curiosity, or to a desire to ascertain if the shining objects will, like flowers, yield them food, is a question which need not here concern us. We have merely to deal with the fact that such a general disposition is displayed. Taking then this fact, in connection with the fact that flame is not a sufficiently common object in nature to lead to any instinct expressly directed against its avoidance, it seems to me that the difficulty we are considering is a difficulty no longer.

The shamming-dead of insects appears at first sight a formidable difficulty, because it is impossible to understand how any insect can have acquired the idea either of death or of its intentional simulation. This difficulty occurred to Mr. Darwin thirty or forty years ago, and among his manuscripts I find some very interesting notes of experiments upon the subject. He procured a number of insects which exhibited the instinct, and carefully noted the attitude in which they feigned death. Some of these insects he then killed, and he found that in no case did the attitude in which they feigned death resemble the attitude in which they really died. Consequently we must conclude that all the instinct amounts to is that of remaining motionless, and therefore, inconspicuous, in the presence of danger; and there is no more difficulty in understanding how such an instinct as this should be developed by natural selection in an animal which has no great powers of locomotion, than there is in understanding how the instinct to run away from danger should be developed in another animal with powers of rapid locomotion. The case, however, is not, I think, quite so easy to understand in the feigning death of higher animals. From the evidence which I have I find it almost impossible to doubt that certain birds, foxes, wolves, and monkeys, not to mention some other and more doubtful cases, exhibit the peculiarity of appearing dead when captured by man. As all these animals are highly locomotive, we cannot here attribute the fact to protective causes. Moreover, in these animals this behaviour is not truly instinctive, inasmuch as it is not presented by all, or even most individuals. As yet, however, observation of the facts is insufficient to furnish any data as to their

explanation, although I may remark that possibly they may be due to the occurrence of the mesmeric or hypnotic state, which we know from recent researches may be induced in animals under the influence of forcible manipulation.

The instinct of feigning injury by certain birds presents a peculiar difficulty. As we all know, partridges, ducks, and plovers, when they have a brood of young ones, and are alarmed by the approach of a carnivorous quadruped, such as a dog, will pretend to be wounded, flapping along the ground with an apparently broken wing in order to induce the four-footed enemy to follow, and thus to give time for the young brood to disperse and hide themselves. The difficulty here, of course, is to understand how the birds can have acquired the idea of pretending to have a broken wing, for the occasions must be very rare on which any bird has seen a companion thus wounded followed by a carnivorous quadruped; and even if such observations on their part were of frequent occurrence, it would be difficult to accredit the animals with so high a degree of reasoning power as would be required for them intentionally to imitate such movements. When I consulted Mr. Darwin with reference to this difficulty, he gave me a provisional hypothesis by which it appeared to him that it might be met. He said that any one might observe, when a hen has a brood of young chickens and is threatened by a dog, that she will alternately rush at the dog and back again to the chickens. Now if we could suppose that under these circumstances the mother bird is sufficiently intelligent to observe that when she runs away from the dog, she is followed by the dog, it is not impossible that the maternal instinct might induce her to run away from a brood in order to lead the dog away from it. If this happened in any cases, natural selection would tend to preserve those mother birds which adopted this device. I give this explanation as the only one which either Mr. Darwin or myself has been able to suggest. It will be observed, however, that it is unsatisfactory, inasmuch as it fails to account for the most peculiar feature of the instinct—I mean the trailing of the apparently wounded wing.

The instinct of migration furnishes another case of special difficulty, but as I have no space to dwell upon the sundry questions which it presents for solution, I shall now pass on to the last of the special difficulties which most urgently call for consideration. The case to which I refer deserves, I think, to be regarded as the most extraordinary instinct in the world. There is a species of wasp-like insect, called the *Sphex*. This insect lays its eggs in a hole excavated in the ground. It then flies away and finds a spider, which it stings in the main nerve-centre of the animal. This has the effect of paralysing the spider without killing it. The *sphex* then carries the now motionless spider to its nursery, and buries it with the eggs. When the eggs hatch out the grubs feed on the paralysed prey, which is then still

alive and therefore quite fresh, although it has never been able to move since the time when it was buried. Of course the difficulty here is to understand how the sphex insect can have acquired so much anatomical and physiological knowledge concerning its prey as the facts imply. We might indeed suppose, as I in the first instance was led to suppose, that the sting of the sphex and the nerve-centre of the spider being both organs situated on the median line of their respective possessors, the striking of the nerve-centre by the sting might in the first instance have been thus accidentally favoured, and so have supplied a basis from which natural selection could work to the perfecting of an instinct always to sting in one particular spot. But more recently the French entomologist, M. Fabre, who first noticed these facts with reference to the stinging of the spider, has observed another species of sphex which preyed upon the grasshopper, and as the nervous system of a grasshopper is more elongated than the nervous system of a spider, the sphex in this case has to sting its prey in three successive nerve-centres in order to induce paralysis. Again, still more recently, M. Fabre has found another species of sphex, which preys upon a caterpillar, and in this case the animal has to sting its victim in nine successive nerve-centres. On my consulting Mr. Darwin in reference to these astonishing facts, he wrote me the following letter:—

I have been thinking about *Pompilius* and its allies. Please take the trouble to read on perforation of the corolla, by Bees, p. 425, of my 'Cross-fertilisation,' to end of chapter. Bees show so much *intelligence* in their acts, that it seems not improbable to me that the progenitors of *Pompilius* originally stung caterpillars and spiders, &c., in any part of their bodies, and then observed by their intelligence that if they stung them in one particular place, as between certain segments on the lower side, their prey was at once paralysed. It does not seem to me at all incredible that this action should then become instinctive, *i.e.* memory transmitted from one generation to another. It does not seem necessary to suppose that, when *Pompilius* stung its prey in the ganglion it intended, or knew, that their prey would keep long alive. The development of the larva may have been subsequently modified in relation to their half dead, instead of wholly dead prey; supposing that the prey was at first quite killed, which would have required much stinging. Turn this over in your mind, &c.

I confess that this explanation does not appear to me altogether satisfactory, although it is no doubt the best explanation that can be furnished on the lines of Mr. Darwin's theory.

In the brief space at my disposal, I have endeavoured to give an outline sketch of the main features of the evidence which tends to show that animal instincts have been slowly evolved under the influence of natural causes, the discovery of which we owe to the genius of Darwin. And, following the example which he has set, I shall conclude by briefly glancing at a topic of wider interest and more general importance. The great chapter on Instinct in the *Origin of Species* is brought to a close in the following words:—

Finally it may not be a logical deduction, but to my imagination it is far more satisfactory to look at such instincts as the young cuckoo ejecting its foster-brothers, ants making slaves, the larvæ of ichneumonidæ feeding within the live bodies of caterpillars, not as specially endowed or created instincts, but as small consequences of one general law leading to the advancement of all organic beings, namely, multiply, vary, let the strongest live, and the weakest die.

This law may seem to some, as it has seemed to me, a hard one—hard, I mean, as an answer to the question which most of us must at some time and in some shape have had faith enough to ask, ‘Shall not the Judge of all the earth do right?’ For this is a law, rigorous and universal, that the race shall always be to the swift, the battle without fail to the strong; and in announcing it the voice of science has proclaimed a strangely new beatitude—Blessed are the fit, for they shall inherit the earth. Surely these are hard sayings, for in the order of nature they constitute might the only right. But if we are thus led to feel a sort of moral repugnance to Darwinian teaching, let us conclude by looking at this matter a little more closely, and in the light that Darwin himself has flashed upon it in the short passage which I have quoted.

Eighteen centuries before the publication of this book—the ‘Origin of Species’—one of the founders of Christianity had said, in words as strong as any that have been used by the Schopenhauers and Hartmanns of to-day, ‘the whole creation groaneth in pain and travail.’ Therefore we did not need a Darwin to show us this terrible truth; but we did need a Darwin to show us that out of all the evil which we see at least so much of good as we have known has come; that if this is a world of pain and sorrow, hunger, strife and death, at least the suffering has not been altogether profitless; that whatever may be ‘the far-off divine event to which the whole creation moves,’ the whole creation, in all its pain and in all its travail, is certainly moving, and this in a direction which makes, if not for ‘righteousness,’ at all events for improvement. No doubt the origin of evil has proved a more difficult problem to solve than the origin of species; but, thus viewed, I think that the Darwinian doctrine deserves to be regarded as in some measure a mitigation of the difficulty; certainly in no case an aggravation of it. I do not deny that an immense residuum of difficulty remains, seeing that, so far as we can judge, the means employed certainly do not appear to be justified by the ends attained. But even here we ought not to lose sight of the possibility that, if we could see deeper into the mystery of things, we might find some further justification of the evil, as unsuspected as was that which, as it seems to me, Darwin has brought to light. It is not in itself impossible—perhaps it is not even improbable—that the higher instincts of man may be pointing with as true an aim as those lower instincts of the brutes which we have been contemplating. And, even if the theory of evolution were ever to succeed in furnishing

as satisfactory an explanation of the natural development of the former as it has of the natural development of the latter, I think that the truest exponent of the meaning—as distinguished from the causation—of these higher instincts would still be, not the man of science, but the poet. Here, therefore, it seems to me, that men of science ought to leave the question of pain in Nature to be answered, so far as it can be answered, by the general voice of that humanity which we all share, and which is able to acknowledge that at least its own allotment of suffering is not an unmitigated evil.

For clouds of sorrow deepness lend,
To change joy's early rays,
And manhood's eyes alone can send
A grief-ennobled gaze.

While to that gaze alone expand
Those skies of fullest thought,
Beneath whose star-lit vault we stand,
Lone, wondering, and untaught.

We look before and after,
And pine for what is not,
Our sincerest laughter
With some pain is fraught.

Yet still,—

Our sweetest songs are those that tell of saddest thought.

G. J. ROMANES.