

extraordinary amount of accurate technical knowledge, which, if it fail to inspire implicit faith in all the judgments, at least ensures solid respect for the opinions of the authors. And, indeed, it is this profound acquaintance with the practical science of art which gives to their volumes a distinguishing and exceptional value. It is a work of laborious and grave research, not written to amuse the general reader, but to interest and inform the sincere student.

SCIENCE.

IN speaking, as briefly as may be, of the scientific results of the year, we find it necessary as usual to confine ourselves to those investigations which have a more or less popular side to them. As it happens, the year 1871 was remarkably fertile in discussions which may be described as lying on the border-land between scientific and moral speculation, and in which, therefore, men of science obtain a far larger audience than usual. We refer especially to the long controversy which has been excited by the latest developments of Mr. Darwin's theory. It is our duty to maintain an absolute impartiality in regard to such questions. We may, however, say what will be admitted on all hands, that the question raised by Mr. Darwin as to the origin of species marks the precise point at which the theological and scientific modes of thought come into contact. Now the relations between these two currents of opinion is of primary importance, and therefore upon the mode in which divines and philosophers will ultimately reconcile their differences depends in great measure the future of human thought. Religion undoubtedly corresponds to an ineradicable instinct; and we can have no fear that religion itself will permanently suffer from scientific discoveries; it is quite possible, however, that the current religious ideas may be materially modified in conception of the external world changes, and it is therefore well worth while to give some attention to this debatable land in which so many vigorous blows are being exchanged by the contending parties, previous to the final reconciliation which we may confidently anticipate.

The publication of Mr. Darwin's "Descent of Man" marks a kind of epoch in these discussions. We are brought face to face in this book with those difficult problems which previously had only revealed themselves more or less indistinctly on the dim horizon; and the interest which it excited is so far from appearing to us excessive, that we should doubt whether the full importance of the new theories has even yet been appreciated by any but a very small number of competent observers. The Darwinian theories go to the root of psychology; they more or less affect every question concerning the genesis of morals and the origin of societies. They exert especially an influence to which it is impossible to set limits—an influence upon method. Mr. Darwin's work, in short, is one of those rare achievements which effect a transformation throughout the whole range of intellectual effort. We know, with more or less certainty, how profound was the influence of the Newtonian philosophy over the two or three generations which followed its promulgation; and we may confidently expect that a similar influence will be produced on the generation now beginning its work by Mr. Darwin's theory. One comes upon traces of its influence in the most remote and unexpected quarters; in historical, social, and even artistic questions no less than in those which are more directly

in question, we are every where meeting with that series of ideas to which Mr. Darwin has done more than any other man to give prominence.

We shall merely attempt to give a bare outline of Mr. Darwin's argument in his last work, without more than the most cursory glance at the more remote conclusions from his theories, or the difficulties which may be opposed to them. The point, as we need hardly say, which Mr. Darwin seeks to demonstrate is that man is descended from the apes. The main grounds on which he bases his argument may be briefly indicated: first, there is the correspondence in bodily structure between man and other animals; the bones of his skeleton, the muscles, nerves, viscera, and brain correspond; the structure of the tissues and the composition of the blood are similar; men and animals have common parasites. The whole process of reproduction is the same in all mammals. Second, the embryo of man closely resembles the embryos of other mammals, and undergoes a corresponding order of development—the embryos of forms, finally so different, preserving up to a certain period the structure of the common ancestor. Third, man possesses certain rudimentary organs, muscles, and other parts, which can only be explained by the fact of their having been possessed by some forerunner in a perfect and serviceable state. These three sets of facts concur in furnishing reasons for supposing that Man is no more by his descent than a more highly organized form or modification of a pre-existent mammal.

Against all this it has been urged from various sides, that there is some fundamental difference between the faculties of man and those of other animals; and that the distinction, for example, between human reason and animal instinct is one not of degree, but of kind. To this Mr. Darwin replies that the force of the objection depends ultimately on propositions which no one now could seriously assert, namely, that man is the only organic being possessed of mental power, and that his power is of a *wholly different nature* from that of other creatures. So far as the emotional parts of mental constitution go, the emotions of animals are plainly our own; terror, suspicion, courage, good humour, bad humour, revenge, affection—all these moods and turns may be as truly predicated, and in the same sense, of the lower creatures as of the highest. If we turn to the faculties of intelligence, we find in the lower, as in the highest, Memory, Imitation, Curiosity, and the rudiments of Imagination (as shown in their dreams), and even the complex and derivative quality of Reason. For what definition of Reason can we accept that shall banish to the lower region of instinct a multitude of cases in which a snake, a bird, an ape, plainly goes through the processes of experience, observation, pausing, deliberation on experience, forming new resolutions as a consequence?

A great mass of interesting phenomena have been collected by Mr. Darwin in proof of these propositions, but we cannot find room even to hint at them. The argument from the absence of language has again been frequently urged. Mr. Darwin says that it would be a natural consequence of the higher development of the intellectual faculties. Apes do not speak, because their intelligence is not sufficiently advanced. Then language has reacted on the intelligence, as great instruments of intelligence always do, and stimulated that development of which it was at first the product. "The mental powers in some early progenitor of man must have been more highly developed than in any existing ape, before even the most imperfect form of speech could have come into use; but we may confidently believe that the

continued use and advancement of this power would have reacted on the mind by enabling and encouraging it to carry on long trains of thought." Other differences between man and the highest anthropomorphous ape may be in the same way described as differences flowing from the highly advanced faculties of man, and some of them are mainly the result of a highly developed language.

Mr. Darwin next endeavours to explain the modes of physical and intellectual development. Here, of course, the doctrine of natural relation assumes great prominence, and is applied, with Mr. Darwin's usual clearness and fertility of resource, to the explanation of the facts. He then asks, what was the manner of the development of the intellectual faculties? This, again, is to be explained by the action of natural selection. "We can see this in the rudest state of society, the individuals who were the most sagacious, who invented and used the best weapons or traps, and who were best able to defend themselves, would rear the greatest number of offspring. The tribes which included the largest number of men thus endowed would increase in number and supplant other tribes." For the same reason which makes savage nations die out before civilized nations, every new step in the perfection of the intellectual faculties would confer an advantage on those who had been able to make such a step. In the same way with the social qualities. The progenitors of man have acquired them by natural selection, as the lower animals have done; that is to say, "when two tribes of primeval man living in the same country came into competition, if the one tribe included (other circumstances being equal) a greater number of courageous, sympathetic, and faithful members who were always ready to warn each other of danger, to aid and defend each other, this tribe would without doubt succeed best and conquer the other."

Such is a statement of Mr. Darwin's main argument, which, however, takes up a comparatively small part of his book. The bulk of the two volumes before us is occupied with the establishment of a different theory. Mr. Darwin holds that the difference between races are due in some measure to what he calls "sexual selection;" he argues, in other words, that when a variation has occurred of a kind to give to its possessor a preference in attraction for the other sex, then the larger choice which such a possessor of a variation will naturally have among the strong and vigorous of the opposite sex will tend to a superior multiplication of progeny inheriting the same variation. "If the individuals of one sex were during a long series of generations to prefer pairing with certain individuals of the other sex, characterized in some peculiar manner, the offspring would slowly but surely become modified in the same manner." While natural selection depends upon an advantage in gaining subsistence, possessed by one species and not possessed by a competing species, sexual selection depends upon advantages in relation to reproduction belonging to certain individuals of a sex and species, and not belonging to other individuals of the same sex and species. Mr. Darwin makes a laborious survey of animated creatures, marked by peculiarities of structure, colouring, and so forth, the acquisition of which seems to him most intelligibly explained by the theory that they have assisted their owners in the competition connected with reproduction. And this survey fills the greater part of his work.

Mr. Darwin has so far changed his ground as to discover in "sexual

selection" a force capable of accounting for many characters which, as not being beneficial in the struggle for existence, cannot be explained by the ordinary process of natural selection. Modifications of this kind have, as Mr. Darwin believes, been acquired through advantages which they conferred on their possessors in respect of propagation, by giving them the choice of the most vigorous and fruitful partners. He finds this agency to be the most satisfactory way of explaining such facts as the richer plumage of the peacock or the male pheasant, the brilliant top-knots of many male birds, and so on. These characteristics charm the female, and give their first possessors, those in whom the variation first appeared, a preference over rivals less favoured by nature, which, by attracting the most vigorous females, or a greater number of them, caused the variation to be more abundantly reproduced, according to the laws of inheritance and accumulation. With mammals the rivalry is less peaceful and apparently æsthetic than with birds. Their struggle goes mainly by law of battle, and depends on certain individuals of one sex "having been successful in conquering other males, and in their having left a larger number of offspring to inherit their superiority, than the less successful males."

But this theory does more than cover the difference of secondary sexual characters. It also explains the acquisition by individuals of both sexes of certain characters which cannot be adequately explained by natural selection; by any advantage, that is, which they have conferred on their possessors in the struggle for subsistence. Such characters, though possessed in the first instance by the male only, and giving him an advantage in respect of reproduction, are in given cases, by an observed uniformity, transmitted not only to the male offspring, but to the female also. On the conditions of this transmission of the variations in one sex to descendants of both sexes, and the limits and measures of its operation, Mr. Darwin says many pertinent and highly interesting things. The result of this transmission of both sexes is a permanent modification, and leads to differences in the conditions of race—such as colour, degree and locality of hairiness, shape of head, cheek-bones, nose, and the like. The lowest tribes of men admire their own characteristics in these respects, and "hence these and other such points could hardly fail to have been slowly and gradually exaggerated from the more powerful and able men in each tribe, who would succeed in rearing the largest number of offspring, having selected during many generations as their wives the most strongly characterized, and therefore most attractive women." There seems to us to be a difficulty here, which Mr. Darwin does not notice; for how is it, if after a characteristic has been thus established, the tribe resents or despises a novel variation, as so many peoples, for example, consider the whiteness of skin, or the preservation of the front teeth, to be detestable peculiarities, that yet that characteristic itself, before being permanently acquired, was seized as a delightful novelty? Mr. Darwin tells us, and gives us excellent reasons for thinking, that "the men of each race prefer what they are accustomed to behold; they cannot endure change" (ii. 354). Yet is there not an inconsistency between this fact and the other that one race differs from another exactly because novelties presented themselves and were eagerly seized and propagated? All the rare differences have been established through the passion for novelty, yet no sooner are they established than every novelty is straightway unendurable.

We shall not venture upon any criticisms of this remarkable book, which will be scarcely less useful as exercising thought, if many of the hypotheses which it suggests should prove to be unfounded. We will merely make one remark as to a point on which Mr. Darwin has naturally been exposed to much hostile criticism. He endeavours to account for the origin of the moral sense by which, according to many thinkers, man is most mainly distinguished from the whole brute creation. We are of opinion—and we could assign our reasons were it worth while—that Mr. Darwin has fallen into some confusion of language, and perhaps into some positive errors, from the use of a terminology with which the course of his studies have not rendered him so familiar as he is with all matters of natural science. At the same time, Mr. Darwin's views on this question are of special interest to many readers, because they point to the direction in which future controversies on such subjects are likely to extend. Mr. Darwin gives some highly ingenious explanations of the mode in which a moral sense may be presumed to have originated. If his account were adequate and satisfactory, we should be in a position to account for many things which puzzle previous inquirers; but even if that very large assumption were granted, there would still be room for the old controversy between the utilitarian and the intuitional schools, though it would take different forms, and be decided by different tests.

Mr. Darwin's theory, if completely established, would by no means prove that we have not an intuitive perception of certain moral truths, but would explain in what way those intuitions had been generated. The scientific reader of discussions would in many respects transform the problem; but the old divergence of opinion would still be true.

Without following out this line of thought, we may remark that considerations of this kind might serve to obviate the dread which some persons appear to entertain of the possible results of Mr. Darwin's investigations. In this as in other cases it is conceivable that men of science may explain how certain instincts gradually evolve themselves; but they are by no means the nearer to proving that the instincts have not a real existence, or that they do not possess all the value that has ever been attributed to them.

Various attacks have been made upon Mr. Darwin's theory, and few of the antagonists on either side have succeeded in rivalling the admirable candour and calmness which this great originator of thought has preserved in the midst of the warfare which he has stirred up in every direction. We shall content ourselves with noticing a contribution to a discussion more or less allied to Mr. Darwin's speculations, which has been carried on with an acrimony which is certainly to be regretted. The old feud between the disciples of Pasteur and Pouchet has recently been renewed in England; and Dr. Bastian, in his recently published book, takes the side of the possibility of spontaneous generation. He professes to have taken living organisms from flasks that had been a few months before hermetically sealed and heated to temperatures varying from 260° to 302° Fahrenheit.

But the theory is advanced by some of his antagonists that he was not sufficiently careful to exclude air, and that, in fact, his flasks not being hermetically sealed, he was liable to the same line of criticism as Pasteur in the early stages of the controversy applied to Pouchet. There is too much of the *argumentum ad hominem* in this style of answer, and the attribution of carelessness or error to other observers will not by any means suffice to end

the present dispute. In fact, we fail to discern in the sixty-five detailed experiments which are recounted at such enormous length in the present work, any thing like the carelessness or rashness which some months ago were attributed to Dr. Bastian. So far as appears, the experiments have been free from mistake; and we only see two ways of disproving the facts which appear on the face of the present work. The first is by supposing that Dr. Bastian has not duly closed the flasks so as to exclude the air; and the second is by accepting the theory that an observer, who is so renowned as a microscopical discoverer, really does not know a Bacterium when he sees it. The latter theory cannot readily be accepted. Is the former more probable? Here again there is no apparent probability that Dr. Bastian has become a victim to self-delusion with regard to the perfect closure of the flasks. Therefore we cannot yet awhile assent to the condemnation of his facts.

Four theories with respect to the origin of these simple forms of life have been promulgated. 1. That they are independent organisms derived by fission or gemmation from pre-existing Bacteria or Torulæ. 2. That they represent subordinate stages in the life history of other organisms (fungi), from some portion of which they have derived their origin, and into which again they tend to develop. These methods are termed those of homogenesis, the former being called direct and the latter indirect. 3. That they may have a heterogenetic mode of origin, owing to the more complete individualization of minute particles of living matter entering into the composition of higher organisms, both animal and vegetable. 4. That they may arise *de novo* in certain fluids containing organic matter, independently of pre-existing living things (*archebiosis*). The last theory is what Dr. Bastian thinks he has proved, and what at present we are unable to disprove, except by the arguments to which we have above alluded.

We will venture to touch briefly upon a question of a very different kind. It has lately been attempted by Mr. Crookes and others to subject the phenomena generally known as spiritualistic to a series of scientific tests. A society, which describes itself as the Dialectical Society of London, has appointed a committee, who held a number of sittings, and produced a quantity of evidence on the subject. A very admirable article, subsequently acknowledged to be from the pen of Dr. Carpenter, dealt with the whole question in the *Quarterly Review* for October. Although the Dialectical Society is not constituted in such a manner as to command very much respect from careful observers, it is still remarkable in many ways that a superstition of this kind should be flourishing in modern society. Mr. Crookes, too, is a man of a certain scientific reputation, and the name of "psychic force" which he has invented, and which heads a pamphlet published by him, has done something to force the matter on public attention by giving it a certain scientific flavour.

All kinds of extraordinary and absurd manifestations have been witnessed by persons who report them to the Dialectical Society. Ghosts have been seen walking about in rooms. Mr. Home, the well-known medium, has been lengthened and shortened; he has been carried out of the window of a room at a height of seventy feet above a street, and carried back again through another window. These stories, and stories such as these are gravely refuted and made the subjects of serious argument.

It is difficult to speak or think with any thing else than contemptuous pain of proceedings such as those described in this report. Mr. Crookes has, however, given some prominence to alleged physical movements in solid bodies, which he believes can be produced by the emission from the body, and apparently from the finger-ends, of a pseudo-force unknown and undescribed. His experiments, set forth in a recent number of the *Quarterly Journal of Science*, have an appearance of precision. We see, however, in the primary point, that no means are taken to interpose between the mover and the thing to be moved an indicator of any kind. The index is, so to speak, attached to the wrong end of the beam; and, to speak frankly also, experiments conducted by Mr. Home, as these were, are by that very fact now suspicious. Mr. Crookes' papers have been thought by investigators as impartial as Professor Stokes not to be worthy of discussion before serious scientific societies; but it would be well that they should be submitted to competent independent scrutiny. If they have any value, they lead to a branch of physical investigation widely different from spiritualism. According to the existing data of science, it seems improbable that any emission of transformed electric or other currents from the human body can produce under the stated conditions the appreciable dynamic effect which his index shows; but the improbability is not inherent, inasmuch as the constant correlation of electric effects with every muscular contraction is a matter of familiar knowledge and a part of the teaching of every physiological primer. The improbability is of that secondary character which arises from the collision of Mr. Crookes' observations with those of ordinary life, and of experiments hitherto made. That the phenomena of ordinary muscular action are attended with electric charge and discharge is a doctrine developed at length in Dr. Radcliff's recent studies in vital "electro-dynamics," and it is just possible, though unlikely, that Mr. Crookes' experiments studied in this connexion may not be without value. It is unfortunate that he has accepted for them at the hands of Mr. Cox the misnomer of "psychic force," and the scepticism with which they are regarded by experienced physicists deters us from giving much importance to them. In any case, however, they are rather curious and doubtful than incredible. They may be valueless, but they are at least removed from the supernatural and the absurd, and give no countenance to the follies which disgrace the reports of the Dialectical Society.

The British Association held its meeting at Edinburgh, and the proceedings were opened on the 3rd of August, by an address from the President, Sir W. Thompson. Sir William began by referring to the many eminent men of science who have been lost to us during the preceding twelve months; most prominent among these was Sir John Herschel, to whose eminent services the President paid an eloquent tribute. Another honour to British Science was lost in Professor De Morgan, and the President remarked that if his book on the Differential Calculus was now less studied than of old, the neglect was only due to the fact that it was not convenient for examination purposes, a remark which incidentally throws some light upon the less desirable tendencies of competitive examination. The President next referred to the services rendered by the observatory at Kew, which has now, by Mr. Gassiot's munificent gift of 10,000*l.*, become independent of the voluntary contributions of the Association.

After referring to the useful results of the scientific labours of different

sections of the Association, and illustrating his remarks by various appropriate instances, the President proceeded to make some observations on the great problem to which we have already referred in discussing Mr. Darwin's work on the Origin of Life. He remarked that many thinkers still clung to the ancient hypothesis that dead matter may have run together, or crystallized, or fermented into "germs of life," or "organic cells," or "protoplasia." Science, he said, had brought a vast mass of inductive evidence to bear against this theory, as had been explained at great length by Professor Huxley, the previous occupant of the presidential chair. The experiments of such men as Huchet, Pasteur, and Bastian were indeed worthy of careful attention; but Sir William confessed to being deeply impressed by Professor Huxley's views, and to be ready to adopt, as an article of scientific faith, that through all space and through all time life proceeds from life, and from nothing but life. How then, he asked, did life originate on the earth? Every year thousands and millions of fragments of solid matter fall upon the earth, and it is often assumed that meteoric stones are fragments which have been broken off from larger masses and launched into space. It is as certain that collisions must occur between heavenly bodies as that ships, steered without intelligence, could not cross the Atlantic for thousands of years without them. If the earth ever meets a body of dimensions comparable to its own, whilst still clothed with vegetation, fragments, bearing seeds and animals, must be launched into space. It is probable, then, that these are countless meteoric seed-bearing bodies. If, at the present moment, there were no life on earth, and one of them fell upon it, it might lead to its being covered with vegetation. The hypothesis that life originated here from the moss-grown fragments of another world might seem wild and visionary, but Sir William maintained that it was not unscientific. In conclusion, Sir William remarked that the argument from design had been too much lost sight of in recent zoological speculations. Remarks against the frivolities of teleology, such as are found not rarely in the notes of learned commentators on "Paley's Natural Theology," had had a temporary effect in turning attention from the solid and impregnable argument so well put forward in that excellent old book. But overpoweringly strong proofs of intelligent and benevolent design lie all around us; and if ever perplexities, whether metaphysical or scientific, turn us away from them for a time, they come back upon us with irresistible force, showing to us through nature the influence of a free will, and teaching us that all living beings depend on one ever *acting* creative power.

Other papers of much interest occupied the attention of the Association on subsequent occasions. Professor Tait delivered an eloquent address, though chiefly of too technical a character for our pages. Colonel Yule discussed the state of our knowledge of the regions between India and China. Professor Abel gave a popular lecture on Explosive Compounds; Mr. Glaisher read the report of the Committee on Luminous Meteors. Mr. Pengelly and Mr. Symonds gave accounts of investigations into various bone-bearing caves. Colonel Leslie read a paper on ancient hieroglyphic sculptures, many examples of which have been found in the British islands; we have, however, no space to give any thing like a complete catalogue.

The meeting was on the whole successful, but a certain damp was thrown upon the proceedings by an unfortunate misunderstanding. The people of

Edinburgh, it seems, fancied themselves to have been slighted because the preference was given last year to Liverpool, as the place of meeting of the Association. On the present occasion, the renewed invitation came from the University, whilst the town held aloof, and consequently the members of the Association were scarcely received with that warmth of welcome to which they have been generally accustomed. On the whole, however, they cannot be said to have undergone many hardships in their pursuit of science.