

Turner has more tersely defined the Darwinian theory as "Heredity, modified and influenced by variability." In amplification of the above, he wrote:—

The signification of the variations which arise in plants and animals had not been apprehended until a flood of light was thrown on the entire subject by the genius of Charles Darwin, who formulated the wide-reaching theory that variations would arise, accumulate, and be perpetuated, which would in course of time assume specific importance. New species might thus be evolved out of organisms originally distinct from them, and their specific characters would in turn be transmitted to their descendants. By a continuance of this process new species would multiply in many directions, until at length from one or more originally simple forms the earth would become peopled by the infinite varieties of plant and animal organisms, which have in ages past inhabited, or do at present inhabit, our globe. Through the accumulation of useful characters the specific variation was perpetuated by natural selection, so long as the conditions were favourable for its existence, and it survived as being the best fitted to live.

Thus Paley's doctrine of design, which regarded the organism as perfect and impossible of improvement, made and adapted to carry out the special function ordained for it, was supplanted by the doctrine of Evolution.

Goodsir would not accept the new teaching. He worked to check the growth of Darwinism in Britain, and to counteract the impression that had been made upon the minds of the citizens of Edinburgh by the publication of the 'Vestiges of Creation,' and by Huxley's lectures at the Philosophical Institution on "Man's Place in Nature." He sought to defend orthodoxy against what he considered was an unqualified and hasty expression of thought. Turner, although coming under the spell of Goodsir and stimulated by the great mental qualities of his master, was nevertheless inspired by the evolutionary movement. A study of his work will show just what his position

was, and how persistently his mind dwelt upon the problem, as he carried on his researches in the field of Comparative Anatomy and Anthropology. He very early turned his attention to the study of those structural variations which occur in the human body, recognising their significance as furnishing evidence of Man's origin. Many of his papers, published in the sixties, deal with variability in structure, malformations of organs, hereditary deformities, supernumerary and rudimentary structures, and their relation to corresponding features in the lower animals, all illustrating points in the evolutionary history of Man. It is interesting to observe at this point that, like his friend George Rolleston of Oxford, he was not prepared to accept the evolutionary doctrine in its entirety. Darwin sought his assistance upon a number of points, especially upon those dealing with rudimentary structures and variations in man and the higher mammals, and the correspondence between the two men dealt mainly with matters of this kind. In one of his letters to Darwin, Turner, while pointing out that in the 'Descent of Man' a confusion had arisen in the author's mind between the supra-condyloid foramen sometimes present in the arm-bone of a man and the inter-condyloid foramen of the same bone, had evidently expressed some doubts regarding the evolutionary doctrine. Darwin's reply was as follows:—

March 28, 1871,
DOWN, BECKENHAM, KENT.

I am much obliged for your kind note and especially for your offer of sometimes sending me corrections, for which I shall be very grateful. I know that there are many mistakes to which I am very liable. That is a terrible one confusing the supra-condyloid foramen with another one. This, however, I have corrected in all the copies struck off after the first lot of 2500.

I daresay there will be a new edition in the course of nine months or a year, and I will correct as well as I can. As yet,

the publisher has kept up type and grumbles dreadfully if I make many corrections.

I am very far from surprised that you have not committed yourself to full acceptance of the Evolution of Man. Difficulties and objections there undoubtedly are, enough and to spare, to stagger any very cautious man who has much knowledge like yourself.

CH. DARWIN.

Turner, like Goodsir, took a wide view of his subject, and he embraced within its horizon much more than the details of human anatomy. In his scientific work as in his teaching, he came under the influence of the traditions and the spirit of the Edinburgh School. We have endeavoured to show how, in the past, her anatomists were not confining their attention to the mere descriptive anatomy of the human body, but were probing its secrets by the study of its development and of its functions, and by comparing it with the structure of the lower forms of animal life. In his own Department all that was best in Anatomy was embodied in the personality of John Goodsir. When Turner entered the school in 1854, her teachers held scientific positions of world-wide reputation, so that he could not fail to absorb some of the atmosphere of his immediate environment and be stimulated to take his share in maintaining the prestige of the School. It is doubtful whether any one of the scientific workers in Edinburgh at that time, or indeed in the past, showed such catholicity of pursuits as he did. Chemistry, Pathology, Human Anatomy (descriptive and microscopical), Physiology, Zoology, Comparative Anatomy, Anthropology (including Archæology), all received his attention. His energies were not dissipated by reason of the various lines along which he worked: on the contrary, his wide and precise knowledge of every branch of anatomical science was a source of strength, as it enabled him to bring to bear upon each piece of work which he had in hand a more exact interpretation of the meaning of the facts which he observed and described.

Domestication,' sought to elucidate how far man's bodily structure showed traces, more or less plainly, of his descent from some lower form of animal life. The question, therefore, as to whether man possessed, in a rudimentary state, organs or structures which were fully developed in some of the lower animals, was one of considerable importance to Darwin in constructing his thesis. Such structures are very variable, because being useless, or nearly so, they are no longer subjected to natural selection. They often, too, become wholly suppressed, but they are nevertheless liable to occasional reappearance through reversion.

Darwin's letters to Turner, though few in number, are of additional interest from the fact that they have not hitherto been published. They also illustrate one of the methods which the great naturalist employed in acquiring accurate information; they show, too, the great consideration and respect with which he treated the opinion of experts, a feature which was a marked characteristic of Darwin's attitude towards his fellow-workers.

Dec. 14, 1866,
DOWN, KENT.

Your kindness when I met you at the Royal Society makes me think that you would grant me the favour of a little information, if in your power.

I am preparing a book on 'Domestic Animals,' and as there has been so much discussion on the bearing of such views as I hold on Man, I have some thoughts of adding a chapter on this subject.

The point on which I want information is in regard to any part which may be fairly called rudimentary in comparison with the same part in the *Quadrumana* or any other mammals.

Now the *os coccyx* is rudimentary as a tail, and I am anxious to hear about its muscles. Mr Flower found for me in some work that its one muscle (with *striæ*) was supposed only to bring this bone back to its proper position after parturition.

This seems to me hardly credible. He said he had never particularly examined this part, and when I mentioned your

name, he said you were the most likely man to give me information. Are there any traces of other muscles? It seems strange if there are none. Do you know how the muscles are in this part in the Anthropoid Apes?

The muscles of the Ear in Man may, I suppose, in most cases be considered as rudimentary; and so they seem to be in the Anthropoids: at least, I am assured that in the Zoological Gardens they do not erect their ears. I gather that there are a good many muscles in various parts of the body which are in the same state. Could you specify any of the best cases?

The mammæ in man are rudimentary. Are there any other glands or other organs which you can think of? I know I have no right whatever to ask all these questions, and can only say that I shall be grateful for any information. If you tell me anything about the os coccyx, or other structures, I hope that you will permit me to quote the statement on your authority, as that would so greatly add to its value. Pray excuse me for troubling you, and do not hurry yourself in the least in answering me.

I do not know whether you would care to possess a copy, but I told my publisher to send you a copy of the new edition of the 'Origin.'

CH. DARWIN.

Jan. 15, 1867,

DOWN, BROMLEY, KENT.

As you were so kind as to say that I might ask you a few more questions, and as my wishes are now rather more definite, I do so; but you must not suppose that I am in any hurry for an answer.

1. One or two good cases of any rudiment of a muscle would suffice; if any muscle in our arms exists in a rudimentary or nearly rudimentary condition, and which would be of service to a quadruped, going on all fours, such a case would perhaps be best.

2. You reminded me that there were two sets of muscles for moving the whole ear and its parts: which of such muscles are rudimentary in the human ear?

3. I have used your information about muscles to the os coccyx; if my memory does not deceive me, the four coccygeal bones contain spinal marrow at an early embryonic age, and afterwards it retreats. If this is so, are vestiges of the membranes of the spinal marrow retained?

4. Is any other gland rudimentary in mankind besides the mammary glands in male mammals ?

5. I may add that I have alluded to traces of the supra-condyloid foramen in the humerus of man, and to the nictitating membrane. By the way, do you chance to remember whether the nictitating membrane is well developed in Marsupials ?

Pray forgive me, if you can, for being so very troublesome.
CH. DARWIN.

Feb. 1, 1867,

DOWN, BROMLEY, KENT.

I thank you cordially for all your full information, and I regret much that I have given you such great trouble at a period when your time is so much occupied. But the facts are so valuable to me that I cannot pretend that I am sorry that I did trouble you, and I am the less so, as, from what you say, I hope you may be induced some time to write a full account of all rudimentary structures in man; it would be a very curious and interesting memoir.

I shall at present give only a brief abstract of the chief facts which you have so very kindly communicated to me, and will not touch on some of the doubtful points. I have received far more information than I ventured to anticipate.

There is one point which has occurred to me, but I suspect there is nothing in it. If, however, there should be, perhaps you will let me have a brief note, and if I do not hear I will understand there is nothing in the notion. I have included the down on the human body as the rudimentary representation of a hairy coat.

I do not know whether there is any direct functional connection between the presence of hair and the *panniculus carnosus*, but both are superficial and would perhaps together become rudimentary. But to put the question from another point of view: is it the primary or aboriginal function of the *panniculus* to move the several appendages or the skin itself ?

I was led to think of this by the places (as far as my ignorance of anatomy has allowed me to judge) of the rudimentary muscular fasciculi, which you specify. Now, some persons can move the skin of their hairy hands, and is this not effected by the panniculus ? How is it with the eyebrows ? You specify the axilla and the front of the chest and lower part of the shoulder blades. Now these are all

hairy spots in Man. On the other hand, the back is not hairy. So, as I said, I presume there is nothing in this notion. If there were, then rudiments of the panniculus ought perhaps to occur more plainly in men than in women.

With sincere thanks for all that you have done for me, and for the very kind manner in which you granted me your favour.

CH. DARWIN.

Although Turner's answers to these letters, unfortunately, are not preserved, the information which he was able to supply is embodied and acknowledged in 'The Descent of Man.' The main points dealt with were the rudimentary muscles and tail, the remains of a hairy covering upon the human body, a third eyelid, and the rudimentary mammary gland in man. Amongst the various muscles uniformly present in some of the lower animals, and which can occasionally be detected in man, the most interesting perhaps is the *panniculus carnosus*, a layer of muscular fibres lying just beneath the skin, and capable of producing voluntary movement of the overlying integument. The action of this muscle is well seen in many quadrupeds, as, for example, the horse, which possesses the power of moving or twitching its skin. Remnants of the muscle, both in an active and inactive condition, are observed in the human body. Well-known examples are seen on the scalp and in the muscles of the external ear, by the action of which individuals are enabled to raise their eyebrows, or even to move the whole hairy scalp, while others again have the power of drawing their ears backwards and forwards. Turner had occasionally detected inactive remains of this muscle in other parts of the body, as on the front and back of the chest. The association of this muscle with parts of the skin which are also hairy, led Darwin, in the last of the three letters just quoted, to put forward the proposition that there was probably a developmental association between the panniculus and the hairy coat, and that both structures together became rudimentary in man.