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CURIOUS ANIMAL RELATIONSHIPS.

As paleontological discoveries multiply, they reveal to us in a constantly increasing degree the mobility of the beings of which our earth has seen the successive development. All living creatures of past ages have been ephemeral, and those whose histories are the shortest seem curiously enough to have been the ones which possessed the greatest strength. Such monsters as the dinotherium, the dinoceras, the bronchotherium, etc., existed over but a comparatively brief period; and it might almost be conceived that, because these giants expended vast quantities of vital energy, the quicker was the same used up.

Among these fossil beings, the mammifers which have characterized the third great phase of the history of nature, called the tertiary epoch, offer conditions particularly favorable for the study of questions relative to evolution. At this epoch they formed a striking contrast with the rest of animate creation. The plants then belonged to present genera; their generic transformations were accomplished, and modification was restricted to species and races. The great traits of the invertebrata were nearly all defined; their species varied, their genera and families likewise, but in degree. The fishes had reached their highest development, the reptiles had passed theirs and were diminishing. But the mammifers were then in full evolution; and in the enormous multitude of species—a new form almost for every instant of geological time—some were suddenly appearing, others as suddenly disappearing. In the midst of this confusion there may be traced, however, certain curious chains of development, and to some of these, M. Gaudry devotes an admirable paper in the Revue des Deux Mondes.

Among the placental mammifers which played a prominent part in tertiary times are those to which, on account of their thick skin, the name pachyderm has been given. At the present time they are scattered, and between the various species there seems little or no relationship. The hog, the rhinoceros, and the tapir, for example, differ widely. But when we go back to the fossils, we find that preceding the hog of to-day there has been a whole succession of fossil hogs, then animals of a genus closely related, called hyotherium; this in turn is related to the paleocheirus so closely that the two are often confounded. The paleocheirus in turn again differs little from the cheiropotamus and dichobune. Now the present rhinoceros was preceded by tertiary rhinoceri. Between these and the hornless animal known as the acerotherium, it is easy to trace relationship. The latter may be connected with the paleotherium; and of this last the remains are found with those of the cheiropotamus in Montmartre gypsum, and thus the connection between the rhinoceros and the hog is established. Similarly a chain of relationship can be found between these animals and the tapir.

But the signs of transition are not merely apparent between pachyderm and pachyderm, but between the pachyderm order and that of the ruminants. It would hardly be supposed that the light and graceful antelope bears any relationship to the unwieldy rhinoceros; yet paleontologists are supplying the connecting links. The majority of ruminants differ from the pachyderms, in that the former have horns on the frontal bones, but the first ruminants had no horns; later the horns were but rudimentary, and branching antlers arrived still more recently. Present ruminants are also unlike pachyderms in their lack of incisive teeth on the upper jaw, but ancient ruminants had such teeth. The molars of present ruminants are especially adapted to mastication of herbs, those of pachyderms are suited for crushing hard bodies. Yet the hog's molars resemble those of the anthracotherium, and from this creature, through the hypopotamus, the lophiomeryx, and the dorcatherium, can be traced every step of transition to the molars of the herbivorous antelope. Again, take the feet; note the difference between the great splay foot of the hippopotamus and the delicate hoof of the gazelle. The hippopotamus' foot is like the hog's; it is not difficult to see that the hog's is like the peccary's. Then there is a chain of resemblance from peccary to hyomochus, to tragule, to steinbock, and finally to the sheep. The hoof of the horse can also be connected with the foot of the rhinoceros.

Another curious chain is that between bear and dog. Bears now differ from the canines in that they are plantigrade, and in the size of their tubular teeth, the last indicating their omnivorous diet. But in the tertiary epoch there existed amphicyons—plantigrade dogs with tubular teeth; these were replaced by the hyenarctos, more bear than dog. Then there is a hyena connection, for the cynodon links the dog and the civet. Of three species of ictitherium, found in Greece, one was half hyena half civet, one more civet than hyena, and one more hyena than civet. The relation of the lemur to the pachyderms is also strikingly shown in the fossils. Remains of small pachyderms have been found having monkey dentition, and M. Gervais has discovered an animal which he calls cebochoerus anceps, or, to use Patent Office parlance, combined pig and monkey.

THE SCIENCE OF PLAY.

There is not much obvious connection between the homely couplet "All work and no play makes Jack a dull boy," and Schiller's hypothesis of a "Spieltrieb," or sport impulse which he recognizes as existing in human nature, and to which he traces the origin of all fiction, and especially that of a poetic and dramatic character. Yet both ideas express truths which need but to be blended together, to bring before us a realization of the absolute necessity of play in a

practical and physiological light. The first may be taken as referring to the physical gambols of the young animal; the second, to that which in one sense may be mental relaxation, in another, not so; affirmatively if the exercise of the sport impulse involves a total change of thought and idea, negatively if no such change takes place.

Play is an instinctive faculty, inherent in all animals. It is as much an instinct as the desire to seek food when hungry; and to regard it as a mere aimless and trifling species of exertion is a total mistake. The gambols of a child emerging from babyhood, or of a kitten, are due to precisely similar reasons. At this period of life the purpose of play in man and brute is the same; in after years the difference vastly widens through the introduction of the intellectual element in the actions of the child, and of course its total absence in those of the brute. The games and playthings of youth are not those of childhood; but the play of an old dog—though more rarely occurring—is nevertheless the same as that of a young puppy. The object of play in young life is exercise. It is the peculiar exercise which Nature prompts the organism to undertake; and it may be said that it is the only possible form of exercise which is at once attended by pleasure, and is able to mould the frame of the growing animal in the direction of its perfect development. Its antithesis is task work, which, though it may not involve one tithe the exertion, nevertheless passes quickly into fatigue, and thus results in straining some muscles unduly while others are left comparatively undeveloped. In play alone, the instinctive sense of physical need gets full scope; its spontaneity and aimlessness are therefore only apparent, and its nature and amount are determined by the sense of pleasure in the exercise itself; while on the other hand, a strictly natural limit is imposed on all undue exertion by obedience to the sense of fatigue. The result is an equable and harmonious development of muscular energy and nutrition in every muscle and fiber; and it is one attainable in no other way—certainly not by any prescribed routine of exertion—or save by obeying a natural instinct.

Dr. John Strachan, of Edinburgh, has recently published a valuable little treatise, physiologically inquiring into the bearing of play upon education and training; and after adducing conclusions substantially similar to those above enumerated, he proceeds further and states that the law of spontaneous development through play does not end with physical improvement, but that, after a time, the higher and more differentiated faculties come to be required for the perfection of the animal, and that the same law presides over their evolution. Play, he explains, that is apparently aimless, or, at least, not consciously directed exercise, is the means of securing the equable development of the brain and its faculties—memory, imagination, hope, wonder, and even special kinds of intellectual and moral activity, according to the endowments, and perhaps also the accidents, of social position in the individual. "Exercise is accompanied by pleasure up to the limit of fatigue; beyond this limit, by pain or uneasiness. Special endowments or faculties brought into prominence by accident and after exercised are more, others are less, developed. But in every case there is a limit, and the only sure way of ascertaining the limit is by giving scope to the instinct; in other words, by allowing 'play' or apparently unregulated and spontaneous impulse its due place in the work of education."

Of course the practical deductions to be made from Dr. Strachan's conclusions are, first, that tasks should never be arranged so as to carry the organism over the limit of fatigue, that play as such should be real play, nothing but the "absolutely free and spontaneous direction of the sport impulse," and not circumscribed by any limits as to kind or nature. Our author's treatment ends with the bearing of play upon the education and training of the young, else he might have pursued his inquiry further and reached the hardly avoidable conclusion that, as the human being grows older, play becomes more and more a mental process, until at last it becomes scarcely distinguishable from work itself. The labors of almost any professional man will demonstrate this; the results of his sport impulse viewed individually are due to what would to another man involve hard labor. Eventually play becomes merely difference in work, and involves the disuse of one set of tired brain molecules, as it were, and the calling into action of a fresh series, and the more different the labor the greater and more enjoyable, and doubtless the more beneficial the change. The author of that supremely funny children's story "Alice in Wonderland," and the wildly absurd "Hunting of the Snark," is a grave theological professor in a great English university—and both writings are productions which professional wits and humorists would shrink from attempting to rival. So, also, hard physical work presenting a still wider dissimilarity to mental labor becomes comparatively play. The ex-Prime Minister of England finds his greatest enjoyment in hewing down the trees on his estate. And we know of many an instance where an amateur's mechanical workshop adjoins the office of a physician or lawyer, or where the artist's easel furnishes the necessary play to a brain closely engaged in scientific study.

Specific Heat of Water.

According to new experiments by Munchhausen, of Moscow, the specific heat of water taken at unity at 32° is at 212° Fah. 1.0302, as against 1.013 found by Régnault, and 1.122 determined by Jamin. The investigations were made with the greatest refinement of accuracy.