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disease I do not know how at this moment to say anything satisfactory; for as to the remark that an otherwise quick-seeing traveller, Foucher d'Obsonville, has made, that Leucœthiopians are begotten when the parents are taking mercury or cinnabar at the time, it is impossible to imagine it correct in many of the cases of the nations mentioned, and in many of the animals among whom Kakerlacken are found, even if the whole idea were not to the last extent extremely improbable. So also the old assertion, that no Leucœthiopian of either sex was capable of procreation, is completely untrue. De Brue has already found an instance in which a Leucœthiopian became pregnant by a negro, and a perfect young negro was born, and the well-known negro Vasa, in his above-mentioned interesting work, has given a remarkable account of a Leucœthiopian female, who was lately married in England to an European, and has borne him three genuine Mulattos with light hair.

APPENDIX I. To p. 284 *n.*

On the gradation in nature.

Two scientific societies, the one at Rouen and the other at Haarlem, have lately given out as the subject for a prize, *Whether the asserted gradation in nature has any real foundation or not?* I am acquainted with only one essay in answer to this question which was sent in to the last-mentioned learned society, whose renowned author, our worthy Professor De Luc, has handled the whole subject only from a metaphysical *à priori* point of view, and even in this way comes to the conclusion that there is neither continuity nor imperceptible gradation in the creation, and that the harmony of the creation is rather supported by marked differences, having sharply defined boundaries between them. On the other hand, I long ago[1] pointed out considerations against the reality of the structural conceptions of the gradation of creatures according to their mere exterior

[1] *Handbuch der Naturgesch.* p. 6, 7th ed.

form, and against the very well-meant, but at the bottom very presumptuous tendency towards this idea, which is found in many physico-theologians; and these are entirely empirical, taken from natural history itself, and from the visible constraint which, in all the various essays on such gradations, is done to nature. Who does not feel how constrained he is when Bradley carries up his scale from the simplest fossils through the vegetable and animal kingdom up to man, but has to put off what he cannot readily make fit into this scale into a second, by which he descends on the other side again from that elevation? or, when in order to stand fast by particular passages and connecting links, Vallisneri brings forward the analogy of grasshoppers with birds, Oehme the analogy of birds with house-flies and other *Dipteræ*, and when Bonnet chooses the shield-lice as creatures of the transition from other insects to the tape-worm, &c. We should find it much easier to excuse the older describers of nature, when, deceived by the great resemblance of the exterior, they located the armadilloes of the genus *Manis* with the lizards, or the sertularia, and above all the corals, with the cryptogamic plants; since with certainly quite as much reason, in consequence of an extremely superficial view of an outward structure very nearly resembling them, many even phanogeramic species of plants out of the genera *Saxifraga, Andromedæ, Aretiæ*, &c. in spite of all their remaining heterogeneity, have had a place found for them on the ladder close to the large-leaved moss.

When that extraordinary wonder-animal of the fifth part of the world, the *Ornithorhynchus paradoxus*, was discovered, many partisans of gradation looked upon it as a fresh support of that theory, whereas, it seems to me much rather to be a new evidence against its reality. It seems to me so very isolated a creature of its sort, that it can be no more brought into the natural arrangement of the animal kingdom without visible constraint, than the tortoises, cuttle-fish, &c., or than many genera of plants, as the *Vitis, Cissus*, &c. in that of the vegetable kingdom. Besides this, in the scale of Bonnet, and simple ones of that kind, the transition department from the birds to the quadrupeds has been long since filled up by the bat; and yet it would

be difficult to imagine two forms of mammals, which differ more surprisingly from each other, and which must therefore in any gradation stand further apart from each other, than those of the bat and the ornithorhynchus.

It must be understood that all that has been said here, as well as what was suggested above (p. 283), by the expressions quoted from an otherwise meritorious writer on the use of petrifactions, is only to be regarded as a warning against the misuse of the common conception of gradation, according to the outward form of creatures under the favourite images of ladders and links: since, on the other hand, the very greatest use may be made of this very metaphorical image not only towards the exercise of observation, but also with the greatest advantage towards the regular use of a natural system in the description of nature, and also for the most advantageous arrangement of natural collections. Only instead of the partisans of this gradation acknowledging its value in dividing the productions of nature into kingdoms, classes, &c., and as a means of methodizing study and an assistance to the memory, but allowing that it has no real existence in nature itself; exactly the opposite seems to have come of those structural conceptions, whose unmistakeable value for the science of method cannot be denied, but which are so very far from having any real ground in nature itself, that it has often happened to well-meaning physico-theologians that "they have attributed it to the Creator in the plan of His creation, and have made its completeness and connexion to be sought for in the fact that nature, as the expression goes, *makes no leap, because* creatures with respect to their outward habit can be arranged so closely in gradation one with another."

APPENDIX II. To p. 285.

On the Succession of the different Earth-catastrophes.

If petrifactions can be made of regular use for the archæology and the physical geography of the earth, as the surest

documents in the archives of nature for the fruitful history of the catastrophes which have been connected with our planet since its creation, the study of them, and its tendency, demands as well a thorough critical comparison of them with the organized bodies of the present creation, as also an accurate investigation of their different localities, and their geognostical relations. The first important and instructive result which is immediately derived from this two-fold consideration is, that the lapidifications are of extremely unequal antiquity; many, as the still fresh *Salmo arcticus* of the west coast of Greenland, which is, so to speak, merely mummified in the thin clayish-marl beds, is only of yesterday or the day before, in comparison with the thoroughly strange and puzzling impressions of unknown plants which are found in the grau-wacke strata of the Harz on the borders of the Gangberg in the depths of the earth, and which belong to the very oldest evidences of an organized creation on our planet. A wider examination of these differently made fossils, and of their equally various sort of condition, brings us to a closer conclusion as to the oldest history of the body of this earth, and upon the sort and consequences of the numerous catastrophes it has gone through, and through which its crust has acquired its present appearance, which has been built out of such great convulsions. It is therefore my opinion, that the petrifactions may be arranged off-hand, according to their different antiquity, most easily in three principal divisions. First, those whose complete similarity with still existing representatives, as well as the positions they are found in, prove that they must be comparatively the most recent; secondly, those far older, which have not indeed similar but still more or less allied analogues to them in the present creation, although in climates very distant from those which contain such fossil remains; finally, in the third place, the very oldest of all, consisting for the most part of creatures completely unknown, the records of a perfectly strange creation which has been completely destroyed. These three divisions may to a certain extent be compared to the three epochs in the oldest profane writings of an historical, heroic, and mythical period.

The first of these divisions comprises, therefore, the relatively most modern lapidifications, those namely which seem to have been occasioned by partial local revolutions since the last general catastrophe which our planet suffered; and consequently, nothing but those whose representatives are still in existence, and which are closely allied to the fossil remains in the same country. Amongst them I reckon the uncommonly clear casts and remains from all six classes of the animal kingdom, and the numerous kinds of plants which are to be found in, and have made famous, the stinking slate-quarries at Oeningen on the Bodensee. When I travelled in that country I made a collection of them, and I have seen still more in other collections; but amongst all, which I have myself been able to examine accurately, I have unfortunately found nothing exotic, nothing which might not be referred either unmistakeably, or at all events with the greatest probability, to the fauna and flora of that present country and its waters.

To the second of these principal divisions belong fossils of quite another sort and far higher origin; namely, the now innumerable elephants, rhinoceroses, and other now tropical creatures found in this country, which most probably must have been once naturalized here, as is particularly demonstrated by the enormously large dens of huge species of bears in the famous summits of the Harz, the Fichtelberg, in the Thuringian forest and on the Carpathians. Everything goes to show that those bears came alive into those caves, and found their graves there. But there are also found in these caves with them bones and teeth of beasts of prey, like the lions and hyænas of the present earth, of which I have specimens, from most of the dens mentioned, in my collection. Consequently, according to all probability that species of bears was also a tropical one, just as bears still live in many of the tropical zones of the old world; and as those bears and lions are found in positions where it would be difficult for them to have been floated in by any current after death, so this seems very unlikely to have happened either to the elephants or rhinoceroses. Especially when it is considered that quite little flocks of many of these

have been found together, as the five individual hippopotami on the hither Harz, whose fossil remains have been determined and described with a master's hand by our meritorious Hollmann; and that of others, as of the two elephants from Tonna, mentioned above, the complete skeletons have been dug out, &c. And finally, all this derives a new importance from another geological phenomenon, which according to my conviction belongs to a similar division, and must be joined in close connection with it; I mean the remains of tropical animals in certain limestones. Thus in the calcareous strata of Pappenheim there have been found amongst so many other tropical creatures a kind of Molluscan[1] water-flea, and the still articulated arm bones of a species of bat, very much like the flying-dog, and all these so well preserved, even up to the most delicate Indian star-fishes, so clear and in such perfection, that no notion can remain of any transport of them through a general flood from the southern hemisphere here. On the contrary, it is quite clear that those elephants, rhinoceroses, and hyæna-like animals must once have been just as these water-fleas, star-fishes, &c., domesticated in our latitudes, until through some cause which we cannot now determine with any certainty, a total alteration of the climate took place, which occasioned the destruction of the then living generation of those tropical creatures, as of many other genera and species of organized bodies which existed along with them, of which in the present creation no exactly similar, to say nothing of specifically like, representatives are to be found: as the unknown of Ohio among great land-animals, and amongst the marine-animals in the Pappenheim slate-quarries, so many altogether strange species of crabs, the singular hard-armed medusa head, and many others.

This revolution, which seems to have been merely climatic, must be distinguished from those earlier and much more forcible ones, from which we must date the petrifactions of the *third*

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[1] [The *Pterodactylus*, a reptile; and since the time of Blumenbach, the *Archæopteryx macrurus*, a longtailed bird. Ed.]

division, the oldest of all. In those the firm crust of the earth itself suffered such powerful shocks, that the floors of the previous seas of the primeval world began to cover high mountains with their still uninjured shells; and on the other hand, the previous vegetation of the land was buried deep under the present surface of the sea. It is at once observed that these destructive catastrophes themselves were again of more than one sort, and were very far from happening all at the same time; although it is scarcely possible at present to determine with any certainty the chronological arrangement of the successive periods in which they happened, to say nothing of the causes of them.

APPENDIX III. To p. 292.

On the so-called Objects of Design.

Few scientific theories have been supported and opposed with such incredible prejudices on the one side and on the other, as those about the objects of design of the Creator. With many indeed, who contested this point, it was merely a question of words, whether one ought to speak of design or utility. Others considered the whole question of final causes as entirely useless; and Bacon's *bon-mot* is well known, who compared it to a prudent virgin, who weds heaven, and consequently produces nothing for the world. The great thinker would however have come to a different conclusion if he had been reminded out of the literature of physiology and natural history, what completeness in these important sciences and what useful results to mankind the search into the final purposes of nature has produced. But certainly the teleologists have laid themselves wonderfully open by anxiously catching at those things, and have also used great force to them, because they have thought themselves obliged to demonstrate clearly the aim and object of every disposition of nature, especially in the organic creation. Thus the otherwise praiseworthy anatomist Spigel declares that the reason why in man that part on which he sits has been so visibly more

developed than in any other animal is, that people may have a more convenient position in which to apply themselves to higher thoughts[1]. So the physico-theologians thought they had found a perforated disk in a bee-like insect on the front feet of the males, and were not behindhand in demonstrating the use and object of this structure. Wise nature had done this, they said, in order that the pollen of the flower might percolate through the creature, and in that way the fructification of plants be provided for; and from that hour it was immediately called the sieve-bee (*Sphex cribraria*). It is very creditable to a clergyman, Göze of Quedlinburg, who has in every way won great renown in natural history, that he has refuted this mistake out of nature herself, and has shown that the disks on the feet of these insects are not penetrated; and consequently this wise object which was with good intentions attributed to the Creator will not stand.

Others, sometimes, on the contrary, have doubted the reality of any arrangement in nature for the very reason that they cannot find in it any design of the Creator. When I pointed out to my never-to-be-forgotten friend Camper, that, in nature, contrary to every common opinion, the tadpoles of the pipa of Surinam were regularly tailed, he was disposed at first to consider[2] the instance I showed him as an unnatural monstrosity, because he could not understand of what use this fin-tail could be to these little creatures who sit nestled on the back of their mothers. Others, again, have swept the whole road quite clean, and completely denied all design in the creation. Not many years ago a distinguished member of the then Academy of Sciences of Paris

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[1] "Man alone of all animals sits comfortably, because he has larger fleshy buttocks, and these were given him as a support and a cushion, so that when his stomach was full, he could sit without inconvenience, and apply his mind more readily to reflection upon divine matters."—"There was however a respectable English clergyman of another opinion, who amongst other suggestions as to the delicate and particular propriety of conduct which should be observed in church, used to urge very zealously that the psalms should be sung standing, because it was impossible they could come right from the heart in a sitting posture:" see *Remarks on the Public Service of the Church, with some Directions for our Behaviour there, highly proper to be understood by People of all Ranks and Ages*, Lond. 1768, 8vo.

[2] *Comment. Soc. Reg. Scient. Götting.*, T. IX. p. 119.

declared that it was as ridiculous to suppose that the eye was made to see with[1], as to assert that stones were appointed for the purpose of breaking a man's head. This however, please God, will scarcely be satisfactory to any one who has ever had the opportunity of comparing the interior structure of any animal which is remarkable for striking singularities in its mode of life and functions, and can in this way persuade himself from nature itself most incontrovertibly of this pre-established harmony, as it may easily be called, between the purposed structure of creatures and their mode of life. It would be difficult for anyone who is well acquainted with the natural history of the mole or the seal, and will consider with some little reflection the skeleton and muscular system of the former, and the peculiarities of the circulation and the organs of sense of the latter, to allow himself seriously to utter such an expression as the one mentioned above. The hundredfold proofs which may be deduced from comparative anatomy deprive the weak superficialities of some ancient sophists, who supposed that the animal structure was not ordained for its functions, but that the occupations of animals were only the mere consequence of their organization, of the last shadow of speciousness. Thus the production of so many mere temporary organs which only exist in the animal economy for transitory and extremely limited purposes, and which all the same are as good as those which are most durable in all the rest of the structure of those animals in which they are found, are wonderfully adapted to their mode of life. Thus, to produce only one instance of the kind, in the hedgehog, which rolls itself up in defence with such great muscular power, even the unborn fœtuses are completely furnished with one of these powerful springs, most accurately arranged, but which is afterwards in its way an after-birth[2] quite anomalously deformed, thick, and solid, under which the tender immature creature rests

[1] Thus said Lucretius long ago:

"Lumina ne facias oculorum clara creata
Prospicere ut possimus," &c.

[2] I have given representations of this highly remarkable part in my *Handbuch der vergleichenden Anatomie*, Tab. 8.

as under a shield, in order to be as completely as possible protected, on any powerful constriction of the pregnant mother, against the dangerous consequences of that strong grasp from which its abdomen and entrails might thereby suffer.