

CHAPTER IV.

Consideration of the question whether species have a real existence in nature, *continued*—Phenomena of hybrids—Hunter's opinions as to mule animals—Mules not strictly intermediate between the parent species—Hybrid plants—Experiments of Kölreuter—The same repeated by Wiegmann—Vegetable hybrids prolific throughout several generations—Why so rare in a wild state—Decandolle's opinion respecting hybrid plants—The phenomena of hybrids confirms the doctrine of the permanent distinctness of species—Theory of the gradation in the intelligence of animals as indicated by the facial angle—Discovery of Tieddemann that the brain of the fœtus in mammalia assumes successively the form of the brain of a fish, reptile, and bird—Bearing of this discovery on the theory of progressive development and transmutation—Recapitulation.

WE have yet to consider another class of phenomena, those relating to the production of hybrids, which have been regarded in a very different light with reference to their bearing on the question of the permanent distinctness of species; some naturalists considering them as affording the strongest of all proofs in favour of the reality of species; others, on the contrary, appealing to them as countenancing the opposite doctrine, that all the varieties of organization and instinct now exhibited in the animal and vegetable kingdoms, may have been propagated from a small number of original types.

In regard to the mammifers and birds, it is found that no sexual union will take place between races which are remote from each other in their habits and organization; and it is only in species that are very nearly allied that such unions produce offspring. It may be laid down as a general rule, admitting of very few exceptions among quadrupeds, that the hybrid progeny is sterile, and there seem to be no well-authenticated examples of the continuance of the mule race beyond one generation. The principal number of observations and experiments relate to the mixed offspring of the horse and the ass; and in this case it is well established, that the male-mule can generate and the female-mule produce. Such cases occur in Spain and

Italy, and much more frequently in the West Indies and New Holland; but these mules have never bred in cold climates, seldom in warm regions, and still more rarely in temperate countries.

The hybrid offspring of the female-ass and the stallion, the *μύνος* of Aristotle, and the *hinnus* of Pliny, differs from the mule, or the offspring of the ass and mare. In both cases, says Buffon, these animals retain more of the mother than of the father, not only in the magnitude but in the figure of the body; whereas, in the form of the head, limbs, and tail, they bear a greater resemblance to the father. The same naturalist infers, from various experiments respecting cross-breeds between the he-goat and ewe, the dog and she-wolf, the goldfinch and canary-bird, that the male transmits his sex to the greatest number, and that the preponderance of males over females exceeds that which prevails where the parents are of the same species.

The celebrated John Hunter has observed, that the true distinction of species must ultimately be gathered from their incapacity of propagating with each other, and producing offspring capable of again continuing itself. He was unwilling, however, to admit, that the horse and the ass were of the same species, because some rare instances had been adduced of the breeding of mules, which he attributed to a degree of monstrosity in the organs of the mule, for these he suggested might not have been those of a mixed animal, but those of the mare or female-ass. “This, he argues, is not a far-fetched idea, for true species produce monsters, and many animals of distinct sex are incapable of breeding at all; and as we find nature, in its greatest perfection, deviating from general principles, why may it not happen likewise in the production of mules, so that sometimes a mule shall breed from the circumstance of its being a monster respecting mules?”

Yet, in the same memoir, this great anatomist inferred that the wolf, the dog, and the jackal, were all of one species, because he had found, by two experiments, that the dog would

breed, both with the wolf and the jackal; and that the mule, in each case, would breed again with the dog. In these cases, however, we may observe, that there was always one parent at least of pure breed, and no proof was obtained that a true hybrid race could be perpetuated; a fact of which we believe no examples are yet recorded, either in regard to mixtures of the horse and ass, or any other of the mammalia.

Should the fact be hereafter ascertained, that two mules can propagate their kind, we must still inquire whether the offspring may not be regarded in the light of a monstrous birth, proceeding from some accidental cause, or rather, to speak more philosophically, from some general law not yet understood, but which may not be permitted permanently to interfere with those laws of generation, whereby species may, in general, be prevented from becoming blended. If, for example, we discovered that the progeny of a mule race degenerated greatly in the first generation, in force, sagacity, or any attribute necessary for its preservation in a state of nature, we might infer that, like a monster, it is a mere temporary and fortuitous variety. Nor does it seem probable that the greater number of such monsters could ever occur unless obtained by art; for in Hunter's experiments, stratagem or force was, in most instances, employed to bring about the irregular connexion*.

It seems rarely to happen that the mule offspring is truly intermediate in character between the two parents. Thus Hunter mentions, that, in his experiments, one of the hybrid pups resembled the wolf much more than the rest of the litter; and we are informed by Wiegmann, that in a litter lately obtained in the Royal Menagerie at Berlin, from a white pointer and a she-wolf, two of the cubs resembled the common wolf-dog, but the third was like a pointer with hanging ears.

There is, undoubtedly, a very close analogy between these phenomena and those presented by the intermixture of distinct races of the same species, both in the inferior animals and in

* Phil. Trans. 1787. Additional Remarks, Phil. Trans. 1789.

man. Dr. Prichard, in his "Physical History of Mankind," cites examples where the peculiarities of the parents have been transmitted very unequally to the offspring; as where children, entirely white, or perfectly black, have sprung from the union of the European and the negro. Sometimes the colour, or other peculiarities of one parent, after having failed to show themselves in the immediate progeny, reappear in a subsequent generation, as where a white child is born of two black parents, the grandfather having been a white*.

The same author judiciously observes, that if different species mixed their breed, and hybrid races were often propagated, the animal world would soon present a scene of confusion; its tribes would be everywhere blended together, and we should, perhaps, find more hybrid creatures than genuine and uncorrupted races †.

The history of the vegetable kingdom has been thought to afford more decisive evidence in favour of the theory of the formation of new and permanent species from hybrid stocks. The first accurate experiments in illustration of this curious subject appear to have been made by Kölreuter, who obtained a hybrid from two species of Tobacco, *Nicotiana rustica* and *N. paniculata*, which differ greatly in the shape of their leaves, the colour of the corolla, and the height of the stem. The stigma of a female plant of *N. rustica* was impregnated with the pollen of a male plant of *N. paniculata*. The seed ripened and produced a hybrid which was intermediate between the two parents, and which, like all the hybrids which this botanist brought up, had imperfect stamens. He afterwards impregnated this hybrid with the pollen of *N. paniculata*, and obtained plants which much more resembled the last. This he continued through several generations, until, by due perseverance, he actually changed the *Nicotiana rustica* into the *Nicotiana paniculata*.

The plan of impregnation adopted, was the cutting off of the anthers of the plant intended for fructification before they had

* Vol. i., p. 217.

† Ibid., vol. i., p. 97.

shed pollen, and then laying on foreign pollen upon the stigma. The same experiment has since been repeated, with success, by Wiegmann, who found that he could bring back the hybrids to the exact likeness of either parent, by crossing them a sufficient number of times.

The blending of the characters of the parent stocks, in many other of Wiegmann's experiments, was complete; the colour and shape of the leaves and flowers, and even the scent, being intermediate, as in the offspring of the two species of verbascum. An intermarriage, also, between the common onion and the leek (*Allium cepa* and *A. porrum*) gave a mule plant, which, in the character of its leaves and flowers, approached most nearly to the garden onion, but had the elongated bulbous root and smell of the leek.

The same botanist remarks, that vegetable hybrids, when not strictly intermediate, more frequently approach the female than the male parent species, *but they never exhibit characters foreign to both*. A re-cross with one of the original stocks, generally causes the mule plant to revert towards that stock; but this is not always the case, the offspring sometimes continuing to exhibit the character of a full hybrid.

In general, the success attending the production and perpetuity of hybrids among plants, depends, as in the animal kingdom, on the degree of proximity between the species intermarried. If their organization be very remote, impregnation never takes place; if somewhat less distant, seeds are formed, but always imperfect and sterile. The next degree of relationship yields hybrid seedlings, but these are barren; and it is only when the parent species are very nearly allied, that the hybrid race may be perpetuated for several generations. Even in this case the best authenticated examples seem confined to the crossing of hybrids with individuals of pure breed. In none of the experiments most accurately detailed does it appear that both the parents were mules.

Wiegmann diversified, as much as possible, his mode of bringing about these irregular unions among plants. He often

sowed parallel rows, near to each other, of the species from which he desired to breed, and instead of mutilating, after Kölreuter's fashion, the plants of one of the parent stocks, he merely washed the pollen off their anthers. The branches of the plants, in each row, were then gently bent towards each other and intertwined, so that the wind, and numerous insects as they passed from the flowers of one to those of the other species, carried the pollen and produced fecundation.

The same observer saw a good exemplification of the manner in which hybrids may be formed in a state of nature. Some wallflowers and pinks had been growing in a garden, in a dry sunny situation, and their stigmas had been ripened so as to be moist, and to absorb pollen with avidity, although their anthers were not yet developed. These stigmas became impregnated by pollen, blown from some other adjacent plants of the same species, but had they been of different species, and not too remote in their organization, mule races must have resulted.

When, indeed, we consider how busily some insects have been shown to be engaged in conveying anther-dust from flower to flower, especially bees, flower-eating beetles, and the like, it seems a most enigmatical problem how it can happen, that promiscuous alliances between distinct species are not perpetually occurring.

How continually do we observe the bees diligently employed in collecting the red and yellow powder by which the stamens of flowers are covered, loading it on their hind legs, and carrying it to their hive for the purpose of feeding their young! In thus providing for their own progeny, these insects assist materially the process of fructification*. Few of our readers need be reminded, that the stamens in certain plants grow on different blossoms from the pistils, and unless the summit of the pistil be touched with the fertilizing dust, the fruit does not swell, nor the seed arrive at maturity. It is by the help of bees chiefly, that the development of the fruit of many such species

* See Barton on the Geography of Plants, p. 67.

is secured, the powder which they have collected from the stamens being unconsciously left by them in visiting the pistils.

How often, during the heat of a summer's day, do we see the males of diœcious plants, such as the yew-tree, standing separate from the females, and sending off into the air, upon the slightest breath of wind, clouds of buoyant pollen! That the zephyr should so rarely intervene to fecundate the plants of one species with the anther-dust of others, seems almost to realize the converse of the miracle believed by the credulous herdsmen of the Lusitanian mares—

Ore omnes versæ in Zephyrum, stant rupibus altis,
 Exceptantque leves auras : et sæpe sine ullis
 Conjugiis, vento gravidæ, mirabile dictu*.

But, in the first place, it appears that there is a natural aversion in plants, as well as in animals, to irregular sexual unions ; and in most of the successful experiments in the animal and vegetable world, some violence has been used, in order to procure impregnation. The stigma imbibes, slowly and reluctantly, the granules of the pollen of another species, even when it is abundantly covered with it ; and if it happen that, during this period, ever so slight a quantity of the anther-dust of its own species alight upon it, this is instantly absorbed, and the effect of the foreign pollen destroyed. Besides, it does not often happen that the male and female organs of fructification, in different species, arrive at a state of maturity at precisely the same time. Even where such synchronism does prevail, so that a cross impregnation is effected, the chances are very numerous against the establishment of a hybrid race.

If we consider the vegetable kingdom generally, it must be recollected, that even of the seeds which are well ripened, the greater part are either eaten by insects, birds, and other animals, or decay for want of room and opportunity to germinate. Unhealthy plants are the first which are cut off by causes prejudicial to the species, being usually stifled by more vigorous individuals of their own kind. If, therefore, the relative fecundity or

* Georg. lib. iii. 273.

hardiness of hybrids be in the least degree inferior, they cannot maintain their footing for many generations, even if they were ever produced beyond one generation in a wild state. In the universal struggle for existence, the right of the strongest eventually prevails; and the strength and durability of a race depends mainly on its prolificness, in which hybrids are acknowledged to be deficient.

Centaurea hybrida, a plant which never bears seed, and is supposed to be produced by the frequent intermixture of two well-known species of *Centaurea*, grows wild upon a hill near Turin. *Ranunculus lacerus*, also sterile, has been produced accidentally at Grenoble, and near Paris, by the union of two *Ranunculi*; but this occurred in gardens*.

Mr. Herbert, in one of his ingenious papers on mule plants, endeavours to account for their non-occurrence in a state of nature, from the circumstance that all the combinations that were likely to occur, have already been made many centuries ago, and have formed the various species of botanists; but in our gardens, he says, whenever species, having a certain degree of affinity to each other, are transported from different countries, and brought for the first time into contact, they give rise to hybrid species †. But we have no data, as yet, to warrant the conclusion, that a single permanent hybrid race has ever been formed, even in gardens, by the intermarriage of two allied species brought from distant habitations. Until some fact of this kind is fairly established, and a new species, capable of perpetuating itself in a state of perfect independence of man, can be pointed out, we think it reasonable to call in question entirely this hypothetical source of new species. That varieties do sometimes spring up from cross breeds, in a natural way, can hardly be doubted, but they probably die out even more rapidly than races propagated by grafts or layers.

Decandolle, whose opinion on a philosophical question of this kind deserves the greatest attention, has observed, in his Essay

* Hon. and Rev. W. Herbert, Hort. Trans., vol. iv., p. 41.

† Ibid.

on Botanical Geography, that the *varieties* of plants range themselves under two general heads: those produced by external circumstances, and those formed by hybridity. After adducing various arguments to show that neither of these causes can explain the permanent diversity of plants indigenous in different regions, he says, in regard to the crossing of races, " I can perfectly comprehend, without altogether sharing the opinion, that where many species of the same genera occur near together, hybrid species may be formed, and I am aware that the great number of species of certain genera which are found in particular regions, may be explained in this manner; but I am unable to conceive how any one can regard the same explanation as applicable to species which live naturally at great distances. If the three larches, for example, now known in the world, lived in the same localities, I might then believe that one of them was the produce of the crossing of the two others; but I never could admit that the Siberian species has been produced by the crossing of those of Europe and America. I see, then, that there exist, in organized beings, permanent differences which cannot be referred to any one of the actual causes of variation, and these differences are what constitute *species* *."

The most decisive arguments, perhaps, amongst many others, against the probability of the derivation of permanent species from cross breeds, are to be drawn from the fact alluded to by Decandolle, of species having a close affinity to each other occurring in distinct botanical provinces, or countries inhabited by groups of distinct species of indigenous plants. For in this case naturalists, who are not prepared to go the whole length of the transmutationists, are under the necessity of admitting, that in some cases species which approach very near to each other in their characters, were so created from their origin; an admission fatal to the idea of its being a general law of nature, that a few original types only should be formed,

* Essai Élémentaire, &c. 3me. partie.

and that all intermediate races should spring from the intermixture of those stocks.

This notion, indeed, is wholly at variance with all that we know of hybrid generation ; for the phenomena entitle us to affirm, that had the types been at first somewhat distant, *no cross-breeds would ever have been produced*, much less those prolific races which we now recognise as distinct species.

In regard, moreover, to the permanent propagation of hybrid races among animals, insuperable difficulties present themselves, when we endeavour to conceive the blending together of the different instincts and propensities of two species, so as to insure the preservation of the intermediate race. The common mule, when obtained by human art, may be protected by the power of man ; but in a wild state, it would neither have precisely the same wants as the horse or the ass : and if, in consequence of some difference of this kind, it strayed from the herd, it would soon be hunted down by beasts of prey and destroyed.

If we take some genus of insects, such as the bee, we find that each of the numerous species has some difference in its habits, its mode of collecting honey, or constructing its dwelling, or providing for its young, and other particulars. In the case of the common hive-bee, the workers are described, by Kirby and Spence, as being endowed with no less than thirty distinct instincts*. So also we find that amongst a most numerous class of spiders, there are nearly as many different modes of spinning their webs as there are species. When we recollect how complicated are the relations of these instincts with co-existing species, both of the animal and vegetable kingdoms, it is scarcely possible to imagine that a bastard race could spring from the union of two of these species, and retain just so much of the qualities of each parent-stock as to preserve its ground in spite of the dangers which surround it.

We should also ask, if a few generic types alone have been *created* among insects, and the intermediate species have pro-

* *Intr. to Entom.*, vol. ii., p. 504. Ed. 1817.

ceeded from hybridity, where are those original types, combining, as they ought to do, the elements of all the instincts which have made their appearance in the numerous derivative races? So also in regard to animals of all classes, and of plants; if species in general are of hybrid origin, where are the stocks which combine in themselves the habits, properties, and organs, of which all the intervening species ought to afford us mere modifications?

We shall now conclude this subject by summing up, in a few words, the results to which the consideration of the phenomena of hybrids has led us. It appears that the aversion of individuals of distinct species to the sexual union is common to animals and plants, and that it is only when the species approach near to each other, in their organization and habits, that any offspring are produced from their connexion. Mules are of extremely rare occurrence in a state of nature, and no examples are yet known of their having procreated in a wild state. But it has been proved, that hybrids are *not* universally sterile, provided the parent stocks have a near affinity to each other, although the continuation of the mixed race, for several generations, appears hitherto to have been obtained only by crossing the hybrids with individuals of pure species, an experiment which by no means bears out the hypothesis that a true hybrid race could ever be permanently established.

Hence we may infer, that aversion to sexual intercourse is, in general, a good test of the distinctness of original stocks, or of *species*, and the procreation of hybrids is a proof of the very near affinity of species. Perhaps, hereafter, the number of generations for which hybrids may be continued, before the race dies out (for it seems usually to degenerate rapidly), may afford the zoologist and botanist an experimental test of the difference in the degree of affinity of allied species.

We may also remark, that if it could have been shown that a single permanent species had ever been produced by hybridity (of which there is no satisfactory proof), it might certainly have lent some countenance to the notions of the ancients

respecting the gradual deterioration of created things, but none whatever to Lamarck's theory of their progressive perfectibility; for observations have hitherto shown that there is a tendency, in mule animals and plants, to degenerate in organization.

We have already remarked, that the theory of progressive development arose from an attempt to ingraft the doctrines of the transmutationists upon one of the most popular generalizations in geology. But modern geological researches have almost destroyed every appearance of that gradation in the successive groups of animate beings, which was supposed to indicate the slow progress of the organic world from the more simple to the more compound structure. In the more modern formations, we find clear indications that the highest orders of the terrestrial mammalia were fully represented during several successive epochs; but, in the monuments which we have hitherto examined of more remote eras, in which there are as yet discovered few fluvial, and perhaps no lacustrine formations, and, therefore, scarcely any means of obtaining an insight into the zoology of the then existing continents, we have only as yet found one example of a mammiferous quadruped. The recent origin of man, and the absence of all signs of any rational being holding an analogous relation to former states of the animate world, affords one, and the only reasonable argument, in support of the hypothesis of a progressive scheme, but none whatever in favour of the fancied evolution of one species out of another.

When the celebrated anatomist, Camper, first attempted to estimate the degrees of sagacity of different animals, and of the races of man, by the measurement of the facial angle, some speculators were bold enough to affirm, that certain simiæ differed as little from the more savage races of men, as do these from the human race in general; and that a scale might be traced from "apes with foreheads villanous low," to the African variety of the human species, and from that to the European. The facial angle was measured by drawing a line from the prominent centre of the forehead to the most advanced part of the lower jaw-bone, and observing the angle which it

made with the horizontal line ; and it was affirmed, that there was a regular series from birds to the mammalia.

The gradation from the dog to the monkey was said to be perfect, and from that again to man. One of the ape tribe has a facial angle of 42° , and another, which approximated nearest to man in figure, an angle of 50° . To this succeeds (*longo sed proximus intervallo*) the head of the African negro, which, as well as that of the Kalmuc, forms an angle of 70° , while that of the European contains 80° . The Roman painters preferred the angle of 95° , and the character of beauty and sublimity, so striking in some works of Grecian sculpture, as in the head of Apollo, and in the Medusa of Sisocles, is given by an angle which amounts to 100° *.

A great number of valuable facts and curious analogies in comparative anatomy, were brought to light during the investigations which were made by Camper, John Hunter, and others, to illustrate this scale of organization ; and their facts and generalizations must not be confounded with the fanciful systems which White and others deduced from them †.

That there is some connexion between an elevated and capacious forehead in certain races of men, and a large development of the intellectual faculties, seems highly probable ; and that a low facial angle is frequently accompanied with inferiority of mental powers, is certain ; but the attempt to trace a graduated scale of intelligence through the different species of animals accompanying the modifications of the form of the skull, is a mere visionary speculation. It has been found necessary to exaggerate the sagacity of the ape tribe at the expense of the dog, and strange contradictions have arisen in the conclusions deduced from the structure of the elephant, some anatomists being disposed to deny the quadruped the intelligence which he really possesses, because they found that the volume of his brain was small in comparison to that of the other mammalia, while others were inclined to magnify extravagantly

* Prichard, Phys. Hist. of Mankind, vol. i., p. 159.

† Ch. White on the regular Gradation in Man, &c., 1799.

the superiority of its intellect, because the vertical height of its skull is so great when compared to its horizontal length.

It would be irrelevant to our subject if we were to enter into a farther discussion on these topics, because, even if a graduated scale of organization and intelligence could have been established, it would prove nothing in favour of a tendency, in each species, to attain a higher state of perfection. We may refer the reader to the writings of Blumenbach, Prichard, Lawrence, and others, for convincing proofs that the varieties of form, colour, and organization of different races of men, are perfectly consistent with the generally received opinion, that all the individuals of the species have originated from a single pair; and while they exhibit in man as many diversities of a physiological nature, as appear in any other species, they confirm also the opinion of the slight deviation from a common standard of which a species is capable.

The power of existing and multiplying in every latitude, and in every variety of situation and climate, which has enabled the great human family to extend itself over the habitable globe, is partly, says Lawrence, the result of physical constitution, and partly of the mental prerogative of man. If he did not possess the most enduring and flexible corporeal frame, his arts would not enable him to be the inhabitant of all climates, and to brave the extremes of heat and cold, and the other destructive influences of local situation*. Yet, notwithstanding this flexibility of bodily frame, we find no signs of indefinite departure from a common standard, and the intermarriages of individuals of the most remote varieties are not less fruitful than between those of the same tribe.

There is yet another department of anatomical discovery, to which we must not omit some allusion, because it has appeared to some persons to afford a distant analogy, at least, to that progressive development by which some of the inferior species may have been gradually perfected into those of more complex organization. Tieddemann found, and his discoveries have been

* Lawrence, *Lectures on Phys. Zool. and Nat. Hist. of Man*, p. 192. Ed. 1823.

most fully confirmed and elucidated by M. Serres, that the brain of the fœtus, in the highest class of vertebrated animals, assumes, in succession, the various forms which belong to fishes, reptiles, and birds, before it acquires those additions and modifications which are peculiar to the mammiferous tribe. So that in the passage from the embryo to the perfect mammifer, there is a typical representation, as it were, of all those transformations which the primitive species are supposed to have undergone, during a long series of generations, between the present period and the remotest geological era.

If you examine the brain of the mammalia, says M. Serres, at an early stage of uterine life, you perceive the cerebral hemispheres consolidated, as in fish, in two vesicles isolated one from the other; at a later period, you see them affect the configuration of the cerebral hemispheres of reptiles; still later again, they present you with the forms of those of birds; finally, they acquire, at the era of birth, and sometimes later, the permanent forms which the adult mammalia present.

The cerebral hemispheres, then, only arrive at the state which we observe in the higher animals by a series of successive metamorphoses. If we reduce the whole of these evolutions to four periods, we shall see that in the first are born the cerebral lobes of fishes, and this takes place homogeneously in all classes. The second period will give us the organization of reptiles; the third the brain of birds; and the fourth the complex hemispheres of mammalia.

If we could develop the different parts of the brain of the inferior classes, we should make in succession a reptile out of a fish, a bird out of a reptile, and a mammiferous quadruped out of a bird. If, on the contrary, we could starve this organ in the mammalia, we might reduce it successively to the condition of the brain of the three inferior classes.

Nature often presents us with this last phenomenon in monsters, but never exhibits the first. Among the various deformities which organized beings may experience, they never pass the limits of their own classes to put on the forms of the class

above them. Never does a fish elevate itself so as to assume the form of the brain of a reptile; nor does the latter ever attain that of birds; nor the bird that of the mammifer. It may happen that a monster may have two heads, but the conformation of the brain always remains circumscribed narrowly within the limits of its class*.

It will be observed, that these curious phenomena disclose, in a highly interesting manner, the unity of plan that runs through the organization of the whole series of vertebrated animals; but they lend no support whatever to the notion of a gradual transmutation of one species into another, least of all of the passage, in the course of many generations, from an animal of a more simple, to one of a more complex structure. On the contrary, were it not for the sterility imposed on monsters, as well as on hybrids in general, the argument to be derived from Tieddemann's discovery, like that deducible from experiments respecting hybridity, would be in favour of the successive *degeneracy*, rather than the perfectibility, in the course of ages, of certain classes of organic beings.

For the reasons, therefore, detailed in this and the two preceding chapters, we draw the following inferences, in regard to the reality of *species* in nature.

First, That there is a capacity in all species to accommodate themselves, to a certain extent, to a change of external circumstances, this extent varying greatly according to the species.

2dly. When the change of situation which they can endure is great, it is usually attended by some modifications of the form, colour, size, structure, or other particulars; but the mutations thus superinduced are governed by constant laws, and the capability of so varying forms part of the permanent specific character.

3dly. Some acquired peculiarities of form, structure, and instinct, are transmissible to the offspring; but these consist

* E. R. A. Serres, Anatomie Comparée du Cerveau, illustrated by numerous plates, tom. i., 1824.

of such qualities and attributes only as are intimately related to the natural wants and propensities of the species.

4thly. The entire variation from the original type, which any given kind of change can produce, may usually be effected in a brief period of time, after which no farther deviation can be obtained by continuing to alter the circumstances, though ever so gradually,—indefinite divergence, either in the way of improvement or deterioration, being prevented, and the least possible excess beyond the defined limits being fatal to the existence of the individual.

5thly. The intermixture of distinct species is guarded against by the aversion of the individuals composing them to sexual union, or by the sterility of the mule offspring. It does not appear that true hybrid races have ever been perpetuated for several generations, even by the assistance of man; for the cases usually cited relate to the crossing of mules with individuals of pure species, and not to the intermixture of hybrid with hybrid.

6thly. From the above considerations, it appears that species have a real existence in nature, and that each was endowed, at the time of its creation, with the attributes and organization by which it is now distinguished.
