

CHAPTER XXI.

SELECTION, *continued.*

NATURAL SELECTION AS AFFECTING DOMESTIC PRODUCTIONS—CHARACTERS WHICH APPEAR OF TRIFLING VALUE OFTEN OF REAL IMPORTANCE—CIRCUMSTANCES FAVOURABLE TO SELECTION BY MAN—FACILITY IN PREVENTING CROSSES, AND THE NATURE OF THE CONDITIONS—CLOSE ATTENTION AND PERSEVERANCE INDISPENSABLE—THE PRODUCTION OF A LARGE NUMBER OF INDIVIDUALS ESPECIALLY FAVOURABLE—WHEN NO SELECTION IS APPLIED, DISTINCT RACES ARE NOT FORMED—HIGHLY-BRED ANIMALS LIABLE TO DEGENERATION—TENDENCY IN MAN TO CARRY THE SELECTION OF EACH CHARACTER TO AN EXTREME POINT, LEADING TO DIVERGENCE OF CHARACTER, RARELY TO CONVERGENCE—CHARACTERS CONTINUING TO VARY IN THE SAME DIRECTION IN WHICH THEY HAVE ALREADY VARIED—DIVERGENCE OF CHARACTER, WITH THE EXTINCTION OF INTERMEDIATE VARIETIES, LEADS TO DISTINCTNESS IN OUR DOMESTIC RACES—LIMIT TO THE POWER OF SELECTION—LAPSE OF TIME IMPORTANT—MANNER IN WHICH DOMESTIC RACES HAVE ORIGINATED—SUMMARY.

Natural Selection, or the Survival of the Fittest, as affecting domestic productions.—We know little on this head. But as animals kept by savages have to provide throughout the year their own food either entirely or to a large extent, it can hardly be doubted that in different countries, varieties differing in constitution and in various characters would succeed best, and so be naturally selected. Hence perhaps it is that the few domesticated animals kept by savages partake, as has been remarked by more than one writer, of the wild appearance of their masters, and likewise resemble natural species. Even in long-civilised countries, at least in the wilder parts, natural selection must act on our domestic races. It is obvious that varieties having very different habits, constitution, and structure, would succeed best on mountains and on rich lowland pastures. For example, the improved Leicester sheep were formerly taken to the Lammermuir Hills; but an intelligent sheep-master reported that “our coarse lean pastures were unequal to the task of supporting such heavy-bodied sheep; and they gradually dwindled away into less and less bulk: each generation was inferior to the

“preceding one; and when the spring was severe, seldom more than two-thirds of the lambs survived the ravages of the storms.”¹ So with the mountain cattle of North Wales and the Hebrides, it has been found that they could not withstand being crossed with the larger and more delicate lowland breeds. Two French naturalists, in describing the horses of Circassia, remark that, subjected as they are to extreme vicissitudes of climate, having to search for scanty pasture, and exposed to constant danger from wolves, the strongest and most vigorous alone survive.²

Every one must have been struck with the surpassing grace, strength, and vigour of the Game-cock, with its bold and confident air, its long, yet firm neck, compact body, powerful and closely pressed wings, muscular thighs, strong beak massive at the base, dense and sharp spurs set low on the legs for delivering the fatal blow, and its compact, glossy, and mail-like plumage serving as a defence. Now the English game-cock has not only been improved during many years by man’s careful selection, but in addition, as Mr. Tegetmeier has remarked,³ by a kind of natural selection, for the strongest, most active and courageous birds have stricken down their antagonists in the cockpit, generation after generation, and have subsequently served as the progenitors of their race. The same kind of double selection has come into play with the carrier pigeon, for during their training the inferior birds fail to return home and are lost, so that even without selection by man only the superior birds propagate their race.

In Great Britain, in former times, almost every district had its own breed of cattle and sheep; “they were indigenous to the soil, climate, and pasturage of the locality on which they grazed: they seemed to have been formed for it and by it.”⁴ But in this case we are quite unable to disentangle the effects of the direct action of the conditions of life,—of use or habit—of natural selection—and of that kind of

¹ Quoted by Youatt on Sheep, p. 325. See also Youatt on Cattle, pp. 62, 69.

² MM. Lherbette and De Quatre-fages, in ‘Bull. Soc. d’Acclimat.,’ tom.

viii., 1861, p. 311.

³ ‘The Poultry Book,’ 1866, p. 123. Mr. Tegetmeier, ‘The Homing or Carrier Pigeon,’ 1871, pp. 45–58.

⁴ Youatt on Sheep, p. 312.

selection which we have seen is occasionally and unconsciously followed by man even during the rudest periods of history.

Let us now look to the action of natural selection on special characters. Although nature is difficult to resist, yet man often strives against her power, and sometimes with success. From the facts to be given, it will also be seen that natural selection would powerfully affect many of our domestic productions if left unprotected. This is a point of much interest, for we thus learn that differences apparently of very slight importance would certainly determine the survival of a form when forced to struggle for its own existence. It may have occurred to some naturalists, as it formerly did to me, that, though selection acting under natural conditions would determine the structure of all important organs, yet that it could not affect characters which are esteemed by us of little importance; but this is an error to which we are eminently liable, from our ignorance of what characters are of real value to each living creature.

When man attempts to make a breed with some serious defect in structure, or in the mutual relation of the several parts, he will partly or completely fail, or encounter much difficulty; he is in fact resisted by a form of natural selection. We have seen that an attempt was once made in Yorkshire to breed cattle with enormous buttocks, but the cows perished so often in bringing forth their calves, that the attempt had to be given up. In rearing short-faced tumblers, Mr. Eaton says,⁵ "I am convinced that better head and beak birds have "perished in the shell than ever were hatched; the reason "being that the amazingly short-faced bird cannot reach and "break the shell with its beak, and so perishes." Here is a more curious case, in which natural selection comes into play only at long intervals of time: during ordinary seasons the Niata cattle can graze as well as others, but occasionally, as from 1827 to 1830, the plains of La Plata suffer from long-continued droughts and the pasture is burnt up; at such times common cattle and horses perish by the thousand, but many survive by browsing on twigs, reeds, &c.; this the

⁵ 'Treatise on the Almond Tumbler,' 1851, p. 33.

Niata cattle cannot so well effect from their upturned jaws and the shape of their lips; consequently, if not attended to, they perish before the other cattle. In Columbia, according to Roulin, there is a breed of nearly hairless cattle, called Pelones; these succeed in their native hot district, but are found too tender for the Cordillera; in this case, however, natural selection determines only the range of the variety. It is obvious that a host of artificial races could never survive in a state of nature;—such as Italian greyhounds,—hairless and almost toothless Turkish dogs,—fantail pigeons, which cannot fly well against a strong wind,—barbs and Polish fowls, with their vision impeded by their eye wattles and great topknots,—hornless bulls and rams, which consequently cannot cope with other males, and thus have a poor chance of leaving offspring,—seedless plants, and many other such cases.

Colour is generally esteemed by the systematic naturalist as unimportant: let us, therefore, see how far it indirectly affects our domestic productions, and how far it would affect them if they were left exposed to the full force of natural selection. In a future chapter I shall have to show that constitutional peculiarities of the strangest kind, entailing liability to the action of certain poisons, are correlated with the colour of the skin. I will here give a single case, on the high authority of Professor Wyman; he informs me that, being surprised at all the pigs in a part of Virginia being black, he made inquiries, and ascertained that these animals feed on the roots of the *Lachnanthes tinctoria*, which colours their bones pink, and, excepting in the case of the black varieties, causes the hoofs to drop off. Hence, as one of the squatters remarked, “we select the black members of the litter for raising, as they alone have a good chance of living.” So that here we have artificial and natural selection working hand in hand. I may add that in the Tarentino the inhabitants keep black sheep alone, because the *Hypericum crispum* abounds there; and this plant does not injure black sheep, but kills the white ones in about a fortnight’s time.⁶

Complexion, and liability to certain diseases, are believed

* Dr. Heusinger, ‘Wochenschrift für die Heilkunde,’ Berlin, 1846, s. 279.

to run together in man and the lower animals. Thus white terriers suffer more than those of any other colour from the fatal distemper.⁷ In North America plum-trees are liable to a disease which Downing⁸ believes is not caused by insects; the kinds bearing purple fruit are most affected, "and we have "never known the green or yellow fruited varieties infected "until the other sorts had first become filled with the knots." On the other hand, peaches in North America suffer much from a disease called the *yellow*s, which seems to be peculiar to that continent, and more than nine-tenths of the victims, "when the disease first appeared, were the yellow-fleshed "peaches. The white-fleshed kinds are much more rarely "attacked; in some parts of the country never." In Mauritius, the white sugar-canes have of late years been so severely attacked by a disease, that many planters have been compelled to give up growing this variety (although fresh plants were imported from China for trial), and cultivate only red canes.⁹ Now, if these plants had been forced to struggle with other competing plants and enemies, there cannot be a doubt that the colour of the flesh or skin of the fruit, unimportant as these characters are considered, would have rigorously determined their existence.

Liability to the attacks of parasites is also connected with colour. White chickens are certainly more subject than dark-coloured chickens to the *gapes*, which is caused by a parasitic worm in the trachea.¹⁰ On the other hand, experience has shown that in France the caterpillars which produce white cocoons resist the deadly fungus better than those producing yellow cocoons.¹¹ Analogous facts have been observed with plants: a new and beautiful white onion, imported from France, though planted close to other kinds, was alone attacked by a parasitic fungus.¹² White verbenas are especially liable to mildew.¹³ Near Malaga, during an early period of the vine-

⁷ Youatt on the Dog, p. 232.

⁸ 'The Fruit-trees of America,' 1845, p. 270: for peaches, p. 466.

⁹ 'Proc. Royal Soc. of Arts and Sciences of Mauritius,' 1852, p. cxxxv.

¹⁰ 'Gardener's Chronicle,' 1856, p.

379.

¹¹ Quatrefages, 'Maladies Actuelles du Ver à Soie,' 1859, pp. 12, 214.

¹² 'Gardener's Chronicle,' 1851, p. 595.

¹³ 'Journal of Horticulture,' 1862, p. 476.

disease, the green sorts suffered most; "and red and black grapes, even when interwoven with the sick plants, suffered not at all." In France whole groups of varieties were comparatively free, and others, such as the Chasselas, did not afford a single fortunate exception; but I do not know whether any correlation between colour and liability to disease was here observed.¹⁴ In a former chapter it was shown how curiously liable one variety of the strawberry is to mildew.

It is certain that insects regulate in many cases the range and even the existence of the higher animals, whilst living under their natural conditions. Under domestication light-coloured animals suffer most: in Thuringia¹⁵ the inhabitants do not like grey, white, or pale cattle, because they are much more troubled by various kinds of flies than the brown, red, or black cattle. An Albino negro, it has been remarked,¹⁶ was peculiarly sensitive to the bites of insects. In the West Indies¹⁷ it is said that "the only horned cattle fit for work " are those which have a good deal of black in them. The " white are terribly tormented by the insects; and they are " weak and sluggish in proportion to the white."

In Devonshire there is a prejudice against white pigs, because it is believed that the sun blisters them when turned out;¹⁸ and I knew a man who would not keep white pigs in Kent, for the same reason. The scorching of flowers by the sun seems likewise to depend much on colour; thus, dark pelargoniums suffer most; and from various accounts it is clear that the cloth-of-gold variety will not withstand a degree of exposure to sunshine which other varieties enjoy. Another amateur asserts that not only all dark-coloured verbenas, but likewise scarlets, suffer from the sun: "the paler kinds stand better, and pale blue is perhaps the best of all." So again with the heartsease (*Viola tricolor*); hot

¹⁴ 'Gardener's Chronicle,' 1852, pp. 435, 691.

¹⁵ Bechstein, 'Naturgesch. Deutschlands,' 1801, B. i. s. 310.

¹⁶ Prichard, 'Phys. Hist. of Mankind,' 1851, vol. i. p. 224.

¹⁷ G. Lewis's 'Journal of Residence

in West Indies,' 'Home and Col. Library,' p. 100.

¹⁸ Sidney's edit. of Youatt on the Pig, p. 24. I have given analogous facts in the case of mankind in my 'Descent of Man,' 2nd edit. p. 195.

weather suits the blotched sorts, whilst it destroys the beautiful markings of some other kinds.¹⁹ During one extremely cold season in Holland all red-flowered hyacinths were observed to be very inferior in quality. It is believed by many agriculturists that red wheat is hardier in northern climates than white wheat.²⁰

With animals, white varieties from being conspicuous are the most liable to be attacked by beasts and birds of prey. In parts of France and Germany where hawks abound, persons are advised not to keep white pigeons; for, as Parmentier says, "it is certain that in a flock the white always first fall victims to the kite." In Belgium, where so many societies have been established for the flight of carrier-pigeons, white is the one colour which for the same reason is disliked.²¹ Prof. G. Jaeger²² whilst fishing found four pigeons which had been killed by hawks, and all were white; on another occasion he examined the eyrie of a hawk, and the feathers of the pigeons which had been caught were all of a white or yellow colour. On the other hand, it is said that the sea-eagle (*Falco ossifragus*, Linn.) on the west coast of Ireland picks out the black fowls, so that "the villagers avoid as much as possible rearing birds of that colour." M. Daudin,²³ speaking of white rabbits kept in warrens in Russia, remarks that their colour is a great disadvantage, as they are thus more exposed to attack, and can be seen during bright nights from a distance. A gentleman in Kent, who failed to stock his woods with a nearly white and hardy kind of rabbit, accounted in the same manner for their early disappearance. Any one who will watch a white cat prowling after her prey will soon perceive under what a disadvantage she lies.

The white Tartarian cherry, "owing either to its colour

¹⁹ 'Journal of Horticulture,' 1862, pp. 476, 498; 1865, p. 460. With respect to the heartsease, 'Gardener's Chronicle,' 1863, p. 628.

²⁰ 'Des Jacinthes, de leur Culture,' 1768, p. 53: on wheat, 'Gardener's Chronicle,' 1846, p. 653.

²¹ W. B. Tegetmeier, 'The Field,'

Feb. 25, 1865. With respect to black fowls, see a quotation in Thompson's 'Nat. Hist. of Ireland,' 1849, vol. i. p. 22.

²² 'In Sachen Darwin's contra Wigand,' 1874, p. 70.

²³ 'Bull. de la Soc. d'Acclimat., tom. vii., 1860, p. 359.

being so much like that of the leaves, or to the fruit always appearing from a distance unripe," is not so readily attacked by birds as other sorts. The yellow-fruited raspberry, which generally comes nearly true by seed, "is very little molested by birds, who evidently are not fond of it; so that nets may be dispensed with in places where nothing else will protect the red fruit."²⁴ This immunity, though a benefit to the gardener, would be a disadvantage in a state of nature both to the cherry and raspberry, as dissemination depends on birds. I noticed during several winters that some trees of the yellow-berried holly, which were raised from seed from a tree found wild by my father remained covered with fruit, whilst not a scarlet berry could be seen on the adjoining trees of the common kind. A friend informs me that a mountain-ash (*Pyrus aucuparia*) growing in his garden bears berries which, though not differently coloured, are always devoured by birds before those on the other trees. This variety of the mountain-ash would thus be more freely disseminated, and the yellow-berried variety of the holly less freely, than the common varieties of these two trees.

Independently of colour, trifling differences are sometimes found to be of importance to plants under cultivation, and would be of paramount importance if they had to fight their own battle and to struggle with many competitors. The thin-shelled peas, called *pois sans parchemin*, are attacked by birds²⁵ much more commonly than ordinary peas. On the other hand, the purple-podded pea, which has a hard shell, escaped the attacks of tomtits (*Parus major*) in my garden far better than any other kind. The thin-shelled walnut likewise suffers greatly from the tomtit.²⁶ These same birds have been observed to pass over and thus favour the filbert, destroying only the other kinds of nuts which grew in the same orchard.²⁷

Certain varieties of the pear have soft bark, and these suffer severely from wood-boring beetles; whilst other

²⁴ 'Transact. Hort. Soc,' vol. 1. 2nd series, 1835, p. 275. For raspberries, see 'Gard. Chronicle,' 1855, p. 154, and 1863, p. 245.

²⁵ 'Gardener's Chronicle,' 1843, p. 806.

²⁶ *Ibid.*, 1850, p. 732.

²⁷ *Ibid.*, 1860, p. 956.

varieties are known to resist their attacks much better.²⁸ In North America the smoothness, or absence of down on the fruit, makes a great difference in the attacks of the weevil, "which is the uncompromising foe of all smooth stone-fruits;" and the cultivator "has the frequent mortification of seeing nearly all, or indeed often the whole crop, fall from the trees when half or two-thirds grown." Hence the nectarine suffers more than the peach. A particular variety of the Morello cherry, raised in North America, is, without any assignable cause, more liable to be injured by this same insect than other cherry-trees.²⁹ From some unknown cause, certain varieties of the apple enjoy, as we have seen, the great advantage in various parts of the world of not being infested by the coccus. On the other hand, a particular case has been recorded in which aphides confined themselves to the Winter Nelis pear and touched no other kind in an extensive orchard.³⁰ The existence of minute glands on the leaves of peaches, nectarines, and apricots, would not be esteemed by botanists as a character of the least importance for they are present or absent in closely-related sub-varieties, descended from the same parent-tree; yet there is good evidence³¹ that the absence of glands leads to mildew, which is highly injurious to these trees.

A difference either in flavour or in the amount of nutriment in certain varieties causes them to be more eagerly attacked by various enemies than other varieties of the same species. Bullfinches (*Pyrrhula vulgaris*) injure our fruit-trees by devouring the flower-buds, and a pair of these birds have been seen "to denude a large plum-tree in a couple of days of almost every bud;" but certain varieties³² of the apple and thorn (*Crataegus oxyacantha*) are more especially liable to be attacked. A striking instance of this was observed in Mr. Rivers's garden, in which two rows of a particular

²⁸ J. De Jonghe, in 'Gardener's Chronicle,' 1860, p. 120.

²⁹ Downing, 'Fruit-trees of North America,' pp. 266, 501: in regard to the cherry, p. 198.

³⁰ 'Gardener's Chronicle,' 1849, p. 755.

³¹ 'Journal of Horticulture,' Sept. 26th, 1865, p. 254; see other references given in chap. x.

³² Mr. Selby, in 'Mag. of Zoology and Botany,' Edinburgh, vol. ii., 1838, p. 393.

variety of plum³³ had to be carefully protected, as they were usually stripped of all their buds during the winter, whilst other sorts growing near them escaped. The root (or enlarged stem) of Laing's Swedish turnip is preferred by hares, and therefore suffers more than other varieties. Hares and rabbits eat down common rye before St. John's-day-rye, when both grow together.³⁴ In the south of France, when an orchard of almond-trees is formed, the nuts of the bitter variety are sown, "in order that they may not be devoured by field-mice;"³⁵ so we see the use of the bitter principle in almonds.

Other slight differences, which would be thought quite unimportant, are no doubt sometimes of great service both to plants and animals. The Whitesmith's gooseberry, as formerly stated, produces its leaves later than other varieties, and, as the flowers are thus left unprotected, the fruit often fails. In one variety of the cherry, according to Mr. Rivers,³⁶ the petals are much curled backwards, and in consequence of this the stigmas were observed to be killed by a severe frost; whilst at the same time, in another variety with incurved petals, the stigmas were not in the least injured. The straw of the Fenton wheat is remarkably unequal in height; and a competent observer believes that this variety is highly productive, partly because the ears from being distributed at various heights above the ground are less crowded together. The same observer maintains that in the upright varieties the divergent awns are serviceable by breaking the shocks when the ears are dashed together by the wind.³⁷ If several varieties of a plant are grown together, and the seed is indiscriminately harvested, it is clear that the hardier and more productive kinds will, by a sort of natural selection, gradually prevail over the others; this takes place, as Colonel Le Couteur believes,³⁸ in our wheat-fields, for, as

³³ The Reine Claude de Bavay, 'Journal of Horticulture,' Dec. 27, 1864, p. 511.

³⁴ Mr. Pusey, in 'Journal of R. Agricult. Soc.,' vol. vi. p. 179. For Swedish turnips, see 'Gard. Chron.,' 1847, p. 91.

³⁵ Godron, 'De l'Espèce,' tom. ii. p. 98.

³⁶ 'Gardener's Chron.,' 1866, p. 732.

³⁷ 'Gardener's Chronicle,' 1862, pp. 820, 821.

³⁸ 'On the Varieties of Wheat,' p. 59.

formerly shown, no variety is quite uniform in character. The same thing, as I am assured by nurserymen, would take place in our flower-gardens, if the seed of the different varieties were not separately saved. When the eggs of the wild and tame duck are hatched together, the young wild ducks almost invariably perish, from being of smaller size and not getting their fair share of food.³⁹

Facts in sufficient number have now been given showing that natural selection often checks, but occasionally favours, man's power of selection. These facts teach us, in addition, a valuable lesson, namely, that we ought to be extremely cautious in judging what characters are of importance in a state of nature to animals and plants, which have to struggle for existence from the hour of their birth to that of their death,—their existence depending on conditions, about which we are profoundly ignorant.

Circumstances favourable to Selection by Man.

The possibility of selection rests on variability, and this, as we shall see in the following chapters, mainly depends on changed conditions of life, but is governed by infinitely complex and unknown laws. Domestication, even when long continued, occasionally causes but a small amount of variability, as in the case of the goose and turkey. The slight differences, however, which characterise each individual animal and plant would in most, probably in all, cases suffice for the production of distinct races through careful and prolonged selection. We see what selection, though acting on mere individual differences, can effect when families of cattle, sheep, pigeons, &c., of the same race, have been separately bred during a number of years by different men without any wish on their part to modify the breed. We see the same fact in the difference between hounds bred for hunting in different districts,⁴⁰ and in many other such cases.

In order that selection should produce any result, it is manifest that the crossing of distinct races must be prevented; hence facility in pairing, as with the pigeon, is highly

³⁹ Mr. Hewitt and others, in 'Journal of Hort.,' 1862, p. 773.

⁴⁰ 'Encyclop. of Rural Sports,' p. 405.

favourable for the work; and difficulty in pairing, as with cats, prevents the formation of distinct breeds. On nearly the same principle the cattle of the small island of Jersey have been improved in their milking qualities "with a rapidity that could not have been obtained in a widely extended country like France."⁴¹ Although free crossing is a danger on the one side which every one can see, too close interbreeding is a hidden danger on the other side. Unfavourable conditions of life overrule the power of selection. Our improved heavy breeds of cattle and sheep could not have been formed on mountainous pastures; nor could dray-horses have been raised on a barren and inhospitable land, such as the Falkland Islands, where even the light horses of La Plata rapidly decrease in size. It seems impossible to preserve several English breeds of sheep in France; for as soon as the lambs are weaned their vigour decays as the heat of the summer increases:⁴² it would be impossible to give great length of wool to sheep within the tropics; yet selection has kept the Merino breed nearly true under diversified and unfavourable conditions. The power of selection is so great, that breeds of the dog, sheep, and poultry, of the largest and smallest size, long and short beaked pigeons, and other breeds with opposite characters, have had their characteristic qualities augmented, though treated in every way alike, being exposed to the same climate and fed on the same food. Selection, however, is either checked or favoured by the effects of use or habit. Our wonderfully-improved pigs could never have been formed if they had been forced to search for their own food; the English race-horse and greyhound could not have been improved up to their present high standard of excellence without constant training.

As conspicuous deviations of structure occur rarely, the improvement of each breed is generally the result of the selection of slight individual differences. Hence the closest attention, the sharpest powers of observation, and indomitable perseverance, are indispensable. It is, also, highly important

⁴¹ Col. Le Couteur, 'Journal Roy. Agricult. Soc.,' vol. iv. p. 43.

Agricult. Soc.,' vol. xiv., 1853, pp. 215, 217.

⁴² Malingié - Nouel, Journal R

that many individuals of the breed which is to be improved should be raised ; for thus there will be a better chance of the appearance of variations in the right direction, and individuals varying in an unfavourable manner may be freely rejected or destroyed. But that a large number of individuals should be raised, it is necessary that the conditions of life should favour the propagation of the species. Had the peacock been reared as easily as the fowl, we should probably ere this have had many distinct races. We see the importance of a large number of plants, from the fact of nursery gardeners almost always beating amateurs in the exhibition of new varieties. In 1845 it was estimated ⁴³ that between 4000 and 5000 pelargoniums were annually raised from seed in England, yet a decidedly improved variety is rarely obtained. At Messrs. Carter's grounds, in Essex, where such flowers as the Lobelia, Nemophila, Mignonette, &c., are grown by the acre for seed, "scarcely a season passes without some new kinds being raised, or some improvement effected on old kinds."⁴⁴ At Kew, as Mr. Beaton remarks, where many seedlings of common plants are raised, "you see new forms of Laburnums, Spiræas, and other shrubs."⁴⁵ So with animals: Marshall,⁴⁶ in speaking of the sheep in one part of Yorkshire, remarks, "as they belong to poor people, and are mostly in small lots, they never can be improved." Lord Rivers, when asked how he succeeded in always having first-rate greyhounds, answered, "I breed many, and hang many." This, as another man remarks, "was the secret of his success ; and the same will be found in exhibiting fowls,—successful competitors breed largely, and keep the best."⁴⁷

It follows from this that the capacity of breeding at an early age and at short intervals, as with pigeons, rabbits, &c., facilitates selection ; for the result is thus soon made visible, and perseverance in the work encouraged. It can hardly be an accident that the great majority of the culinary and agricultural plants which have yielded numerous races are annuals

⁴³ 'Gardener's Chronicle,' 1845, p. 368.
273.

⁴⁴ 'Journal of Horticulture,' 1862, 406.

p. 157.

⁴⁵ 'Cottage Gardener,' 1860, p. 45.

⁴⁶ 'A Review of Reports,' 1808, p.

⁴⁷ 'Gardener's Chronicle,' 1853, p.

or biennials, which therefore are capable of rapid propagation, and thus of improvement. Sea-kale, asparagus, common and Jerusalem artichokes, potatoes, and onions, must be excepted, as they are perennials: but onions are propagated like annuals, and of the other plants just specified, none, with the exception of the potato, have yielded in this country more than one or two varieties. In the Mediterranean region, where artichokes are often raised from seed, there are several kinds, as I hear from Mr. Bentham. No doubt fruit-trees, which cannot be propagated quickly by seed, have yielded a host of varieties, though not permanent races; but these, judging from pre-historic remains, have been produced at a comparatively late period.

A species may be highly variable, but distinct races will not be formed, if from any cause selection be not applied. It would be difficult to select slight variations in fishes from their place of habitation; and though the carp is extremely variable and is much attended to in Germany, only one well-marked race has been formed, as I hear from Lord A. Russell, namely the *spiegel-carpe*; and this is carefully secluded from the common scaly kind. On the other hand, a closely allied species, the gold-fish, from being reared in small vessels, and from having been carefully attended to by the Chinese, has yielded many races. Neither the bee, which has been semi-domesticated from an extremely remote period, nor the cochineal insect, which was cultivated by the aboriginal Mexicans,⁴⁸ has yielded races; and it would be impossible to match the queen-bee with any particular drone, and most difficult to match cochineal insects. Silk-moths, on the other hand, have been subjected to rigorous selection, and have produced a host of races. Cats, which from their nocturnal habits cannot be selected for breeding, do not, as formerly remarked, yield distinct races within the same country. Dogs are held in abomination in the East, and their breeding is neglected; consequently, as Prof. Moritz Wagner⁴⁹ remarks, one kind alone exists there. The ass in England varies much in

⁴⁸ Isidore Geoffroy Saint-Hilaire, 'Hist. Nat. Gen.,' tom. iii. p. 49. 'On the Cochineal Insect,' p. 46.

⁴⁹ 'Die Darwin'sche Theorie und das Migrationsgesetz der Organismen,' 1868, p. 19.

colour and size; but as it is an animal of little value and bred by poor people, there has been no selection, and distinct races have not been formed. We must not attribute the inferiority of our asses to climate, for in India they are of even smaller size than in Europe. But when selection is brought to bear on the ass, all is changed. Near Cordova, as I am informed (Feb. 1860) by Mr. W. E. Webb, C.E., they are carefully bred, as much as 200*l.* having been paid for a stallion ass, and they have been immensely improved. In Kentucky, asses have been imported (for breeding mules) from Spain, Malta, and France; these "seldom averaged more than fourteen hands high: but the Kentuckians, by great care, have raised them up to fifteen hands, and some times even to sixteen. The prices paid for these splendid animals, for such they really are, will prove how much they are in request. One male, of great celebrity, was sold for upwards of one thousand pounds sterling." These choice asses are sent to cattle-shows, a day being given for their exhibition.⁵⁰

Analogous facts have been observed with plants: the nutmeg-tree in the Malay archipelago is highly variable, but there has been no selection, and there are no distinct races.⁵¹ The common mignonette (*Reseda odorata*), from bearing inconspicuous flowers, valued solely for their fragrance, "remains in the same unimproved condition as when first introduced."⁵² Our common forest-trees are very variable, as may be seen in every extensive nursery-ground; but as they are not valued like fruit-trees, and as they seed late in life, no selection has been applied to them; consequently, as Mr. Patrick Matthews remarks,⁵³ they have not yielded distinct races, leafing at different periods, growing to different sizes, and producing timber fit for different purposes. We have gained only some fanciful and semi-monstrous varieties, which no doubt appeared suddenly as we now see them.

Some botanists have argued that plants cannot have sc

⁵⁰ Capt. Marryat, quoted by Blyth in 'Journ. Asiatic Soc. of Bengal,' vol. xxviii. p. 229.

⁵¹ Mr. Oxley, 'Journal of the Indian Archipelago,' vol. ii., 1848, p.

645.

⁵² Mr. Abbey, in 'Journal of Horticulture,' Dec. 1, 1863, p. 430.

⁵³ 'On Naval Timber,' 1831, p. 107.

strong a tendency to vary as is generally supposed, because many species long grown in botanic gardens, or unintentionally cultivated year after year mingled with our corn crops, have not produced distinct races; but this is accounted for by slight variations not having been selected and propagated. Let a plant which is now grown in a botanic garden, or any common weed, be cultivated on a large scale, and let a sharp-sighted gardener look out for each slight variety and sow the seed, and then, if distinct races are not produced, the argument will be valid.

The importance of selection is likewise shown by considering special characters. For instance, with most breeds of fowls the form of the comb and the colour of the plumage have been attended to, and are eminently characteristic of each race; but in Dorkings, fashion has never demanded uniformity of comb or colour; and the utmost diversity in these respects prevails. Rose-combs, double-combs, cup-combs, &c., and colours of all kinds, may be seen in purely bred and closely related Dorking fowls, whilst other points, such as the general form of body, and the presence of an additional toe, have been attended to, and are invariably present. It has also been ascertained that colour can be fixed in this breed, as well as in any other.⁵⁴

During the formation or improvement of a breed, its members will always be found to vary much in those characters to which especial attention is directed, and of which each slight improvement is eagerly sought and selected. Thus, with short-faced tumbler-pigeons, the shortness of the beak, shape of head and plumage,—with carriers, the length of the beak and wattle,—with fantails, the tail and carriage,—with Spanish fowls, the white face and comb,—with long-eared rabbits, the length of ear, are all points which are eminently variable. So it is in every case; and the large price paid for first-rate animals proves the difficulty of breeding them up to the highest standard of excellence. This subject has been discussed by fanciers,⁵⁵ and the greater

⁵⁴ Mr. Baily, in 'The Poultry Chronicle,' vol. ii., 1854, p. 150. Also vol. i. p. 342; vol. iii. p. 245.

⁵⁵ 'Cottage Gardener,' 1855, December, p. 171; 1856, January, pp. 248, 323.

prizes given for highly improved breeds, in comparison with those given for old breeds which are not now undergoing rapid improvement, have been fully justified. Nathusius makes⁵⁶ a similar remark when discussing the less uniform character of improved Shorthorn cattle and of the English horse, in comparison, for example, with the unennobled cattle of Hungary, or with the horses of the Asiatic steppes. This want of uniformity in the parts which at the time are undergoing selection chiefly depends on the strength of the principle of reversion; but it likewise depends to a certain extent on the continued variability of the parts which have recently varied. That the same parts do continue varying in the same manner we must admit, for if it were not so, there could be no improvement beyond an early standard of excellence, and we know that such improvement is not only possible, but is of general occurrence.

As a consequence of continued variability, and more especially of reversion, all highly improved races, if neglected or not subjected to incessant selection, soon degenerate. Youatt gives a curious instance of this in some cattle formerly kept in Glamorganshire; but in this case the cattle were not fed with sufficient care. Mr. Baker, in his memoir on the Horse, sums up: "It must have been observed in the preceding pages that, whenever there has been neglect, the breed has "proportionally deteriorated."⁵⁷ If a considerable number of improved cattle, sheep, or other animals of the same race, were allowed to breed freely together, with no selection, but with no change in their condition of life, there can be no doubt that after a score or hundred generations they would be very far from excellent of their kind; but, from what we see of the many common races of dogs, cattle, fowls, pigeons, &c., which without any particular care have long retained nearly the same character, we have no grounds for believing that they would altogether depart from their type.

It is a general belief amongst breeders that characters of all kinds become fixed by long-continued inheritance. But I

⁵⁶ 'Ueber Shorthorn Rindvieh,' 1857, s. 51.

720. For the Glamorganshire cattle, see Youatt on Cattle, p. 51

⁵⁷ 'The Veterinary,' vol. xiii. p.

have attempted to show in the fourteenth chapter that this belief apparently resolves itself into the following proposition, namely, that all characters whatever, whether recently acquired or ancient, tend to be transmitted, but that those which have already long withstood all counteracting influences, will, as a general rule, continue to withstand them, and consequently be faithfully transmitted.

Tendency in Man to carry the practice of Selection to an extreme point.

It is an important principle that in the process of selection man almost invariably wishes to go to an extreme point. Thus, there is no limit to his desire to breed certain kinds of horses and dogs as fleet as possible, and others as strong as possible; certain kinds of sheep for extreme fineness, and others for extreme length of wool; and he wishes to produce fruit, grain, tubers, and other useful parts of plants, as large and excellent as possible. With animals bred for amusement, the same principle is even more powerful; for fashion, as we see in our dress, always runs to extremes. This view has been expressly admitted by fanciers. Instances were given in the chapters on the pigeon, but here is another: Mr. Eaton, after describing a comparatively new variety, namely, the Archangel, remarks, "What fanciers intend doing with this bird I am at a loss to know, whether they intend to breed it down to the tumbler's head and beak, or carry it out to the carrier's head and beak; leaving it as they found it, is not progressing." Ferguson, speaking of fowls, says, "their peculiarities, whatever they may be, must necessarily be fully developed: a little peculiarity forms nought but ugliness, seeing it violates the existing laws of symmetry." So Mr. Brent, in discussing the merits of the sub-varieties of the Belgian canary-bird, remarks, "Fanciers always go to extremes; they do not admire indefinite properties."⁵⁸

This principle, which necessarily leads to divergence of character, explains the present state of various domestic

⁵⁸ J. M. Eaton, 'A Treatise on Fancy Pigeons,' p. 82; Ferguson, on Rare and Prize Poultry,' p. 162;

Mr. Brent, in 'Cottage Gardener,' Oct. 1860, p. 13.

racés. We can thus see how it is that race-horses and dray-horses, greyhounds and mastiffs, which are opposed to each other in every character,—how varieties so distinct as Cochinchina fowls and bantams, or carrier-pigeons with very long beaks, and tumblers with excessively short beaks, have been derived from the same stock. As each breed is slowly improved, the inferior varieties are first neglected and finally lost. In a few cases, by the aid of old records, or from intermediate varieties still existing in countries where other fashions have prevailed, we are enabled partially to trace the graduated changes through which certain breeds have passed. Selection, whether methodical or unconscious, always tending towards an extreme point, together with the neglect and slow extinction of the intermediate and less-valued forms, is the key which unlocks the mystery of how man has produced such wonderful results.

In a few instances selection, guided by utility for a single purpose, has led to convergence of character. All the improved and different races of the pig, as Nathusius has well shown,⁵⁹ closely approach each other in character, in their shortened legs and muzzles, their almost hairless, large, rounded bodies, and small tusks. We see some degree of convergence in the similar outline of the body in well-bred cattle belonging to distinct races.⁶⁰ I know of no other such cases.

Continued divergence of character depends on, and is indeed a clear proof, as previously remarked, of the same parts continuing to vary in the same direction. The tendency to mere general variability or plasticity of organisation can certainly be inherited, even from one parent, as has been shown by Gärtner and Kölreuter, in the production of varying hybrids from two species, of which one alone was variable. It is in itself probable that, when an organ has varied in any manner, it will again vary in the same manner, if the conditions which first caused the being to vary remain, as far as can be judged, the same. This is either tacitly or expressly admitted by all

⁵⁹ 'Die Racen des Schweines,' 1860, s. 48.

head by M. de Quatrefages, 'Unité de l'Espèce Humaine,' 1861, p. 119.

⁶⁰ See some good remarks on this

horticulturists: if a gardener observes one or two additional petals in a flower, he feels confident that in a few generations he will be able to raise a double flower, crowded with petals. Some of the seedlings from the weeping Moccas oak were so prostrate that they only crawled along the ground. A seedling from the fastigate or upright Irish yew is described as differing greatly from the parent-form "by the exaggeration of the fastigate habit of its branches."⁶¹ Mr. Shirreff, who has been highly successful in raising new kinds of wheat, remarks, "A good variety may safely be regarded as the forerunner of a better one."⁶² A great rose-grower, Mr. Rivers, has made the same remark with respect to roses. Sageret,⁶³ who had large experience, in speaking of the future progress of fruit-trees, observes that the most important principle is "that the more plants have departed from their original type, the more they tend to depart from it." There is apparently much truth in this remark; for we can in no other way understand the surprising amount of difference between varieties in the parts or qualities which are valued, whilst other parts retain nearly their original character.

The foregoing discussion naturally leads to the question, what is the limit to the possible amount of variation in any part or quality, and, consequently, is there any limit to what selection can effect? Will a race-horse ever be reared fleetier than Eclipse? Can our prize-cattle and sheep be still further improved? Will a gooseberry ever weigh more than that produced by "London" in 1852? Will the beet-root in France yield a greater percentage of sugar? Will future varieties of wheat and other grain produce heavier crops than our present varieties? These questions cannot be positively answered; but it is certain that we ought to be cautious in answering them by a negative. In some lines of variation the limit has probably been reached. Youatt believes that the reduction of bone in some of our sheep has already been carried so far that it entails great delicacy of constitution.⁶⁴

⁶¹ Verlot, 'Des Variétés,' 1865, p. 94.

⁶² Mr. Patrick Shirreff, in 'Gard. Chronicle,' 1858, p. 771.

⁶³ 'Pomologie Physiolog.,' 1830, p. 106.

⁶⁴ Youatt on Sheep, p. 521.

But seeing the great improvement within recent times in our cattle and sheep, and especially in our pigs; seeing the wonderful increase in weight in our poultry of all kinds during the last few years; he would be a bold man who would assert that perfection has been reached. It has often been said that Eclipse never was, and never will be, beaten in speed by any other horse; but on making inquiries I find that the best judges believe that our present race-horses are fleetier.⁶⁵ The attempt to raise a new variety of wheat more productive than the many old kinds, might have been thought until lately quite hopeless; but this has been effected by Major Hallett, by careful selection. With respect to almost all our animals and plants, those who are best qualified to judge do not believe that the extreme point of perfection has yet been reached even in the characters which have already been carried to a high standard. For instance, the short-faced tumbler-pigeon has been greatly modified; nevertheless, according to Mr. Eaton,⁶⁶ "the field is still as open for fresh competitors as it was one hundred years ago." Over and over again it has been said that perfection had been attained with our flowers, but a higher standard has soon been reached. Hardly any fruit has been more improved than the strawberry, yet a great authority remarks,⁶⁷ "it must not be concealed that we are far from the extreme limits at which we may arrive."

No doubt there is a limit beyond which the organisation cannot be modified compatibly with health or life. The extreme degree of fleetness, for instance, of which a terrestrial animal is capable, may have been acquired by our present race-horses; but as Mr. Wallace has well remarked,⁶⁸ the question that interests us, "is not whether indefinite and unlimited change in any or all directions is possible, but whether such differences as do occur in nature could have been produced by the accumulation of varieties by selection." And in the case of our domestic productions, there can be no

⁶⁵ See also Stonehenge, 'British Rural Sports,' edition of 1871, p. 384.

⁶⁶ 'A Treatise on the Almond Tumbler,' p. i.

⁶⁷ M. J. de Jonghe, in 'Gard.

Chron.,' 1858, p. 173.

⁶⁸ 'Contributions to the Theory of Natural Selection,' 2nd edit., 1871, p. 292.

doubt that many parts of the organisation, to which man has attended, have been thus modified to a greater degree than the corresponding parts in the natural species of the same genera or even families. We see this in the form and size of our light and heavy dogs or horses,—in the beak and many other characters of our pigeons,—in the size and quality of many fruits,—in comparison with the species belonging to the same natural groups.

Time is an important element in the formation of our domestic races, as it permits innumerable individuals to be born, and these when exposed to diversified conditions are rendered variable. Methodical selection has been occasionally practised from an ancient period to the present day, even by semi-civilised people, and during former times will have produced some effect. Unconscious selection will have been still more effective; for during a lengthened period the more valuable individual animals will occasionally have been saved, and the less valuable neglected. In the course of time, different varieties, especially in the less civilised countries, will also have been more or less modified through natural selection. It is generally believed, though on this head we have little or no evidence, that new characters in time become fixed; and after having long remained fixed it seems possible that under new conditions they might again be rendered variable.

How great the lapse of time has been since man first domesticated animals and cultivated plants, we begin dimly to see. When the lake-dwellings of Switzerland were inhabited during the Neolithic period, several animals were already domesticated and various plants cultivated. The science of language tells us that the art of ploughing and sowing the land was followed, and the chief animals had been already domesticated, at an epoch so immensely remote, that the Sanskrit, Greek, Latin, Gothic, Celtic, and Slavonic languages had not as yet diverged from their common parent-tongue.⁶⁹

It is scarcely possible to overrate the effects of selection occasionally carried on in various ways and places during thousands of generations. All that we know, and, in a still

⁶⁹ Max Müller, 'Science of Language,' 1861, p. 223.

stronger degree, all that we do not know,⁷⁰ of the history of the great majority of our breeds, even of our more modern breeds, agrees with the view that their production, through the action of unconscious and methodical selection, has been almost insensibly slow. When a man attends rather more closely than is usual to the breeding of his animals, he is almost sure to improve them to a slight extent. They are in consequence valued in his immediate neighbourhood, and are bred by others; and their characteristic features, whatever these may be, will then slowly but steadily be increased, sometimes by methodical and almost always by unconscious selection. At last a strain, deserving to be called a sub-variety, becomes a little more widely known, receives a local name, and spreads. The spreading will have been extremely slow during ancient and less civilised times, but now is rapid. By the time that the new breed had assumed a somewhat distinct character, its history, hardly noticed at the time, will have been completely forgotten; for, as Low remarks,⁷¹ "we know how quickly the memory of such events is effaced."

As soon as a new breed is thus formed, it is liable through the same process to break up into new strains and sub-varieties. For different varieties are suited for, and are valued under, different circumstances. Fashion changes, but, should a fashion last for even a moderate length of time, so strong is the principle of inheritance, that some effect will probably be impressed on the breed. Thus varieties go on increasing in number, and history shows us how wonderfully they have increased since the earliest records.⁷² As each new variety is produced, the earlier, intermediate, and less valuable forms will be neglected, and perish. When a breed, from not being valued, is kept in small numbers, its extinction almost inevitably follows sooner or later, either from accidental causes of destruction or from close interbreeding; and this is an event which, in the case of well-marked breeds, excites attention. The birth or production of a new domestic race is so slow a process that it escapes notice; its death or

⁷⁰ Youatt on Cattle, pp. 116, 128.

⁷¹ 'Domesticated Animals,' p. 188.

⁷² Volz, 'Beiträge zur Kulturgeschichte,' 1852, s. 99 *et passim*.

destruction is comparatively sudden, is often recorded, and when too late sometimes regretted.

Several authors have drawn a wide distinction between artificial and natural races. The latter are more uniform in character, possessing in a high degree the appearance of natural species, and are of ancient origin. They are generally found in less civilised countries, and have probably been largely modified by natural selection, and only to a small extent by man's unconscious and methodical selection. They have, also, during a long period, been directly acted on by the physical conditions of the countries which they inhabit. The so-called artificial races, on the other hand, are not so uniform in character; some have a semi-monstrous character, such as "the wry-legged terriers so useful in rabbit-shooting,"⁷³ turnspit dogs, ancon sheep, niata oxen, Polish fowls, fantail-pigeons, &c.; their characteristic features have generally been acquired suddenly, though subsequently increased by careful selections in many cases. Other races, which certainly must be called artificial, for they have been largely modified by methodical selection and by crossing, as the English race-horse, terrier-dogs, the English game-cock, Antwerp carrier-pigeons, &c., nevertheless cannot be said to have an unnatural appearance; and no distinct line, as it seems to me, can be drawn between natural and artificial races.

It is not surprising that domestic races should generally present a different aspect from natural species. Man selects and propagates modifications solely for his own use or fancy, and not for the creature's own good. *His attention is struck* by strongly marked modifications, which have appeared suddenly, due to some great disturbing cause in the organisation. He attends almost exclusively to external characters; and when he succeeds in modifying internal organs,—when for instance he reduces the bones and offal, or loads the viscera with fat, or gives early maturity, &c.,—the chances are strong that he will at the same time weaken the constitution. On the other hand, when an animal has to struggle throughout its life with many competitors and enemies, under

⁷³ Blaine, 'Encyclop. of Rural Sports,' p. 213.

circumstances inconceivably complex and liable to change, modifications of the most varied nature in the internal organs as well as in external characters, in the functions and mutual relations of parts, will be rigorously tested, preserved, or rejected. Natural selection often checks man's comparatively feeble and capricious attempts at improvement; and if it were not so, the result of his work, and of nature's work, would be even still more different. Nevertheless, we must not overrate the amount of difference between natural species and domestic races; the most experienced naturalists have often disputed whether the latter are descended from one or from several aboriginal stocks, and this clearly shows that there is no palpable difference between species and races.

Domestic races propagate their kind far more truly, and endure for much longer periods, than most naturalists are willing to admit. Breeders feel no doubt on this head: ask a man who has long reared Shorthorn or Hereford cattle, Leicester or Southdown sheep, Spanish or Game poultry, tumbler or carrier-pigeons, whether these races may not have been derived from common progenitors, and he will probably laugh you to scorn. The breeder admits that he may hope to produce sheep with finer or longer wool and with better carcasses, or handsomer fowls, or carrier-pigeons with beaks just perceptibly longer to the practised eye, and thus be successful at an exhibition. Thus far he will go, but no farther. He does not reflect on what follows from adding up during a long course of time many slight, successive modifications; nor does he reflect on the former existence of numerous varieties, connecting the links in each divergent line of descent. He concludes, as was shown in the earlier chapters, that all the chief breeds to which he has long attended are aboriginal productions. The systematic naturalist, on the other hand, who generally knows nothing of the art of breeding, who does not pretend to know how and when the several domestic races were formed, who cannot have seen the intermediate gradations, for they do not now exist, nevertheless feels no doubt that these races are sprung from a single source. But ask him whether the closely allied natural species which he has studied may not have

descended from a common progenitor, and he in his turn will perhaps reject the notion with scorn. Thus the naturalist and breeder may mutually learn a useful lesson from each other.

Summary on Selection by Man.—There can be no doubt that methodical selection has effected and will effect wonderful results. It was occasionally practised in ancient times, and is still practised by semi-civilised people. Characters of the highest importance, and others of trifling value, have been attended to, and modified. I need not here repeat what has been so often said on the part which unconscious selection has played: we see its power in the difference between flocks which have been separately bred, and in the slow changes, as circumstances have slowly changed, which many animals have undergone in the same country, or when transported into a foreign land. We see the combined effects of methodical and unconscious selection, in the great amount of difference in those parts or qualities which are valued by man in comparison with the parts which are not valued, and consequently have not been attended to. Natural selection often determines man's power of selection. We sometimes err in imagining that characters, which are considered as unimportant by the systematic naturalist, could not be affected by the struggle for existence, and could not be acted on by natural selection; but striking cases have been given, showing how great an error this is.

The possibility of selection coming into action rests on variability; and this is mainly caused, as we shall hereafter see, by changes in the conditions of life. Selection is sometimes rendered difficult, or even impossible, by the conditions being opposed to the desired character or quality. It is sometimes checked by the lessened fertility and weakened constitution which follow from long-continued close interbreeding. That methodical selection may be successful, the closest attention and discernment, combined with unwearied patience, are absolutely necessary; and these same qualities, though not indispensable, are highly serviceable in the case of unconscious selection. It is almost necessary that a large number of individuals should be reared; for thus there will

be a fair chance of variations of the desired nature arising, and of every individual with the slightest blemish or in any degree inferior being freely rejected. Hence length of time is an important element of success. Thus, also, reproduction at an early age and at short intervals favours the work. Facility in pairing animals, or their inhabiting a confined area, is advantageous as a check to free crossing. Whenever and wherever selection is not practised, distinct races are not formed within the same country. When any one part of the body or one quality is not attended to, it remains either unchanged or varies in a fluctuating manner, whilst at the same time other parts and other qualities may become permanently and greatly modified. But from the tendency to reversion and to continued variability, those parts or organs which are now undergoing rapid improvement through selection, are likewise found to vary much. Consequently highly-bred animals when neglected soon degenerate; but we have no reason to believe that the effects of long-continued selection would, if the conditions of life remained the same, be soon and completely lost.

Man always tends to go to an extreme point in the selection, whether methodical or unconscious, of all useful and pleasing qualities. This is an important principle, as it leads to continued divergence, and in some rare cases to convergence of character. The possibility of continued divergence rests on the tendency in each part or organ to go on varying in the same manner in which it has already varied; and that this occurs, is proved by the steady and gradual improvement of many animals and plants during lengthened periods. The principle of divergence of character, combined with the neglect and final extinction of all previous, less-valued, and intermediate varieties, explains the amount of difference and the distinctness of our several races. Although we may have reached the utmost limit to which certain characters can be modified, yet we are far from having reached, as we have good reason to believe, the limit in the majority of cases. Finally, from the difference between selection as carried on by man and by nature, we can understand how it is that domestic races often, though by no means always, differ in general aspect from closely allied natural species.

Throughout this chapter and elsewhere I have spoken of selection as the paramount power, yet its action absolutely depends on what we in our ignorance call spontaneous or accidental variability. Let an architect be compelled to build an edifice with uncut stones, fallen from a precipice. The shape of each fragment may be called accidental; yet the shape of each has been determined by the force of gravity, the nature of the rock, and the slope of the precipice,—events and circumstances, all of which depend on natural laws; but there is no relation between these laws and the purpose for which each fragment is used by the builder. In the same manner the variations of each creature are determined by fixed and immutable laws; but these bear no relation to the living structure which is slowly built up through the power of selection, whether this be natural or artificial selection.

If our architect succeeded in rearing a noble edifice, using the rough wedge-shaped fragments for the arches, the longer stones for the lintels, and so forth, we should admire his skill even in a higher degree than if he had used stones shaped for the purpose. So it is with selection, whether applied by man or by nature; for although variability is indispensably necessary, yet, when we look at some highly complex and excellently adapted organism, variability sinks to a quite subordinate position in importance in comparison with selection, in the same manner as the shape of each fragment used by our supposed architect is unimportant in comparison with his skill.