

## CHAPTER XX.

## SELECTION BY MAN.

SELECTION A DIFFICULT ART—METHODICAL, UNCONSCIOUS, AND NATURAL SELECTION—RESULTS OF METHODICAL SELECTION—CARE TAKEN IN SELECTION—SELECTION WITH PLANTS—SELECTION CARRIED ON BY THE ANCIENTS AND BY SEMI-CIVILISED PEOPLE—UNIMPORTANT CHARACTERS OFTEN ATTENDED TO—UNCONSCIOUS SELECTION—AS CIRCUMSTANCES SLOWLY CHANGE, SO HAVE OUR DOMESTICATED ANIMALS CHANGED THROUGH THE ACTION OF UNCONSCIOUS SELECTION—INFLUENCE OF DIFFERENT BREEDERS ON THE SAME SUB-VARIETY—PLANTS AS AFFECTED BY UNCONSCIOUS SELECTION—EFFECTS OF SELECTION AS SHOWN BY THE GREAT AMOUNT OF DIFFERENCE IN THE PARTS MOST VALUED BY MAN.

THE power of Selection, whether exercised by man, or brought into play under nature through the struggle for existence and the consequent survival of the fittest, absolutely depends on the variability of organic beings. Without variability nothing can be effected; slight individual differences, however, suffice for the work, and are probably the chief or sole means in the production of new species. Hence our discussion on the causes and laws of variability ought in strict order to have preceded the present subject, as well as inheritance, crossing, &c.; but practically the present arrangement has been found the most convenient. Man does not attempt to cause variability; though he unintentionally effects this by exposing organisms to new conditions of life, and by crossing breeds already formed. But variability being granted, he works wonders. Unless some degree of selection be exercised, the free commingling of the individuals of the same variety soon obliterates, as we have previously seen, the slight differences which arise, and gives uniformity of character to the whole body of individuals. In separated districts, long-continued exposure to different conditions of life may produce new races without the aid of selection; but to this subject of the direct action of the conditions of life I shall recur in a future chapter.

When animals or plants are born with some conspicuous and firmly inherited new character, selection is reduced to the preservation of such individuals, and to the subsequent prevention of crosses; so that nothing more need be said on the subject. But in the great majority of cases a new character, or some superiority in an old character, is at first faintly pronounced, and is not strongly inherited; and then the full difficulty of selection is experienced. Indomitable patience, the finest powers of discrimination, and sound judgment must be exercised during many years. A clearly predetermined object must be kept steadily in view. Few men are endowed with all these qualities, especially with that of discriminating very slight differences; judgment can be acquired only by long experience; but if any of these qualities be wanting, the labour of a life may be thrown away. I have been astonished when celebrated breeders, whose skill and judgment have been proved by their success at exhibitions, have shown me their animals, which appeared all alike, and have assigned their reasons for matching this and that individual. The importance of the great principle of Selection mainly lies in this power of selecting scarcely appreciable differences, which nevertheless are found to be transmissible, and which can be accumulated until the result is made manifest to the eyes of every beholder.

The principle of selection may be conveniently divided into three kinds. *Methodical selection* is that which guides a man who systematically endeavours to modify a breed according to some predetermined standard. *Unconscious selection* is that which follows from men naturally preserving the most valued and destroying the less valued individuals, without any thought of altering the breed; and undoubtedly this process slowly works great changes. Unconscious selection graduates into methodical, and only extreme cases can be distinctly separated; for he who preserves a useful or perfect animal will generally breed from it with the hope of getting offspring of the same character; but as long as he has not a predetermined purpose to improve the breed, he may be said to be selecting unconsciously.<sup>1</sup> Lastly, we have *Natural selection*,

<sup>1</sup> The term *unconscious selection* has been objected to as a contradiction;

which implies that the individuals which are best fitted for the complex, and in the course of ages changing conditions to which they are exposed, generally survive and procreate their kind. With domestic productions, natural selection comes to a certain extent into action, independently of, and even in opposition to, the will of man.

*Methodical Selection.*—What man has effected within recent times in England by methodical selection is clearly shown by our exhibitions of improved quadrupeds and fancy birds. With respect to cattle, sheep, and pigs, we owe their great improvement to a long series of well-known names—Bakewell, Colling, Ellman, Bates, Jonas Webb, Lords Leicester and Western, Fisher Hobbs, and others. Agricultural writers are unanimous on the power of selection: any number of statements to this effect could be quoted; a few will suffice. Youatt, a sagacious and experienced observer, writes,<sup>2</sup> the principle of selection is “that which enables the agriculturist, not only to modify the character of his flock, but to change it altogether.” A great breeder of Shorthorns<sup>3</sup> says, “In the anatomy of the shoulder modern breeders have made great improvement on the Ketton shorthorns by correcting the defect in the knuckle or shoulder-joint, and by laying the top of the shoulder more snugly in the crop, and thereby filling up the hollow behind it. . . . The eye has its fashion at different periods: at one time the eye high and outstanding from the head, and at another time the sleepy eye sunk into the head; but these extremes have merged into the medium of a full, clear and prominent eye with a placid look.”

Again, hear what an excellent judge of pigs<sup>4</sup> says: “The legs should be no longer than just to prevent the animal’s belly from trailing on the ground. The leg is the least

but see some excellent observations on this head by Prof. Huxley (‘Nat. Hist. Review,’ Oct. 1864, p. 578), who remarks that when the wind heaps up sand-dunes it sifts and *unconsciously selects* from the gravel on the beach grains of sand of equal size.

<sup>2</sup> ‘On Sheep,’ 1838, p. 60.

<sup>3</sup> Mr. J. Wright on Shorthorn Cattle, in ‘Journal of Royal Agricult. Soc.,’ vol. vii. pp. 208, 209.

<sup>4</sup> H. D. Richardson ‘On Pigs,’ 1847, p. 44.

“profitable portion of the hog, and we therefore require no more of it than is absolutely necessary for the support of the rest.” Let any one compare the wild-boar with any improved breed, and he will see how effectually the legs have been shortened.

Few persons, except breeders, are aware of the systematic care taken in selecting animals, and of the necessity of having a clear and almost prophetic vision into futurity. Lord Spencer's skill and judgment were well known; and he writes,<sup>5</sup> “It is therefore very desirable, before any man commences to breed either cattle or sheep, that he should make up his mind to the shape and qualities he wishes to obtain, and steadily pursue this object.” Lord Somerville, in speaking of the marvellous improvement of the New Leicester sheep, effected by Bakewell and his successors, says, “It would seem as if they had first drawn a perfect form, and then given it life.” Youatt<sup>6</sup> urges the necessity of annually drafting each flock, as many animals will certainly degenerate “from the standard of excellence which the breeder has established in his own mind.” Even with a bird of such little importance as the canary, long ago (1780–1790) rules were established, and a standard of perfection was fixed according to which the London fanciers tried to breed the several sub-varieties.<sup>7</sup> A great winner of prizes at the Pigeon-shows,<sup>8</sup> in describing the short-faced Almond Tumbler, says, “There are many first-rate fanciers who are particularly partial to what is called the goldfinch-beak, which is very beautiful; others say, take a full-size round cherry then take a barleycorn, and judiciously placing and thrusting it into the cherry, form as it were your beak; and that is not all, for it will form a good head and beak, provided, as I said before, it is judiciously done; others take an oat; but as I think the goldfinch-beak the handsomest, I would advise the inexperienced fancier to get the head of a goldfinch, and keep it by him for his observation.” Wonderfully different

<sup>5</sup> ‘Journal of Royal Agricult. Soc.,’ vol. i. p. 24.

<sup>6</sup> ‘On Sheep,’ pp. 520, 319.

<sup>7</sup> London's ‘Mag. of Nat. Hist.,’

vol. viii., 1835, p. 618.

<sup>8</sup> ‘A treatise on the Art of Breeding the Almond Tumbler,’ 1851, p. 9.

as are the beaks of the rock pigeon and goldfinch, the end has undoubtedly been nearly gained, as far as external shape and proportions are concerned.

Not only should our animals be examined with the greatest care whilst alive, but, as Anderson remarks,<sup>9</sup> their carcasses should be scrutinised, "so as to breed from the descendants of such only as, in the language of the butcher, cut up well." The "grain of the meat" in cattle, and its being well marbled with fat,<sup>10</sup> and the greater or less accumulation of fat in the abdomen of our sheep, have been attended to with success. So with poultry, a writer,<sup>11</sup> speaking of Cochin-China fowls, which are said to differ much in the quality of their flesh, says, "the best mode is to purchase two young brother-cocks, kill, dress, and serve up one; if he be indifferent, similarly dispose of the other, and try again; if, however, he be fine and well-flavoured, his brother will not be amiss for breeding purposes for the table."

The great principle of the division of labour has been brought to bear on selection. In certain districts<sup>12</sup> "the breeding of bulls is confined to a very limited number of persons, who by devoting their whole attention to this department, are able from year to year to furnish a class of bulls which are steadily improving the general breed of the district." The rearing and letting of choice rams has long been, as is well known, a chief source of profit to several eminent breeders. In parts of Germany this principle is carried with merino sheep to an extreme point.<sup>13</sup> So important is the proper selection of breeding animals considered, "that the best flock-masters do not trust to their own judgment or to that of their shepherds, but employ persons called 'sheep-classifiers,' who make it their special business to attend to this part of the management of several flocks, and thus to preserve, or if possible to improve, the best qualities of both parents in the lambs." In Saxony, "when

<sup>9</sup> 'Recreations in Agriculture,' vol. ii. p. 409.

<sup>10</sup> Youatt on Cattle, pp. 191, 227.

<sup>11</sup> Ferguson, 'Prize Poultry,' 1854, p. 208.

<sup>12</sup> Wilson, in 'Transact. Highland

Agricult. Soc.,' quoted in 'Gard. Chronicle,' 1844, p. 29.

<sup>13</sup> Simmonds, quoted in 'Gard. Chronicle,' 1855, p. 637. And for the second quotation, see Youatt on Sheep, p. 171.

“the lambs are weaned, each in his turn is placed upon a table that his wool and form may be minutely observed. The finest are selected for breeding and receive a first mark. When they are one year old, and prior to shearing them, another close examination of those previously marked takes place: those in which no defect can be found receive a second mark, and the rest are condemned. A few months afterwards a third and last scrutiny is made; the prime rams and ewes receive a third and final mark, but the slightest blemish is sufficient to cause the rejection of the animal.” These sheep are bred and valued almost exclusively for the fineness of their wool; and the result corresponds with the labour bestowed on their selection. Instruments have been invented to measure accurately the thickness of the fibres; and “an Austrian fleece has been produced of which twelve hairs equalled in thickness one from a Leicester sheep.”

Throughout the world, wherever silk is produced, the greatest care is bestowed on selecting the cocoons from which the moths for breeding are to be reared. A careful cultivator<sup>14</sup> likewise examines the moths themselves, and destroys those that are not perfect. But what more immediately concerns us is that certain families in France devote themselves to raising eggs for sale.<sup>15</sup> In China, near Shanghai, the inhabitants of two small districts have the privilege of raising eggs for the whole surrounding country, and that they may give up their whole time to this business, they are interdicted by law from producing silk.<sup>16</sup>

The care which successful breeders take in matching their birds is surprising. Sir John Sebright, whose fame is perpetuated by the “Sebright Bantam,” used to spend “two and three days in examining, consulting, and disputing with a friend which were the best of five or six birds.”<sup>17</sup> Mr. Bult, whose pouter-pigeons won so many prizes, and were exported to North America under the charge of a man sent on purpose,

<sup>14</sup> Robinet, ‘Vers à Soie,’ 1848, p. 271.

<sup>15</sup> Quatrefages, ‘Les Maladies du Ver à Soie,’ 1859, p. 101.

<sup>16</sup> M. Simon, in ‘Bull. de la Soc. d’Acclimat.’ tom. ix., 1862, p. 221.

<sup>17</sup> ‘The Poultry Chronicle,’ vol. i., 1854, p. 607.

told me that he always deliberated for several days before he matched each pair. Hence we can understand the advice of an eminent fancier, who writes,<sup>18</sup> "I would here particularly guard you against having too great a variety of pigeons, otherwise you will know a little of all, but nothing about one as it ought to be known." Apparently it transcends the power of the human intellect to breed all kinds: "it is possible that there may be a few fanciers that have a good general knowledge of fancy pigeons; but there are many more who labour under the delusion of supposing they know what they do not." The excellence of one sub-variety, the Almond Tumbler, lies in the plumage, carriage, head, beak, and eye; but it is too presumptuous in the beginner to try for all these points. The great judge above quoted says, "There are some young fanciers who are over-covetous, who go for all the above five properties at once; they have their reward by getting nothing." We thus see that breeding even fancy pigeons is no simple art: we may smile at the solemnity of these precepts, but he who laughs will win no prizes.

What methodical selection has effected for our animals is sufficiently proved, as already remarked, by our Exhibitions. So greatly were the sheep belonging to some of the earlier breeders, such as Bakewell and Lord Western, changed, that many persons could not be persuaded that they had not been crossed. Our pigs, as Mr. Corringham remarks,<sup>19</sup> during the last twenty years have undergone, through rigorous selection together with crossing, a complete metamorphosis. The first exhibition for poultry was held in the Zoological Gardens in 1845; and the improvement effected since that time has been great. As Mr. Bailey, the great judge, remarked to me, it was formerly ordered that the comb of the Spanish cock should be upright, and in four or five years all good birds had upright combs; it was ordered that the Polish cock should have no comb or wattles, and now a bird thus furnished would be at once disqualified; beards were ordered,

<sup>18</sup> J. M. Eaton, 'A Treatise on Fancy Pigeons,' 1852, p. xiv., and 'A Treatise on the Almond Tumbler,'

1851, p. 11,

<sup>19</sup> 'Journal Royal Agricultural Soc.,' vol. vi. p. 22.

and out of fifty-seven pens lately (1860) exhibited at the Crystal Palace, all had beards. So it has been in many other cases. But in all cases the judges order only what is occasionally produced and what can be improved and rendered constant by selection. The steady increase in weight during the last few years in our fowls, turkeys, ducks, and geese is notorious; "six-pound ducks are now common, whereas four pounds was formerly the average." As the time required to make a change has not often been recorded, it may be worth mentioning that it took Mr. Wicking thirteen years to put a clean white head on an almond tumbler's body, "a triumph," says another fancier, "of which he may be justly proud."<sup>20</sup>

Mr. Tollet, of Betley Hall, selected cows, and especially bulls, descended from good milkers, for the sole purpose of improving his cattle for the production of cheese; he steadily tested the milk with the lactometer, and in eight years he increased, as I was informed by him, the product in proportion of four to three. Here is a curious case<sup>21</sup> of steady but slow progress, with the end not as yet fully attained: in 1784 a race of silkworms was introduced into France, in which one hundred in the thousand failed to produce white cocoons; but now after careful selection during sixty-five generations, the proportion of yellow cocoons has been reduced to thirty-five in the thousand.

With plants selection has been followed with the same good result as with animals. But the process is simpler, for plants in the great majority of cases bear both sexes. Nevertheless, with most kinds it is necessary to take as much care to prevent crosses as with animals or unisexual plants; but with some plants, such as peas, this care is not necessary. With all improved plants, excepting of course those which are propagated by buds, cuttings, &c., it is almost indispensable to examine the seedlings and destroy those which depart from the proper type. This is called "roguing," and is, in fact, a form of selection, like the rejection of inferior animals. Experienced horticulturists and agriculturists

<sup>20</sup> 'Poultry Chronicle,' vol. ii., 1855, p. 596.

<sup>21</sup> Isid. Geoffroy St.-Hilaire, 'Hist. Nat. Gén.,' tom. iii. p. 254.

incessantly urge every one to preserve the finest plants for the production of seed.

Although plants often present much more conspicuous variations than animals, yet the closest attention is generally requisite to detect each slight and favourable change. Mr. Masters relates<sup>22</sup> how "many a patient hour was devoted," whilst he was young, to the detection of differences in peas intended for seed. Mr. Barnet<sup>23</sup> remarks that the old scarlet American strawberry was cultivated for more than a century without producing a single variety; and another writer observes how singular it was that when gardeners first began to attend to this fruit it began to vary; the truth no doubt being that it had always varied, but that, until slight variations were selected and propagated by seed, no conspicuous result was obtained. The finest shades of difference in wheat have been discriminated and selected with almost as much care as, in the case of the higher animals, for instance by Col. Le Couteur and more especially by Major Hallett.

It may be worth while to give a few examples of methodical selection with plants; but in fact the great improvement of all our anciently cultivated plants may be attributed to selection long carried on, in part methodically, and in part unconsciously. I have shown in a former chapter how the weight of the gooseberry has been increased by systematic selection and culture. The flowers of the Heartsease have been similarly increased in size and regularity of outline. With the Cineraria, Mr. Glenny<sup>24</sup> "was bold enough when "the flowers were ragged and starry and ill defined in colour, "to fix a standard which was then considered outrageously "high and impossible, and which, even if reached, it was "said, we should be no gainers by, as it would spoil the "beauty of the flowers. He maintained that he was right; "and the event has proved it to be so." The doubling of flowers has several times been effected by careful selection: the Rev. W. Williamson,<sup>25</sup> after sowing during several years

<sup>22</sup> 'Gardener's Chron.,' 1850, p. 198.

<sup>23</sup> 'Transact. Hort. Soc.,' vol. vi. p. 152.

<sup>24</sup> 'Journal of Horticulture,' 1862, p. 369.

<sup>25</sup> 'Transact. Hort. Soc.,' vol. iv. p. 381.

seed of *Anemone coronaria*, found a plant with one additional petal; he sowed the seed of this, and by perseverance in the same course obtained several varieties with six or seven rows of petals. The single Scotch rose was doubled, and yielded eight good varieties in nine or ten years.<sup>26</sup> The Canterbury bell (*Campanula medium*) was doubled by careful selection in four generations.<sup>27</sup> In four years Mr. Buckman,<sup>28</sup> by culture and careful selection, converted parsnips, raised from wild seed, into a new and good variety. By selection during a long course of years, the early maturity of peas has been hastened by between ten and twenty-one days.<sup>29</sup> A more curious case is offered by the beet plant, which since its cultivation in France, has almost exactly doubled its yield of sugar. This has been effected by the most careful selection; the specific gravity of the roots being regularly tested, and the best roots saved for the production of seed.<sup>30</sup>

*Selection by Ancient and Semi-civilised People.*

In attributing so much importance to the selection of animals and plants, it may be objected, that methodical selection would not have been carried on during ancient times. A distinguished naturalist considers it as absurd to suppose that semi-civilised people should have practised selection of any kind. Undoubtedly the principle has been systematically acknowledged and followed to a far greater extent within the last hundred years than at any former period, and a corresponding result has been gained; but it would be a greater error to suppose, as we shall immediately see, that its importance was not recognised and acted on during the most ancient times, and by semi-civilised people. I should premise that many facts now to be given only show that care was taken in breeding; but when this is the case, selection is almost sure to be practised to a certain extent. We shall hereafter be enabled better to judge how far selection, when only occa-

<sup>26</sup> 'Transact. Hort. Soc.,' vol. iv. p. 285.

<sup>27</sup> Rev. W. Bromehead, in 'Gard. Chronicle,' 1857, p. 550.

<sup>28</sup> 'Gard. Chronicle,' 1862, p. 721.

<sup>29</sup> Dr. Anderson, in 'The Bee,' vol.

vi. p. 96; Mr. Barnes, in 'Gard. Chronicle,' 1844, p. 476.

<sup>30</sup> Godron, 'De l'Espèce,' 1859, tom. ii. p. 69; 'Gard. Chronicle,' 1854, p. 258.

sionally carried on, by a few of the inhabitants of a country, will slowly produce a great effect.

In a well-known passage in the thirtieth chapter of Genesis, rules are given for influencing, as was then thought possible, the colour of sheep; and speckled and dark breeds are spoken of as being kept separate. By the time of David the fleece was likened to snow. Youatt,<sup>31</sup> who has discussed all the passages in relation to breeding in the Old Testament, concludes that at this early period "some of the best principles of breeding must have been steadily and long pursued." It was ordered, according to Moses, that "Thou shalt not let thy cattle gender with a diverse kind;" but mules were purchased,<sup>32</sup> so that at this early period other nations must have crossed the horse and ass. It is said<sup>33</sup> that Erichthonius, some generations before the Trojan war, had many brood-mares, "which by his care and judgment in the choice of stallions produced a breed of horses superior to any in the surrounding countries." Homer (Book v.) speaks of Æneas' horses as bred from mares which were put to the steeds of Laomedon. Plato, in his 'Republic,' says to Glaucus, "I see that you raise at your house a great many dogs for the chase. Do you take care about breeding and pairing them? Among animals of good blood, are there not always some which are superior to the rest?" To which Glaucus answers in the affirmative.<sup>34</sup> Alexander the Great selected the finest Indian cattle to send to Macedonia to improve the breed.<sup>35</sup> According to Pliny,<sup>36</sup> King Pyrrhus had an especially valuable breed of oxen: and he did not suffer the bulls and cows to come together till four years old, that the breed might not degenerate. Virgil, in his Georgics (lib. iii.), gives as strong advice as any modern agriculturist could do, carefully to select the breeding stock; "to note the tribe, the lineage, and the sire; whom to reserve for husband of the herd;"—to brand the progeny;—to select sheep of the purest white, and to examine if their tongues are swarthy. We have seen that the

<sup>31</sup> On Sheep, p. 18.

<sup>32</sup> Volz, 'Beiträge zur Kulturgeschichte,' 1852, s. 47.

<sup>33</sup> Mitford's 'History of Greece,' vol. i. p. 73.

<sup>34</sup> Dr. Dally, translated in 'Anthropological Review,' May 1864, p. 101.

<sup>35</sup> Volz, 'Beiträge,' &c., 1852, s. 80.

<sup>36</sup> 'History of the World,' ch. 45.

Romans kept pedigrees of their pigeons, and this would have been a senseless proceeding had not great care been taken in breeding them. Columella gives detailed instructions about breeding fowls: "Let the breeding hens therefore be of a choice colour, "a robust body, square-built, full-breasted, with "large heads, with upright and bright-red combs. Those "are believed to be the best bred which have five toes."<sup>37</sup> According to Tacitus, the Celts attended to the races of their domestic animals; and Cæsar states that they paid high prices to merchants for fine imported horses.<sup>38</sup> In regard to plants, Virgil speaks of yearly culling the largest seeds; and Celsus says, "where the corn and crop is but small, we must pick out the best ears of corn, and of them lay up our seed separately by itself."<sup>39</sup>

Coming down the stream of time, we may be brief. At about the beginning of the ninth century Charlemagne expressly ordered his officers to take great care of his stallions; and if any proved bad or old, to forewarn him in good time before they were put to the mares.<sup>40</sup> Even in a country so little civilised as Ireland during the ninth century, it would appear from some ancient verses,<sup>41</sup> describing a ransom demanded by Cormac, that animals from particular places, or having a particular character, were valued. Thus it is said,—

Two pigs of the pigs of Mac Lir,  
A ram and ewe both round and red,  
I brought with me from Aengus.  
I brought with me a stallion and a mare  
From the beautiful stud of Manannan,  
A bull and a white cow from Druim Cain.

Athelstan, in 930, received running-horses as a present from Germany; and he prohibited the exportation of English horses. King John imported "one hundred chosen stallions from Flanders."<sup>42</sup> On June 16th, 1305, the Prince of Wales

<sup>37</sup> 'Gardener's Chronicle,' 1848, p. 323.

<sup>38</sup> Reynier, 'De l'Économie des Celtes,' 1818, pp. 487, 503.

<sup>39</sup> Le Couteur on Wheat, p. 15.

<sup>40</sup> Michel, 'Des Haras,' 1861, p. 84.

<sup>41</sup> Sir W. Wilde, an 'Essay on Un-manufactured Animal Remains,' &c., 1860, p. 11.

<sup>42</sup> Col. Hamilton Smith, 'Nat. Library,' vol. xii., Horses, pp. 135, 140.

wrote to the Archbishop of Canterbury, begging for the loan of any choice stallion, and promising its return at the end of the season.<sup>43</sup> There are numerous records at ancient periods in English history of the importation of choice animals of various kinds, and of foolish laws against their exportation. In the reigns of Henry VII. and VIII. it was ordered that the magistrates, at Michaelmas, should scour the heaths and commons, and destroy all mares beneath a certain size.<sup>44</sup> Some of our earlier kings passed laws against the slaughtering rams of any good breed before they were seven years old, so that they might have time to breed. In Spain Cardinal Ximenes issued, in 1500, regulations on the *selection* of good rams for breeding.<sup>45</sup>

The Emperor Akbar Khan before the year 1600 is said to have "wonderfully improved" his pigeons by crossing the breeds; and this necessarily implies careful selection. About the same period the Dutch attended with the greatest care to the breeding of these birds. Belon in 1555 says that good managers in France examined the colour of their goslings in order to get geese of a white colour and better kinds. Markham in 1631 tells the breeder "to elect the largest and goodliest conies," and enters into minute details. Even with respect to seeds of plants for the flower-garden, Sir J. Hanmer writing about the year 1660<sup>46</sup> says, in "choosing seed, the best seed is the most weighty, and is had from the lustiest and most vigorous stems;" and he then gives rules about leaving only a few flowers on plants for seed; so that even such details were attended to in our flower-gardens two hundred years ago. In order to show that selection has been silently carried on in places where it would not have been expected, I may add that in the middle of the last century, in a remote part of North America, Mr. Cooper improved by careful selection all his vegetables, "so that they were greatly superior to those of any other person. When his radishes,

<sup>43</sup> Michel, 'Des Haras,' p. 90.

<sup>44</sup> Mr. Baker, 'History of the Horse,' 'Veterinary,' vol. xiii. p. 423.

<sup>45</sup> M. l'Abbé Carlier, in 'Journal de Physique,' vol. xxiv., 1784, p. 181; this memoir contains much informa-

tion on the ancient selection of sheep; and is my authority for rams not being killed young in England.

<sup>46</sup> 'Gardener's Chronicle,' 1843, p. 389.

“ for instance, are fit for use, he takes ten or twelve that he most approves, and plants them at least 100 yards from others that blossom at the same time. In the same manner he treats all his other plants, varying the circumstances according to their nature.”<sup>47</sup>

In the great work on China published in the last century by the Jesuits, and which is chiefly compiled from ancient Chinese encyclopædias, it is said that with sheep “ improving the breed consists in choosing with particular care the lambs which are destined for propagation, in nourishing them well, and in keeping the flocks separate.” The same principles were applied by the Chinese to various plants and fruit-trees.<sup>48</sup> An imperial edict recommends the choice of seed of remarkable size; and selection was practised even by imperial hands, for it is said that the Ya-mi, or imperial rice, was noticed at an ancient period in a field by the Emperor Khang-hi, was saved and cultivated in his garden, and has since become valuable from being the only kind which will grow north of the Great Wall.<sup>49</sup> Even with flowers, the tree pæony (*P. moutan*) has been cultivated, according to Chinese traditions, for 1400 years; between 200 and 300 varieties have been raised, which are cherished like tulips formerly were by the Dutch.<sup>50</sup>

Turning now to semi-civilised people and to savages: it occurred to me, from what I had seen of several parts of South America, where fences do not exist, and where the animals are of little value, that there would be absolutely no care in breeding or selecting them; and this to a large extent is true. Roulin,<sup>51</sup> however, describes in Columbia a naked race of cattle, which are not allowed to increase, on account of their delicate constitution. According to Azara<sup>52</sup> horses are often born in Paraguay with curly hair; but, as the natives

<sup>47</sup> ‘Communications to Board of Agriculture,’ quoted in Dr. Darwin’s ‘Phytologia,’ 1800, p. 451.

<sup>48</sup> ‘Mémoire sur les Chinois,’ 1786, tom. xi. p. 55; tom. v. p. 507.

<sup>49</sup> ‘Recherches sur l’Agriculture des Chinois,’ par L. D’Hervey Saint-Denys, 1850, p. 229. With respect

to Khang-hi, see Huc’s ‘Chinese Empire,’ p. 311.

<sup>50</sup> Anderson, in ‘Linn. Transact.,’ vol. xii. p. 253.

<sup>51</sup> ‘Mém. de l’Acad.’ (divers savants), tom. vi., 1835, p. 333.

<sup>52</sup> ‘Des Quadrupèdes du Paraguay,’ 1801, tom. ii. pp. 333, 371.

do not like them, they are destroyed. On the other hand, Azara states that a hornless bull, born in 1770, was preserved and propagated its race. I was informed of the existence in Banda Oriental of a breed with reversed hair; and the extraordinary niata cattle first appeared and have since been kept distinct in La Plata. Hence certain conspicuous variations have been preserved, and others have been habitually destroyed, in these countries, which are so little favourable for careful selection. We have also seen that the inhabitants sometimes introduce fresh cattle on their estates to prevent the evil effects of close interbreeding. On the other hand, I have heard on reliable authority that the Gauchos of the Pampas never take any pains in selecting the best bulls or stallions for breeding; and this probably accounts for the cattle and horses being remarkably uniform in character throughout the immense range of the Argentine republic.

Looking to the Old World, in the Sahara Desert "The Touareg is as careful in the selection of his breeding Mahari (a fine race of the dromedary) as the Arab is in that of his horse. The pedigrees are handed down, and many a dromedary can boast a genealogy far longer than the descendants of the Darley Arabian."<sup>53</sup> According to Pallas the Mongolians endeavour to breed the Yaks or horse-tailed buffaloes with white tails, for these are sold to the Chinese mandarins as fly-flappers; and Moorcroft, about seventy years after Pallas, found that white-tailed animals were still selected for breeding.<sup>54</sup>

We have seen in the chapter on the Dog that savages in different parts of North America and in Guiana cross their dogs with wild *Canidæ*, as did the ancient Gauls, according to Pliny. This was done to give their dogs strength and vigour, in the same way as the keepers in large warrens now sometimes cross their ferrets (as I have been informed by Mr. Yarrell) with the wild polecat, "to give them more devil." According to Varro, the wild ass was formerly caught and crossed with the tame animal to improve the breed, in the

<sup>53</sup> 'The Great Sahara,' by the Rev. H. B. Tristram, 1860, p. 238.

<sup>54</sup> Pallas, 'Act. Acad. St. Peters-

burg,' 1777, p. 249, Moorcroft and Trebeck, 'Travels in the Himalayan Provinces,' 1841.

same manner as at the present day the natives of Java sometimes drive their cattle into the forests to cross with the wild Banteng (*Bos sondaicus*).<sup>55</sup> In Northern Siberia, among the Ostyaks, the dogs vary in markings in different districts, but in each place they are spotted black and white in a remarkably uniform manner;<sup>56</sup> and from this fact alone we may infer careful breeding, more especially as the dogs of one locality are famed throughout the country for their superiority. I have heard of certain tribes of Esquimaux who take pride in their teams of dogs being uniformly coloured. In Guiana, as Sir R. Schomburgk informs me,<sup>57</sup> the dogs of the Turuma Indians are highly valued and extensively bartered: the price of a good one is the same as that given for a wife: they are kept in a sort of cage, and the Indians "take great care when the female is in season to prevent her uniting with a dog of an inferior description." The Indians told Sir Robert that, if a dog proved bad or useless, he was not killed, but was left to die from sheer neglect. Hardly any nation is more barbarous than the Fuegians, but I hear from Mr. Bridges, the Catechist to the Mission, that, "when these savages have a large, strong, and active bitch, they take care to put her to a fine dog, and even take care to feed her well, that her young may be strong and well favoured."

In the interior of Africa, negroes, who have not associated with white men, show great anxiety to improve their animals; they "always choose the larger and stronger males for stock;" the Malakolo were much pleased at Livingstone's promise to send them a bull, and some Bakalolo carried a live cock all the way from Loanda into the interior.<sup>58</sup> At Falaba Mr. Winwood Reade noticed an unusually fine horse, and the negro King informed him that "the owner was noted for his skill in breeding horses." Further south on the same continent, Andersson states that he has known a Damara give two fine oxen for a dog which struck his fancy. The

<sup>55</sup> Quoted from Raffles, in the 'Indian Field,' 1859, p. 196: for Varro, see Pallas, *ut supra*.

<sup>56</sup> Erman's 'Travels in Siberia,' Eng. transl., vol. i. p. 453.

<sup>57</sup> See also 'Journal of R. Geo-

graph. Soc.,' vol. xiii. part i. p. 65.

<sup>58</sup> Livingstone's 'First Travels,' pp. 191, 439, 565; see also 'Expedition to the Zambesi,' 1865, p. 495, for an analogous case respecting a good breed of goats.

Damaras take great delight in having whole droves of cattle of the same colour, and they prize their oxen in proportion to the size of their horns. "The Namaquas have a perfect mania for a uniform team; and almost all the people of Southern Africa value their cattle next to their women, and take a pride in possessing animals that look high-bred." They rarely or never make use of a handsome animal as a beast of burden.<sup>59</sup> The power of discrimination which these savages possess is wonderful, and they can recognise to which tribe any cattle belong. Mr. Andersson further informs me that the natives frequently match a particular bull with a particular cow.

The most curious case of selection by semi-civilised people, or indeed by any people, which I have found recorded, is that given by Garcilazo de la Vega, a descendant of the Incas, as having been practised in Peru before the country was subjugated by the Spaniards.<sup>60</sup> The Incas annually held great hunts, when all the wild animals were driven from an immense circuit to a central point. The beasts of prey were first destroyed as injurious. The wild Guanacos and Vicunas were sheared; the old males and females killed, and the others set at liberty. The various kinds of deer were examined; the old males and females were likewise killed; "but the young females, with a certain number of males, selected from the most beautiful and strong," were given their freedom. Here, then, we have selection by man aiding natural selection. So that the Incas followed exactly the reverse system of that which our Scottish sportsman are accused of following, namely, of steadily killing the finest stags, thus causing the whole race to degenerate.<sup>61</sup> In regard to the domesticated llamas and alpacas, they were separated in the time of the Incas according to colour: and if by chance one in a flock was born of the wrong colour, it was eventually put into another flock.

In the genus *Auchenia* there are four forms,—the Guanaco

<sup>59</sup> Andersson's 'Travels in South Africa,' pp. 232, 318, 319. 136.

<sup>60</sup> Dr. Vavasseur, in 'Bull. de la Soc. d'Acclimat.,' tom. viii., 1861, p.

<sup>61</sup> 'The Natural History of Dee Side,' 1855, p. 476.

and Vicuna, found wild and undoubtedly distinct species; the Llama and Alpaca, known only in a domesticated condition. These four animals appear so different, that most naturalists, especially those who have studied these animals in their native country, maintain that they are specifically distinct, notwithstanding that no one pretends to have seen a wild llama or alpaca. Mr. Ledger, however, who has closely studied these animals both in Peru and during their exportation to Australia, and who has made many experiments on their propagation, adduces arguments<sup>62</sup> which seem to me conclusive, that the llama is the domesticated descendant of the guanaco, and the alpaca of the vicuna. And now that we know that these animals were systematically bred and selected many centuries ago, there is nothing surprising in the great amount of change which they have undergone.

It appeared to me at one time probable that, though ancient and semi-civilised people might have attended to the improvement of their more useful animals in essential points, yet that they would have disregarded unimportant characters. But human nature is the same throughout the world: fashion everywhere reigns supreme, and man is apt to value whatever he may chance to possess. We have seen that in South America the niata cattle, which certainly are not made useful by their shortened faces and upturned nostrils, have been preserved. The Damaras of South Africa value their cattle for uniformity of colour and enormously long horns. And I will now show that there is hardly any peculiarity in our most useful animals which, from fashion, superstition, or some other motive, has not been valued, and consequently preserved. With respect to cattle, "an early record," according to Youatt,<sup>63</sup> "speaks of a hundred white cows with red ears "being demanded as a compensation by the princes of North "and South Wales. If the cattle were of a dark or black "colour, 150 were to be presented." So that colour was attended to in Wales before its subjugation by England. In Central Africa, an ox that beats the ground with its tail is killed; and in South Africa some of the Damaras will not eat

<sup>62</sup> 'Bull. de la Soc. d'Acclimat.,' tom. vii., 1860, p. 457. <sup>63</sup> 'Cattle,' p. 48.

the flesh of a spotted ox. The Kaffirs value an animal with a musical voice; and "at a sale in British Kaffraria the low of a heifer excited so much admiration that a sharp competition sprung up for her possession, and she realised a considerable price."<sup>64</sup> With respect to sheep, the Chinese prefer rams without horns; the Tartars prefer them with spirally wound horns, because the hornless are thought to lose courage.<sup>65</sup> Some of the Damaras will not eat the flesh of hornless sheep. In regard to horses, at the end of the fifteenth century animals of the colour described as *liart pommé* were most valued in France. The Arabs have a proverb, "Never buy a horse with four white feet, for he carries his shroud with him;"<sup>66</sup> the Arabs also, as we have seen, despise dun-coloured horses. So with dogs, Xenophon and others at an ancient period were prejudiced in favour of certain colours; and "white or slate-coloured hunting dogs were not esteemed."<sup>67</sup>

Turning to poultry, the old Roman gourmands thought that the liver of a white goose was the most savoury. In Paraguay black-skinned fowls are kept because they are thought to be more productive, and their flesh the most proper for invalids.<sup>68</sup> In Guiana, as I am informed by Sir R. Schomburgk, the aborigines will not eat the flesh or eggs of the fowl, but two races are kept distinct merely for ornament. In the Philippines, no less than nine sub-varieties of the gamecock are kept and named, so that they must be separately bred.

At the present time in Europe, the smallest peculiarities are carefully attended to in our most useful animals, either from fashion, or as a mark of purity of blood. Many examples could be given; two will suffice. "In the Western counties of England the prejudice against a white pig is nearly as strong as against a black one in Yorkshire." In one of the

<sup>64</sup> Livingstone's Travels, p. 576; Andersson, 'Lake Ngami,' 1856, p. 222. With respect to the sale in Kaffraria, see 'Quarterly Review,' 1860, p. 139.

<sup>65</sup> 'Mémoire sur les Chinois' (by the Jesuits), 1786, tom. xi. p. 57.

<sup>66</sup> F. Michel, 'Des Haras,' pp. 47, 50.

<sup>67</sup> Col. Hamilton Smith, Dogs, in 'Nat. Lib.,' vol. x. p. 103.

<sup>68</sup> Azara, 'Quadrupèdes du Paraguay,' tom. ii. p. 324.

Berkshire sub-breeds, it is said, "the white should be confined to four white feet, a white spot between the eyes, and a few white hairs behind each shoulder." Mr. Saddler possessed "three hundred pigs, every one of which was marked in this manner."<sup>69</sup> Marshall, towards the close of the last century, in speaking of a change in one of the Yorkshire breeds of cattle, says the horns have been considerably modified, as "a clean, small, sharp horn has been *fashionable* for the last twenty years."<sup>70</sup> In a part of Germany the cattle of the Race de Gfoehl are valued for many good qualities, but they must have horns of a particular curvature and tint, so much so that mechanical means are applied if they take a wrong direction; but the inhabitants "consider it of the highest importance that the nostrils of the bull should be flesh-coloured, and the eyelashes light; this is an indispensable condition. A calf with blue nostrils would not be purchased, or purchased at a very low price."<sup>71</sup> Therefore let no man say that any point or character is too trifling to be methodically attended to and selected by breeders.

*Unconscious Selection.*—By this term I mean, as already more than once explained, the preservation by man of the most valued, and the destruction of the least valued individuals, without any conscious intention on his part of altering the breed. It is difficult to offer direct proofs of the results which follow from this kind of selection; but the indirect evidence is abundant. In fact, except that in the one case man acts intentionally, and in the other unintentionally, there is little difference between methodical and unconscious selection. In both cases man preserves the animals which are most useful or pleasing to him, and destroys or neglects the others. But no doubt a far more rapid result follows from methodical than from unconscious selection. The "roguing" of plants by gardeners, and the destruction by law in Henry VIII.'s reign of all under-sized mares, are instances of a process the reverse of selection in the ordinary sense of the

<sup>69</sup> Sidney's edit. of Youatt, 1860, pp. 24, 25.

vol. ii. p. 182.

<sup>70</sup> 'Rural Economy of Yorkshire,'

<sup>71</sup> Moll et Gayot, 'Du Bœuf,' 1860, p. 547.

word, but leading to the same general result. The influence of the destruction of individuals having a particular character is well shown by the necessity of killing every lamb with a trace of black about it, in order to keep the flock white; or again, by the effects on the average height of the men of France of the destructive wars of Napoleon, by which many tall men were killed, the short ones being left to be the fathers of families. This at least is the conclusion of some of those who have closely studied the effects of the conscription; and it is certain that since Napoleon's time the standard for the army has been lowered two or three times.

Unconscious selection blends with methodical, so that it is scarcely possible to separate them. When a fancier long ago first happened to notice a pigeon with an unusually short beak, or one with the tail-feathers unusually developed, although he bred from these birds with the distinct intention of propagating the variety, yet he could not have intended to make a short-faced tumbler or a fantail, and was far from knowing that he had made the first step towards this end. If he could have seen the final result, he would have been struck with astonishment, but, from what we know of the habits of fanciers, probably not with admiration. Our English carriers, barbs, and short-faced tumblers have been greatly modified in the same manner, as we may infer both from the historical evidence given in the chapters on the Pigeon, and from the comparison of birds brought from distant countries.

So it has been with dogs; our present fox-hounds differ from the old English hound; our greyhounds have become lighter; the Scotch deer-hound has been modified, and is now rare. Our bulldogs differ from those which were formerly used for baiting bulls. Our pointers and Newfoundlands do not closely resemble any native dog now found in the countries whence they were brought. These changes have been effected partly by crosses; but in every case the result has been governed by the strictest selection. Nevertheless, there is no reason to suppose that man intentionally and methodically made the breeds exactly what they now are. As our horses became fleeter, and the country more cultivated and smoother, fleeter fox-hounds were desired and produced, but probably

without any one distinctly foreseeing what they would become. Our pointers and setters, the latter almost certainly descended from large spaniels, have been greatly modified in accordance with fashion and the desire for increased speed. Wolves have become extinct, and so has the wolf-dog; deer have become rarer, bulls are no longer baited, and the corresponding breeds of the dog have answered to the change. But we may feel almost sure that when, for instance, bulls were no longer baited, no man said to himself, I will now breed my dogs of smaller size, and thus create the present race. As circumstances changed, men unconsciously and slowly modified their course of selection.

With race-horses selection for swiftness has been followed methodically, and our horses now easily surpass their progenitors. The increased size and different appearance of the English race-horse led a good observer in India to ask, "Could any one in this year of 1856, looking at our race-horses, conceive that they were the result of the union of the Arab horse and the African mare?"<sup>72</sup> This change has, it is probable, been largely effected through unconscious selection, that is, by the general wish to breed as fine horses as possible in each generation, combined with training and high feeding, but without any intention to give to them their present appearance. According to Youatt,<sup>73</sup> the introduction in Oliver Cromwell's time of three celebrated Eastern stallions speedily affected the English breed; "so that Lord Harleigh, one of the old school, complained that the great horse was fast disappearing." This is an excellent proof how carefully selection must have been attended to; for without such care, all traces of so small an infusion of Eastern blood would soon have been absorbed and lost. Notwithstanding that the climate of England has never been esteemed particularly favourable to the horse, yet long-continued selection, both methodical and unconscious, together with that practised by the Arabs during a still longer and earlier period, has ended in giving us the best breed of horses in the world. Macaulay<sup>74</sup> remarks,

<sup>72</sup> 'The India Sporting Review,' vol. ii. p. 181; 'The Stud Farm,' by Cecil, p. 58.

<sup>73</sup> 'The Horse,' p. 22.

<sup>74</sup> 'History of England,' vol. i. p. 316.

“Two men whose authority on such subjects was held in great esteem, the Duke of Newcastle and Sir John Fenwick, pronounced that the meanest hack ever imported from Tangier would produce a finer progeny than could be expected from the best sire of our native breed. They would not readily have believed that a time would come when the princes and nobles of neighbouring lands would be as eager to obtain horses from England as ever the English had been to obtain horses from Barbary.”

The London dray-horse, which differs so much in appearance from any natural species, and which from its size has so astonished many Eastern princes, was probably formed by the heaviest and most powerful animals having been selected during many generations in Flanders and England, but without the least intention or expectation of creating a horse such as we now see. If we go back to an early period of history, we behold in the antique Greek statues, as Schaaffhausen has remarked,<sup>75</sup> a horse equally unlike a race or dray horse, and differing from any existing breed.

The results of unconscious selection, in an early stage, are well shown in the difference between the flocks descended from the same stock, but separately reared by careful breeders. Youatt gives an excellent instance of this fact in the sheep belonging to Messrs. Buckley and Burgess, which “have been purely bred from the original stock of Mr. Bakewell for upwards of fifty years. There is not a suspicion existing in the mind of any one at all acquainted with the subject that the owner of either flock has deviated in any one instance from the pure blood of Mr. Bakewell’s flock; yet the difference between the sheep possessed by these two gentlemen is so great, that they have the appearance of being quite different varieties.”<sup>76</sup> I have seen several analogous and well marked cases with pigeons: for instance, I had a family of barbs descended from those long bred by Sir J. Sebright, and another family long bred by another fancier, and the two families plainly differed from each other. Nathusius—and a more competent witness could not be cited—observes that, though the Shorthorns are remarkably uniform in appearance

<sup>75</sup> ‘Ueber Beständigkeit der Arten.

<sup>76</sup> Youatt on Sheep, p. 315.

(except in colour), yet the individual character and wishes of each breeder become impressed on his cattle, so that different herds differ slightly from one another.<sup>77</sup> The Hereford cattle assumed their present well-marked character soon after the year 1769, through careful selection by Mr. Tomkins,<sup>78</sup> and the breed has lately split into two strains—one strain having a white face, and differing slightly, it is said,<sup>79</sup> in some other points: but there is no reason to believe that this split, the origin of which is unknown, was intentionally made; it may with much more probability be attributed to different breeders having attended to different points. So again, the Berkshire breed of swine in the year 1810 had greatly changed from what it was in 1780; and since 1810 at least two distinct sub-breeds have arisen bearing the same name.<sup>80</sup> Keeping in mind how rapidly all animals increase, and that some must be annually slaughtered and some saved for breeding, then, if the same breeder during a long course of years deliberately settles which shall be saved and which shall be killed, it is almost inevitable that his individual turn of mind will influence the character of his stock, without his having had any intention to modify the breed.

Unconscious selection in the strictest sense of the word, that is, the saving of the more useful animals and the neglect or slaughter of the less useful, without any thought of the future, must have gone on occasionally from the remotest period and amongst the most barbarous nations. Savages often suffer from famines, and are sometimes expelled by war from their own homes. In such cases it can hardly be doubted that they would save their most useful animals. When the Fuegians are hard pressed by want, they kill their old women for food rather than their dogs; for, as we were assured, "old women no use—dogs catch otters." The same sound sense would surely lead them to preserve their more useful dogs when still harder pressed by famine. Mr. Oldfield, who has seen so much of the aborigines of Australia, informs me

<sup>77</sup> 'Ueber Shorthorn Rindvieh,' 1857, s. 51,

<sup>78</sup> Low, 'Domesticated Animals,' 1845, p. 363.

<sup>79</sup> 'Quarterly Review,' 1849, p. 392.

<sup>80</sup> H. von Nathusius, 'Vorstudien . . . Schweineschädel,' 1864, s. 140.

that "they are all very glad to get a European kangaroo dog, and several instances have been known of the father killing his own infant that the mother might suckle the much-prized puppy." Different kinds of dogs would be useful to the Australian for hunting opossums and kangaroos, and to the Fuegian for catching fish and otters; and the occasional preservation in the two countries of the most useful animals would ultimately lead to the formation of two widely distinct breeds.

With plants, from the earliest dawn of civilisation, the best variety which was known would generally have been cultivated at each period and its seeds occasionally sown; so that there will have been some selection from an extremely remote period, but without any prefixed standard of excellence or thought of the future. We at the present day profit by a course of selection occasionally and unconsciously carried on during thousands of years. This is proved in an interesting manner by Oswald Heer's researches on the lake-inhabitants of Switzerland, as given in a former chapter; for he shows that the grain and seed of our present varieties of wheat, barley, oats, peas, beans, lentils, and poppy, exceed in size those which were cultivated in Switzerland during the Neolithic and Bronze periods. These ancient people, during the Neolithic period, possessed also a crab considerably larger than that now growing wild on the Jura.<sup>81</sup> The pears described by Pliny were evidently extremely inferior in quality to our present pears. We can realise the effects of long-continued selection and cultivation in another way, for would any one in his senses expect to raise a first-rate apple from the seed of a truly wild crab, or a luscious melting pear from the wild pear? Alphonse de Candolle informs me that he has lately seen on an ancient mosaic at Rome a representation of the melon; and as the Romans, who were such gourmands, are silent on this fruit, he infers that the melon has been greatly ameliorated since the classical period.

Coming to later times, Buffon,<sup>82</sup> on comparing the flowers,

<sup>81</sup> See also Dr. Christ, in Rüttemeyer's 'Pfablbauten,' 1861, s. 226.

<sup>82</sup> The passage is given, 'Bull. Soc. d'Acclimat.,' 1858, p. 11.

fruit, and vegetables which were then cultivated with some excellent drawings made a hundred and fifty years previously, was struck with surprise at the great improvement which had been effected; and remarks that these ancient flowers and vegetables would now be rejected, not only by a florist but by a village gardener. Since the time of Buffon the work of improvement has steadily and rapidly gone on. Every florist who compares our present flowers with those figured in books published not long since, is astonished at the change. A well-known amateur,<sup>83</sup> in speaking of the varieties of *Pelargonium* raised by Mr. Garth only twenty-two years before, remarks, "What a rage they excited: surely we had attained perfection, it was said; and now not one of the flowers of those days will be looked at. But none the less is the debt of gratitude which we owe to those who saw what was to be done, and did it." Mr. Paul, the well-known horticulturist, in writing of the same flower,<sup>84</sup> says he remembers when young being delighted with the portraits in Sweet's work; "but what are they in point of beauty compared with the *Pelargoniums* of this day? Here again nature did not advance by leaps; the improvement was gradual, and if we had neglected those very gradual advances, we must have foregone the present grand results." How well this practical horticulturist appreciates and illustrates the gradual and accumulative force of selection! The *Dahlia* has advanced in beauty in a like manner; the line of improvement being guided by fashion, and by the successive modifications which the flower slowly underwent.<sup>85</sup> A steady and gradual change has been noticed in many other flowers: thus an old florist,<sup>86</sup> after describing the leading varieties of the Pink which were grown in 1813, adds, "the pinks of those days would now be scarcely grown as border-flowers." The improvement of so many flowers and the number of the varieties which have been raised is all the more striking when we hear that the

<sup>83</sup> 'Journal of Horticulture,' 1862, p. 394.

<sup>84</sup> 'Gardener's Chronicle,' 1857, p. 85.

<sup>85</sup> See Mr. Wildman's address to the

Floricult. Soc., in 'Gardener's Chronicle,' 1843, p. 86.

<sup>86</sup> 'Journal of Horticulture,' Oct. 24th, 1865, p. 239.

earliest known flower-garden in Europe, namely at Padua, dates only from the year 1545.<sup>87</sup>

*Effects of Selection, as shown by the parts most valued by man presenting the greatest amount of difference.*—The power of long-continued selection, whether methodical or unconscious, or both combined, is well shown in a general way, namely, by the comparison of the differences between the varieties of distinct species, which are valued for different parts, such as for the leaves, or stems, or tubers, the seed, or fruit, or flowers. Whatever part man values most, that part will be found to present the greatest amount of difference. With trees cultivated for their fruit, Sageret remarks that the fruit is larger than in the parent-species, whilst with those cultivated for the seed, as with nuts, walnuts, almonds, chestnuts, &c., it is the seed itself which is larger; and he accounts for this fact by the fruit in the one case, and by the seed in the other, having been carefully attended to and selected during many ages. Galesio has made the same observation. Godron insists on the diversity of the tuber in the potato, of the bulb in the onion, and of the fruit in the melon; and on the close similarity of the other parts in these same plants.<sup>88</sup>

In order to judge how far my own impression on this subject was correct, I cultivated numerous varieties of the same species close to one another. The comparison of the amount of difference between widely different organs is necessarily vague; I will therefore give the results in only a few cases. We have previously seen in the ninth chapter how greatly the varieties of the cabbage differ in their foliage and stems, which are the selected parts, and how closely they resemble one another in their flowers, capsules, and seeds. In seven varieties of the radish, the roots differed greatly in colour and shape, but no difference whatever could be detected in their foliage, flowers, or seeds. Now what a contrast is

<sup>87</sup> Prescott's 'Hist. of Mexico,' vol. ii. p. 61.

<sup>88</sup> Sageret, 'Pomologie Physiologique,' 1830, p. 47; Galesio, 'Teoria della Riproduzione,' 1816, p. 88; Godron, 'De l'Espèce,' 1859, tom. ii. pp. 63, 67, 70. In my tenth and

eleventh chapters I have given details on the potato; and I can confirm similar remarks with respect to the onion. I have also shown how far Naudin concurs in regard to the varieties of the melon.

presented, if we compare the flowers of the varieties of these two plants with those of any species cultivated in our flower-gardens for ornament; or if we compare their seeds with those of the varieties of maize, peas, beans, &c., which are valued and cultivated for their seeds. In the ninth chapter it was shown that the varieties of the pea differ but little except in the tallness of the plant, moderately in the shape of the pod, and greatly in the pea itself, and these are all selected points. The varieties, however, of the *Pois sans parchemin* differ much more in their pods, and these are eaten and valued. I cultivated twelve varieties of the common bean; one alone, the Dwarf Fan, differed considerably in general appearance; two differed in the colour of their flowers, one being an albino, and the other being wholly instead of partially purple; several differed considerably in the shape and size of the pod, but far more in the bean itself, and this is the valued and selected part. Toker's bean, for instance, is twice-and-a-half as long and broad as the horse-bean, and is much thinner and of a different shape.

The varieties of the gooseberry, as formerly described, differ much in their fruit, but hardly perceptibly in their flowers or organs of vegetation. With the plum, the differences likewise appear to be greater in the fruit than in the flowers or leaves. On the other hand, the seed of the strawberry, which corresponds with the fruit of the plum, differs hardly at all; whilst every one knows how greatly the fruit—that is, the enlarged receptacle—differs in several varieties. In apples, pears, and peaches the flowers and leaves differ considerably, but not, as far as I can judge, in proportion with the fruit. The Chinese double-flowering peaches, on the other hand, show that varieties of this tree have been formed, which differ more in flower than in fruit. If, as is highly probable, the peach is the modified descent of the almond, a surprising amount of change has been effected in the same species, in the fleshy covering of the former and in the kernels of the latter.

When parts stand in close relationship to each other, such as the seed and the fleshy covering of the fruit (whatever its homological nature may be), changes in the one are

usually accompanied by modifications in the other, though not necessarily to the same degree. With the plum-tree, for instance, some varieties produce plums which are nearly alike, but include stones extremely dissimilar in shape; whilst conversely other varieties produce dissimilar fruit with barely distinguishable stones; and generally the stones, though they have never been subjected to selection, differ greatly in the several varieties of the plum. In other cases organs which are not manifestly related, through some unknown bond vary together, and are consequently liable, without any intention on man's part, to be simultaneously acted on by selection. Thus the varieties of the stock (*Matthiola*) have been selected solely for the beauty of their flowers, but the seeds differ greatly in colour and somewhat in size. Varieties of the lettuce have been selected solely on account of their leaves, yet produce seeds which likewise differ in colour. Generally, through the law of correlation, when a variety differs greatly from its fellow-varieties in any one character, it differs to a certain extent in several other characters. I observed this fact when I cultivated together many varieties of the same species, for I used first to make a list of the varieties which differed most from each other in their foliage and manner of growth, afterwards of those that differed most in their flowers, then in their seed-capsules, and lastly in their mature seed; and I found that the same names generally occurred in two, three, or four of the successive lists. Nevertheless the greatest amount of difference between the varieties was always exhibited, as far as I could judge, by that part or organ for which the plant was cultivated.

When we bear in mind that each plant was at first cultivated because useful to man, and that its variation was a subsequent, often a long subsequent, event, we cannot explain the greater amount of diversity in the valuable parts by supposing that species endowed with an especial tendency to vary in any particular manner were originally chosen. We must attribute the result to the variations in these parts having been successively preserved, and thus continually augmented; whilst other variations, excepting such as inevitably appeared through correlation, were neglected and

lost. We may therefore infer that most plants might be made, through long-continued selection, to yield races as different from one another in any character as they now are in those parts for which they are valued and cultivated.

With animals we see nothing of the same kind; but a sufficient number of species have not been domesticated for a fair comparison. Sheep are valued for their wool, and the wool differs much more in the several races than the hair in cattle. Neither sheep, goats, European cattle, nor pigs are valued for their fleetness or strength; and we do not possess breeds differing in these respects like the race-horse and dray-horse. But fleetness and strength are valued in camels and dogs; and we have with the former the swift dromedary and heavy camel; with the latter the greyhound and mastiff. But dogs are valued even in a higher degree for their mental qualities and senses; and every one knows how greatly the races differ in these respects. On the other hand, where the dog is kept solely to serve for food, as in the Polynesian islands and China, it is described as an extremely stupid animal.<sup>89</sup> Blumenbach remarks that "many dogs, such as the badger-dog, have a build so marked and so appropriate for particular purposes, that I should find it very difficult to persuade myself that this astonishing figure was an accidental consequence of degeneration."<sup>90</sup> Had Blumenbach reflected on the great principle of selection, he would not have used the term degeneration, and he would not have been astonished that dogs and other animals should become excellently adapted for the service of man.

On the whole we may conclude that whatever part or character is most valued—whether the leaves, stems, tubers, bulbs, flowers, fruit, or seed of plants, or the size, strength, fleetness, hairy covering, or intellect of animals—that character will almost invariably be found to present the greatest amount of difference both in kind and degree. And this result may be safely attributed to man having preserved during a long course of generations the variations which were useful to him, and neglected the others.

<sup>89</sup> Godron, 'De l'Espèce,' tom. ii. p. 27.

<sup>90</sup> 'The Anthropological Treatises of Blumenbach,' 1856, p. 292.

I will conclude this chapter by some remarks on an important subject. With animals such as the giraffe, of which the whole structure is admirably co-ordinated for certain purposes, it has been supposed that all the parts must have been simultaneously modified; and it has been argued that, on the principle of natural selection, this is scarcely possible. But in thus arguing, it has been tacitly assumed that the variations must have been abrupt and great. No doubt, if the neck of a ruminant were suddenly to become greatly elongated, the fore limbs and back would have to be simultaneously strengthened and modified; but it cannot be denied that an animal might have its neck, or head, or tongue, or fore-limbs elongated a very little without any corresponding modification in other parts of the body; and animals thus slightly modified would, during a dearth, have a slight advantage, and be enabled to browse on higher twigs, and thus survive. A few mouthfuls more or less every day would make all the difference between life and death. By the repetition of the same process, and by the occasional intercrossing of the survivors, there would be some progress, slow and fluctuating though it would be, towards the admirably co-ordinated structure of the giraffe. If the short-faced tumbler-pigeon, with its small conical beak, globular head, rounded body, short wings, and small feet—characters which appear all in harmony—had been a natural species, its whole structure would have been viewed as well fitted for its life; but in this case we know that inexperienced breeders are urged to attend to point after point, and not to attempt improving the whole structure at the same time. Look at the greyhound, that perfect image of grace, symmetry, and vigour; no natural species can boast of a more admirably co-ordinated structure, with its tapering head, slim body, deep chest, tucked-up abdomen, rat-like tail, and long muscular limbs, all adapted for extreme fleetness, and for running down weak prey. Now, from what we see of the variability of animals, and from what we know of the method which different men follow in improving their stock—some chiefly attending to one point, others to another point, others again correcting defects by crosses, and so forth—we may feel assured that if we

could see the long line of ancestors of a first-rate greyhound up to its wild wolf-like progenitor, we should behold an infinite number of the finest gradations, sometimes in one character and sometimes in another, but all leading towards our present perfect type. By small and doubtful steps such as these, nature, as we may confidently believe, has progressed, on her grand march of improvement and development.

A similar line of reasoning is as applicable to separate organs as to the whole organisation. A writer<sup>91</sup> has recently maintained that "it is probably no exaggeration to suppose that in order to improve such an organ as the eye at all, it must be improved in ten different ways at once. And the improbability of any complex organ being produced and brought to perfection in any such way is an improbability of the same kind and degree as that of producing a poem or a mathematical demonstration by throwing letters at random on a table." If the eye were abruptly and greatly modified, no doubt many parts would have to be simultaneously altered, in order that the organ should remain serviceable.

But is this the case with smaller changes? There are persons who can see distinctly only in a dull light, and this condition depends, I believe, on the abnormal sensitiveness of the retina, and is known to be inherited. Now if a bird, for instance, receive some great advantage from seeing well in the twilight, all the individuals with the most sensitive retina would succeed best and be the most likely to survive; and why should not all those which happened to have the eye itself a little larger, or the pupil capable of greater dilatation, be likewise preserved, whether or not these modifications were strictly simultaneous? These individuals would subsequently intercross and blend their respective advantages. By such slight successive changes, the eye of a diurnal bird would be brought into the condition of that of an owl, which

<sup>91</sup> Mr. J. J. Murphy, in his opening address to the Belfast Nat. Hist. Soc., as given in the 'Belfast Northern Whig,' Nov. 19, 1866. Mr. Murphy here follows the line of argument against my views previously and more

cautiously given by the Rev. C. Pritchard, Pres. Royal Astronomical Soc., in his sermon (Appendix, p. 33) preached before the British Association at Nottingham, 1866.

has often been advanced as an excellent instance of adaptation. Short-sight, which is often inherited, permits a person to see distinctly a minute object at so near a distance that it would be indistinct to ordinary eyes; and here we have a capacity which might be serviceable under certain conditions, abruptly gained. The Fuegians on board the *Beagle* could certainly see distant objects more distinctly than our sailors with all their long practice; I do not know whether this depends upon sensitiveness or on the power of adjustment in the focus; but this capacity for distant vision might, it is probable, be slightly augmented by successive modifications of either kind. Amphibious animals which are enabled to see both in the water and in the air, require and possess, as M. Plateau has shown,<sup>92</sup> eyes constructed on the following plan: "the cornea is always flat, or at least much flattened" "in the front of the crystalline and over a space equal to the diameter of that lens, whilst the lateral portions may be much curved." The crystalline is very nearly a sphere, and the humours have nearly the same density as water. Now as a terrestrial animal became more and more aquatic in its habits, very slight changes, first in the curvature of the cornea or crystalline, and then in the density of the humours, or conversely, might successively occur, and would be advantageous to the animal whilst under water, without serious detriment to its power of vision in the air. It is of course impossible to conjecture by what steps the fundamental structure of the eye in the Vertebrata was originally acquired, for we know nothing about this organ in the first progenitors of the class. With respect to the lowest animals in the scale, the transitional states through which the eye at first probably passed, can by the aid of analogy be indicated, as I have attempted to show in my 'Origin of Species.'<sup>93</sup>

<sup>92</sup> On the Vision of Fishes and Amphibia, translated in 'Annals and Mag. of Nat. Hist.,' vol. xviii., 1866,

p. 469.

<sup>93</sup> Sixth edition, 1872, p. 144.