REVIEW.

DARWIN ON THE VARIATION OF ANIMALS.*

(FIRST NOTICE.)

This is the first of the series of great works which have been promised to us by Mr. Darwin in support of his famous theory of the origin of species by natural selection. It contains, as one of the bases of Mr. Darwin's hypothesis, an immense body of facts relating to the variation of animals and plants in a state of domestication. The whole of the first volume and the greater part of the second are taken up with a minute detail of facts, carefully gathered from the best authorities, as well as from the author's own experience and observation. A summary of these, together with a general re-statement of the argument, is given in the concluding chapters, which contain Mr. Darwin's final position. As to this, whatever may be the reader's opinion, it is impossible not to admire the wonderful spirit of candour, of truthfulness, and of pure philosophy in which Mr. Darwin writes. The *Origin of Species* may or may not have occurred as Mr. Darwin supposes. The principle of evolution and the theory of selection may be right or wrong; but as to the value of the hypothesis as a help to inquiry, and a means of truth, there can be no doubt whatever. As the author himself says:—

"In scientific investigations it is permitted to invent any hypothesis, and if it explains various large and independent classes of facts, it rises to the rank of a well-grounded theory. The undulations of the ether, and even its existence, are hypothetical, yet every one now admits the undulating theory of light. The principle of natural selection may be looked at as a mere hypothesis, but rendered, in some degree, probable by what we know positively of the variability of organic beings in a state of nature,—by what we positively know of the struggle for existence, and the consequent, almost inevitable, preservation of favourable variations,—and from the analogical formation of domestic races. Now, this hypothesis may be tested; and this seems to me the only fair and legitimate manner of considering the whole question, by trying whether it explains several large and independent classes of facts—such as the geological succession of organic beings, their distribution in past and present times, and their natural affinities and homologues. If the principle of natural selection does explain these and other large bodies of facts, it ought to be received. On the ordinary view of each species having been independently created, we gain no scientific explanation of any one of these facts. We can only say that it has so pleased the Creator to command that the past and present inhabitants of the world should appear in a certain order and in certain areas; that He has impressed on them the most extraordinary resemblances, and has classed them in groups subordinate to groups. But by such statements we gain no new knowledge; we do not connect together facts and laws; we explain nothing."

Surely this is the spirit of true science as well as of the highest reverence. It seems hard to believe that any inquiry such as that which Mr. Darwin has instituted should have come to be scoffed at as "infidel" and "godless." Who can administer more to the glory of the Creator than he who teaches us of the infinite ways by which creatures are bound together, and who endeavours to explain the process of their gradual evolution? And is the glory of the Maker lessened by showing that the work was not done without law and without purpose, but that it was fitted to its use and its object? Man, who, in the noble Baconian phrase, is "the minister and interpreter of nature," can justify his own gifts no more excellently than by endeavouring to solve the mystery of existence. He may not succeed, but what then? Is he not to try and succeed, if he cannot know everything, at least to keep, as Goethe says, "within the limits of the knowable?" It is greatly to Mr. Darwin's credit that he has refrained, even by a single word, from noticing any of the foolish and malignant attacks of some of his would-be orthodox critics. He shows in this, as in the rest, that he is a better Christian, as well as a better philosopher, than those who have assailed his science and denied his religion. He pursues his own way steadily to the discovery of the truth, and is not diverted in the least by any taunts or gibes from the straight path of his purpose. He had to prove, in support of his theory, that what were called "species" had no natural fixed limits—that they were capable of variation, and did vary—that the modifications caused in the animal in the course of the struggle for existence, were sufficient to account for many distinctions which were regarded as generic—that these modifications were capable of being transmitted, quite as certainly as what are supposed to be specific characters, from one generation to another. Varieties, according to Mr. Darwin's own phrase, are but "incipient species." That which is the accident or the freak of to-day may be reproduced and fixed in successive stages until it becomes a permanent variety. All nature is subject to these variations. No two beings, or germs of beings, are equally alike. The differences may be very slight, and almost imperceptible, but they are sufficient, especially under selection, to produce yet greater differences. The cumulative result of these variations is the production of a distinct and separate type of being, which is quite as much to be distinguished from any of the acknowledged species as one species is from another. Indeed, as Professor Huxley, in his notice of Mr. Darwin's book in the *Pall Mall Gazette* (February 15), very pertinently observes, that there is no such thing in nature as a "species." It is but an abstract name, given by scientific men, to signify some particular group of animals having properties in common. Nature does not work by species, but by individuals. Neither a species nor a genus has

Nature does not work by species, but by individuals. Neither a species nor a genus has any real existence. "Both are terms," argues Professor Huxley "to express resemblances; nothing more. In certain fundamental characters all animals have a community, and that is why they are grouped under the general term animal. But while all animals have thus certain resemblances, they have also certain differences. No two objects in in nature are absolutely identical; some differences necessarily exist. These may be few and slight, or many and important. When they are few and slight, we designate them as varieties; when they reach a certain degree of importance, we designate them as specific; when they are still greater, we designate them as generic; and so on." There is no objective reality called "species," any more than there is an objective reality called "animal." To believe otherwise is to revive a superstition which, though favoured by Plato and cherished by the schoolmen, was finally and effectively laid to rest by Bishop Berkeley.

Those who have been led to suppose, through certain orthodox interpreters of the Darwinian theory, that Mr. Darwin is the "shallow infidel" who lives for the hideous ambition of making out that man is descended from monkey, will be a good deal surprised, if they ever get over their dread of the book, to find how different the Darwin of fact is from the Darwin of pious fiction. It is impossible to conceive of any work written with a purer and holier purpose, in the highest spirit of science, than the book which Mr. Darwin has now given us. It is a perfect storehouse of facts, collected together with wonderful industry and patience, in illustration of what is surely in itself one of the most wonderful of the phenomena of creation—the tendency of created things to vary under the power of man. Whatever we may think of the author's argument, or however we may demur to his conclusions, it is impossible not to admire the calm and honest spirit in which he has set about to build up that which is certainly the most

* The Variation of Animals and Plants under Domestication. By Charles Darwin, M.A., F.R.S., &c., author of the "Origin of Species." 2 vols. 8vo. London: John Murray. 1868.

daring and brilliant theory of animal development which any philosopher has yet propounded. We can only find space to give but an imperfect idea of the scope and nature of Mr. Darwin's present work, the chief value of which is in the extraordinary accumulation of facts relating to the life of animals and plants under the various conditions of domestication. To those who have not read, or who have not borne in mind, what our author has previously written about the origin of the species, it may be necessary to give, in Mr. Darwin's own words, a succinct statement of the design of his new work:—

"From a remote period in all parts of the world, man has subjected many animals and plants to domestication or culture. Man has no power of altering the absolute conditions of life; he cannot change the climate of any country; he adds no new element to the soil; but he can remove an animal or plant from one climate or soil to another, and give it food on which it did not subsist in its natural state. It is an error to speak of man 'tampering with nature,' and causing variability. If organic beings had not possessed an inherent tendency to vary, man could have done nothing. He unintentionally exposes his animals and plants to various conditions of life, and variability supervenes, which he cannot even prevent or check. Consider the simple case of a plant which has been cultivated during a long time in its native country, and which consequently has not been subjected to any change of climate. It has been protected to a certain extent from the competing roots of plants of other kinds; it has generally been grown in manured soil, but probably not richer than that of many an alluvial flat; and, lastly, it has been exposed to changes in its conditions, being grown sometimes in one district and sometimes in another, in different soils. Under such circumstances, scarcely a plant can be named, though cultivated in the rudest manner, which has not given birth to several varieties. It can hardly be maintained that during the many changes which this earth has undergone, and during the natural migrations of plants from one land or island to another, tenanted by different species, that such plants will not often have been subjected to changes in their conditions analogous to those which almost inevitably cause cultivated plants to vary. No doubt man selects varying individuals, sows their seeds, and again selects their varying offspring. But the initial variation on which man works, and without which he can do nothing, is caused by slight changes in the conditions of life, which must often have occurred under nature. Man, therefore, may be said to have been trying an experiment on a gigantic scale; and it is an experiment which nature, during the long lapse of time, has incessantly tried. Hence it follows that the principles of domestication are important for us. The main result is, that organic beings thus treated have varied largely, and the variations have been inherited. This has apparently been one chief cause of the belief long held by some few naturalists that species in a state of nature undergo change. . . . . Although man does not cause variability, and cannot even prevent it, he can select, preserve, and accumulate the variations given to him by the hand of nature in any way which he chooses; and thus he can certainly produce a great result. Selection may be followed either methodically and intentionally, or unconsciously and unintentionally. Man may select and preserve each successive variation, with the distinct intention of improving and altering a breed in accordance with a preconceived idea; and by thus adding up variations, often so slight as to be imperceptible by an uneducated eye, he has effected wonderful changes and improvements."

To carry out his design, and to lay the foundation of his theory, Mr. Darwin has collected a host of facts from all quarters relating to the changes which animals and

collected a host of facts from all quarters relating to the changes which animals and plants undergo under domestication. It is almost impossible, by quotation, to give any idea of the immense mass of material thus accumulated. Every kind of animal which has been subjected to man at any period of history is passed in review, to show how great have been the variations wrought in the process of selection. About dogs, for instance, Mr. Darwin endeavours to prove that all the varieties now known have been the result of an arbitrary and artificial mode of creation. The proof of this is in the fact that the earliest dogs of which we have any record were all of a similar kind, with little variation. So early as the Roman classical era, indeed, there were various breeds analogous to those now existing, such as hounds, house-dogs, lap-dogs, &c. A sculpture representing two greyhound puppies was found in the villa of Antoninus. Mastiffs are figured on some of the Assyrian monuments. In the Egyptian picture-writings, a hound with a long back, pointed head, and a short curly tail is frequently seen, as also a turn-spit closely resembling the existing variety. But there is no evidence that any of these dogs belonged to the identical sub-varieties which are at present cultivated. Considering that we have now distinct proofs, from the discovery of flint tools embedded in strata with the remains of extinct animals, that man must have occupied the earth for a much longer period than the commonly received space of 6,000 years. There has been ample time for a divergence of the breeds of dogs, supposing them to have been originally one. A social animal like the dog would naturally be one of the first which a savage would domesticate, as we know, from our modern experience, that savages do :—

"Long before the period of any historical record the dog was domesticated in Europe. In the Danish middens of the Neolithic or Newer Stone Period, bones of a canine animal are imbedded, and Steenstrup ingeniously argues that these belonged to a domestic dog, for a very large proportion of the bones of birds preserved in the refuse consists of long-bones, which it was found that dogs cannot devour. This ancient dog was succeeded in Denmark, during the Bronze period, by a larger kind, presenting certain differences; and this again, during the Iron period, by a still larger kind. In Switzerland, we hear from Professor Rütimeyer that, during the Neolithic period, a domesticated dog of middle size existed, which, in its skull, was about equally remote from the wolf and the jackal, and partook of the characters of our hounds and setters, or spaniels. Rütimeyer insists strongly on the constancy of forms during a very long period of time of this the most ancient known dog. During the Bronze period a larger dog appeared, and this closely resembled in its jaw a dog of the same age in Denmark."

The close affinity not only of the various breeds of dogs to one another, but also to other animals of the canine race, such as wolves, foxes, and jackals, tends to strengthen the belief in a common origin. Among the Esquimaux, wolves are sometimes used to improve the race of dogs, and the produce is fertile and domesticable. In North America, the black wolf-dog of the Indians differs in nothing from the wolves of the country, except in barking. But some wolves, bred in confinement, have been known to take to barking as naturally as dogs. The pariahs, or half-domestic dogs, which swarm in every village of the East, from Damascus to Bangkok, cross habitually with the jackal, and are often found in association with them. On the other hand, some domestic dogs on the coast of Guinea are dumb, like foxes. In Australia, the dingo is, to all intents and purposes, a dog. Dogs which have turned wild become exactly like foxes or wolves in character, and generally lose the power of barking. Some dogs on the Island of Juan de Nova, in the Indian Ocean, which had sprung from a few tame dogs which had been left on shore by accident, were found to congregate in vast packs, and to hunt sea-birds with as much address as foxes could display.

All these and numerous other facts quoted by Mr. Darwin go to show that the varieties of dog now existing were originally very much fewer—that they all probably sprung from the wild races—and that those wild races were themselves closely allied, and had, it is reason to believe, one common ancestor. That dogs have been varied in form, in colour, and in habits directly by human effort, is a fact within historical experience. Man has made the dog,

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in fact, obey his wants. For hunting by sight, the greyhound was developed out of some species presenting somewhat analogous properties. Reared for many generations for speed alone, they became perfect in that quality, but after a time, having begun to lose stoutness by over-fineness of breeding, they have been restored by crosses with dogs of stronger build. Lord Orford, it is well known, crossed his famous greyhounds, which were failing in courage, with a bull-dog, this breed being chosen from being deficient in the power of scent; "after the sixth or seventh generation," says Youatt, "there was not a vestige left of the form of the bull-dog, but his courage and his perseverance remained behind." A more remarkable instance still, familiar to all Australian colonists, is the kangaroo dog, which being required to have unusual strength, power of holding, and courage, united to speed, was produced by crossing up to the form which it now has. For water dogs, man would select a breed which could swim best in water, and thus the web-footed dog became developed. The bull-dog and the mastiff are evidently first cousins, the former being bred by a gradual reduction of the latter. Thus, setters,

first cousins, the former being bred by a gradual reduction of the latter. Thus, setters, spaniels, and retrievers are unquestionably akin. The case of the Newfoundland dog is a remarkable instance of what may be done by cultivation of the native breed. The Newfoundland of the English dog-fancier is unknown in Newfoundland itself, but his parent is to be found there in the smaller dog, with curly hair and web-foot, of the indigenous race :—

"These several cases," says Mr. Darwin, "of slow and gradual changes in our English dogs possess some interest ; for though the changes have generally, but not invariably, been caused by one or two crosses with a distinct breed, yet we may feel sure, from the well-known extreme variability of crossed breeds, that rigorous and long-continued selection must have been practised in order to improve them in a definite manner. As soon as any strain or family became slightly improved, or better adapted to altered circumstances, it would tend to supplant the older and less-improved strains. For instance, as soon as the old fox-hound was improved by a cross with the greyhound, or by simple selection, and assumed its present character—and the change was probably required by the increased fleetness of our hunters—it rapidly spread throughout the country, and is now everywhere nearly uniform. But the process of improvement is still going on, for every one tries to improve his strain by occasionally procuring dogs from the best kennels."

Of cats Mr. Darwin has less to say, seeing that, although they have varied considerably, it is next to impossible, through their nocturnal habits, to prevent indiscriminate crossing, and thus to keep up distinct varieties. But in islands apart from each other, and in countries completely separated, we meet with breeds more or less distinct. The cats in the Island of Man are tailless. The cat of Antigua is smaller, and has a more elongated head than the British. In Ceylon, the cat is also of small size, with very close hair. In Paraguay, the cats are low and lanky. In another part of South America it has lost the habit of miaouling at night. On the coast of Guinea, the cats are all black and wrinkled, with long bare legs. At Munbas, the cats are covered with bristles instead of hair. Throughout the Malayan archipelago the cats have short stumpy tails, with a knot at the end. At Tobolk they are red, and at the Cape have a red stripe down the back. Lastly, the cats of Angora, like all the other animals of the place, have beautiful long and soft fur. All these cats are fertile with each other, and are evidently members of one family.

We must reserve for another article that which perhaps will, to our readers, be the most interesting portion of Mr. Darwin's book, namely, the chapters relating to the breeding and the variations of the animals of the stockyard.

REVIEW.

DARWIN ON THE VARIATION OF ANIMALS.*

(SECOND NOTICE.)

Mr. Darwin's chapter on horses and asses is a mine of curious and minute information, some of which is of a kind which is probably novel to the breeder or the "horsey" man. He recounts the fact of the great variability of the equine races, as tending to illustrate and strengthen his theory of selection. Horses differ in size, shape, and character almost as much as any other domestic animal; and from the brewer's dray-horse to the Shetland pony, or the racer to the horse of the Pampas, there is a distance as wide as between any other living species of the genus *equus*. But Mr. Darwin has noted other variations still more remarkable, such as the tendency to a nineteenth rib, and eight permanent incisors instead of six in the jaw; the growth of a kind of wool instead of hair, as in the horses of Russia; and projections on the frontal bone, like the beginning of horns (observed by M. Azara, in the horses of Paraguay), which go to prove that there is a much wider field of variation in the horse-nature than is usually supposed to be possible, and that we could alter, by breed, even the anatomy of a horse, and develop, if we pleased, a kind of unicorn, if we needed to do so. But as horses are wanted for the two great purposes of riding and draught, they have been developed only in the direction of their fitness for those purposes. There is every probability that, although more than one original species of horse was tamed by man (several varieties having been found even in strata of the tertiary period), the existing breeds are all sprung from one species, of which no purely wild type now exists—the so-called wild-horses of South America and Tartary being, as most authors suppose, only escaped domestic animals. That the varieties such as we have now were produced by selection, aided by natural accidents, no one can doubt. Take the modern English racehorse himself—how different he is from either of his progenitors—the Arab or the old English horse! The ass, though less cultivated than the horse, shows in an equal degree the power of selection. In countries where he is not valued and used, as in India, he is a diminutive, puny creature, scarcely so big as a mastiff, while in Spain and Syria he grows to the height of sixteen hands, and is nearly as handsome, and much more valuable than the horse.

The pigs are traced to their origin with equal care and ingenuity. Two primitive species, the sus scrofa, and the sus Indica, are believed by our author to be the parents of all the pigs on earth—the type of the former being the common wild boar of Europe, and of the latter the Chinese pig. The chief difference between the two is in the form of the skull—the former having a long, bony head—the latter a short one. The cross between the two, and all the pig-crosses, are fertile *inter se*. No animal differs so much under domestication, and it is scarcely possible to believe, if one did not know it, that the old Irish pig, for instance, shaped like a greyhound, was own brother to the high-bred animal who wins the gold medal at the shows. One remarkable fact about pigs is, that the results of all cultivation, even of the most opposite kinds, produce, contrary to the usual rule, not diversity but uniformity. Selection, which makes other animals diverge, makes pigs converge. The large-headed, long-eared convex animals become short-headed, small-eared, and concave. This is partly accounted for by the pig being bred simply for one purpose, namely, for the greatest amount of flesh and fat. As to cattle, Mr. Darwin believes that all the varieties are the product of two original kinds, the humped and the non-humped. The former we know to have been domesticated, by the Egyptian monuments, as early as 2100 B.C. Of the non-humped there are reckoned in modern Europe upwards of fifty-five varieties, nineteen of which are peculiar to the British Islands. The so-called wild cattle of Chillingham-park are the sole living representatives of an extinct species (Bos Primigenius), which was domesticated by man in the Neolithic period. The cross between the humped and the ordinary cattle is quite fertile, as has been proved by many experiments. All cattle vary under cultivation greatly, as it is needless to say. While at one end we have the improved shorthorn, the lord of the ox kind, at the other we have the dwarf *niata* cattle of La Plata, who hold the same relation to the rest of the family as the pugs do to the dog race. In the *niata* bull, the forehead is very short and broad, with the nose turned upwards, and the lower jaw protruding. The upper lip is drawn back, the nostrils are seated high up, and the horns are monstrously large; in fact, according to the testimony of Professor Owen, there is scarcely a single bone of the *niata* which presents the same shape as the corresponding bone in the common ox. And yet there is no doubt whatever of their common origin. Of the wonders which have been wrought in our own days, by methodical selection, in altering the forms of cattle, we need scarcely speak. Taking advantage of slight natural variations, in themselves the result of accidental or unconscious selection, the breeder, having in his eye a model of an improved ox, goes to work by carefully choosing his animals from the specimens which come nearest to his ideal. The same process has produced the same results in the breeds of sheep. Climate is generally the original factor in the variation, and the selector gets the hint of what he desires from what nature

the hint of what he desires from what nature does—that is to say, he makes a new Lincolnshire, which shall be large in the carcase and long in the fleece, and fit for wet lands, out of the old Lincolnshire breed, which exhibited the tendencies to all these characteristics. Yet man may do much by care to combat the natural tendency to change and to fix the breed which he has improved. The pure merino can be preserved equally well in Queensland, on the borders of the tropic, in the marshes of Holland, and under the rigorous winters of Sweden. In the hands of Bakewell, Ellman, Webb, and others, the sheep, indeed, has been changed into precisely the animal which was required. The celebrated Manchamp merino was the result of one ram which, forty years ago, was found to have remarkable and singular qualities of wool. All these results are so near our own time that there can be no difficulty in believing in the efficacy of selection; yet, as Mr. Darwin observes, had some of these improved breeds originated a century or two ago, we should have found naturalists contending that they had been descended from some unknown aboriginal form.

We cannot follow Mr. Darwin through all his chapters, deeply interesting as they are for their store of carefully-gleaned facts relating to other domestic animals. There is a particular interest, however, attached to the chapter on pigeons, seeing that the facts in their case admit of very easy verification, and have indeed been tested by Mr. Darwin himself in his own experience. The varieties of pigeon are very great, yet we are able to follow their history with much greater closeness than that of any other breed of animals. According to the best authorities, there are no less than 150 different kinds of pigeon, all of which can be depended upon for breeding true, and nearly all of which have separate names. Yet there can be no doubt—especially to any one who reads this portion of Mr. Darwin's book—that these 150 pigeons have all sprung from one single stock—the rock pigeon, or Columba livia. After looking over the collection of the columbidæ in the British Museum, Mr. Darwin does not hesitate to say that "some domestic races of the rock-pigeon differ fully as much from each other in external characters as do the most distinct natural genera." "We may look in vain," he adds, "through the 288 known species for a beak so small and comical as that of the short-faced tumbler; for one so long and short as that of the barb; for one so long, straight, and narrow, with its enormous wattles, as that of the English carrier; for an expanded, up-raised tail, like that of the fantail; or for an œsophagus like that of the pouter." The experiments of Mr. Darwin, in corroboration of his theory, are very interesting. Although all domestic pigeons of pure breed, breed true if properly matched—that is, pouter with pouter, and carrier with carrier—Mr. Darwin informs us of the remarkable fact, that by crossing the various breeds you arrive at a form and colour different from either parent, and not known in the breed, but which are precisely the form and colour of the rock-pigeon. A repetition of the cross through several generations brings us, at each step, nearer and nearer to that one type—white, black, and almond colour gradually change into the primitive blue—the carrier loses his long beak, the pouter his pouch, the fantail his tail. The well-known broad black marks appear on the wings and on the tail-coverts, and, in fact, you arrive at length, by whatever road you take and through whatever breeds, at Columba livia, the primal domestic or domesticable pigeon.

In regard to fowls, Mr. Darwin is of belief that all the varieties have sprung from the wild type represented by Gallus bankiva, whose colours are borne by the well-known English black-red game-cocks—the purest, noblest, and the most fixed, as it is the most beautiful, of all our domestic races. The evidence on this point is not so clear as that with regard to pigeons, and apparently it is not quite satisfactory to Mr. Darwin himself. Although some of the breeds of the domestic fowl are of modern origin and can be easily traced—such as the Sebright bantam and Brahma-pootra—others date very far back, and the game-fowl, for one, is certainly much older than Mr. Darwin supposes. In the British Islands, the game-cock was known at least as early as the time of Julius Cæsar, and seeing that the sport for which he was bred is perhaps the most ancient of all sports of the kind, it is probable that this bird represents an animal which was made as it is for more than two thousand years—an ancestry more illustrious than can be boasted of by any other domestic animal. Mr. Darwin does not seem to be aware of the fact that the game-cock, to which he refers, is peculiar to the British Islands, and is unknown elsewhere except as the English fowl, and introduced from England. The game-cock of India and Malaya, as well as of the Phillippines and South America, is of widely different types, and does not in the least resemble his English namesake, except in his uses. There is strong reason, indeed, for believing that the game-fowl of the pure breed is sprung, not from Gallus bankiva, which is an inhabitant of tropical regions, but from some extinct wild congener which was once indigenous in Britain. The English game-cock, in the tropics, loses, like the English bulldog, his moral qualities, and degenerates both in body and in spirit. Even in Australia it has been found

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qualities, and degenerates both in body and in spirit. Even in Australia it has been found to be necessary to keep up the pure strain in its original vigour by constant importations. Another curious fact, which can be verified by the testimony of any careful breeder of game-fowls, is, that the cock of this race shows a natural antipathy to admit any hens of a meaner race into his domestic arrangements, and has been known even to expel by violence from his yard ladies who have come to him under the ungainly garb of Cochin-China, or the unwieldy form of Dorking.

That Mr. Darwin is perfectly justified, however, in quoting all the animals of what the French call *la basse cour* in favour of his theory, is undeniable. Fowls, geese, and ducks have varied in an extraordinary degree under domestication; and even gold-fish, after long cultivation, exhibit several differences of structure. No one will think that our author has dwelt too long upon this part of his subject, which takes up the whole of his first volume. In the second, Mr. Darwin devotes himself to an examination of the laws relating to inheritance, reversion, or Atansin, inter-breeding, crossing, and hybridism; concluding with a general *resumé* of the causes and effects of variation, and the formal restatement of his hypothesis of the origin of species. The whole of this volume is of great and singular value to our readers, especially to that portion of them who are interested in stock-keeping. For the sake of practical breeders, indeed, we trust that Mr. Darwin will be induced to re-issue this portion of his work in a cheaper and simpler form. We can hardly attempt to give any idea, by quotations, of the nature of Mr. Darwin's labours. For the benefit of Mr. Macknight, however, and with reference to a question of great importance in this colony, it may be necessary to give Mr. Darwin's final opinion upon "in and in breeding:—

"That evil directly follows from any degree of close inter-breeding has been denied by many persons, but rarely by any practical breeder, and never, as far as I know, by one who has largely bred animals which propagate their kind quickly. Many physiologists attribute the evil exclusively to the combination and consequent increase of morbid tendencies common to both parents; that this is an active source of mischief there can be no doubt. It is, unfortunately, too notorious, that men and various domestic animals endowed with a wretched constitution, and with a strong hereditary disposition to disease, if not actually ill, are fully capable of procreating their kind. Close inter-breeding, on the other hand, induces sterility, and this indicates something quite distinct from the augmentation of morbid tendencies common to both parents. The evidence convinces me that it is a great law of nature, that all organic beings profit from an occasional cross with individuals not closely related to them in blood, and that, on the other hand, long continued close inter-breeding is injurious."

Numerous facts and authorities are quoted in support of this opinion. Although by carefully selecting the best animals already highly improved by the process of selection, it is possible to carry on close inter-breeding, as in the New Leicester sheep and the short-horn cattle, for some time, yet the good effects of a cross between any two breeds is immediately shown by the greater size and vigour of the offspring. Many of the cattle which have won the chief prizes at our recent shows have been cross-bred, who, though useless for breeding from themselves, have still exhibited to most perfection the points which the breeders desire to attain. And although by careful selection the near inter-breeding of sheep, as Mr. Macknight has maintained, may be long continued without evil, still it is shown to be the practice of all the most celebrated breeders to cross distinct breeds to obtain animals for the butcher, which plainly shows that good is derived from the practice. Lord Somerville, a celebrated breeder, distinctly affirms that his half-breeds from Ryelands and Spanish sheep were larger animals than either the pure Ryelands or the pure Spanish. A few instances may certainly be quoted which seem to bear witness against the law, but there is no case, perhaps, of very close inter-breeding—that is, father and daughter, and brother and sister, indiscriminately—being continued for any length of time without both positive deterioration and sterility. Sir John Sebright declares that, by breeding in and in, he has seen strong spaniels became weak and diminutive lap-dogs. The Rev. W. D. Fox communicates to Mr. Darwin the case of a small lot of bloodhounds, long kept in the same family, which had become very bad breeders, and nearly all had a bony enlargement on the tail. A single cross with a distinct breed of bloodhounds restored their fertility, and drove away the tendency to caudal malformation. Mr. Scrope, a high authority, attributes the rarity and the degeneration of the Scotch deerhound chiefly to close inter-breeding. In one remarkable case, quoted from the *Journal of the Royal Agricultural Society*, it is shown that a breed of pigs, which had been bred in and in for seven generations, came at last to be nearly incapable of reproducing their kind. The few that were born were reared with difficulty—some were idiotic, without sense even to suck. Yet the external form of the animals remained unimpaired. The best sow in outward appearance produced during the whole seven generations of this incestuous race was one in the last stage of descent; but the litter consisted of her only. Being put to her own sire, she would not breed at all, but bred at the first trial to a stranger boar. Mr. Darwin's final conclusion, after a careful balancing of all the facts, is, that there is a great law of nature that "the crossing of animals and plants which are not closely related to each other is highly beneficial or even necessary, and that inter-breeding prolonged during many generations is highly injurious."

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In the chapter on selection, Mr. Darwin shows us how it is that different results are produced in animals originally resembling each other. These differences correspond to the variety of want in man. Each animal is developed for the quality for which he is most useful, and it is in this quality that the cultivated animal most varies. "Sheep are valued for their wool, and the wool differs much more in the several races than the hair in the 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 racehorse 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 even more valued for their mental qualities and senses; and every one knows how greatly the races differ in these respects." A curious fact is quoted, that the dogs in certain Pacific islands, who are grown chiefly for food, are extremely stupid. On the whole, whatever part of the animal, physical or mental, is most valued, that is the part which invariably presents the greatest amount of variation, both in kind and degree. And this result is clearly attributable to the fact that man has preserved, during a long course of generations, the variations which were useful to him, and neglected the others. Some curious correlative changes of form have been observed to accompany changes of breed. All original and wild species of animals have erect ears, yet there is scarcely one race which, after domestication, does not more or less drop its ears. The tail of no wild animal is curled, whereas the tails of pigs and some dogs are curly. The explanation may be that, in a wild state, the animal requires his ears erect for better protection against danger, and his tail straight, for more skilful steering. Other portions of the animal structure become modified, without intention, under domestication. For instance, the coats of the stomach and the intestines vary very much in the cultivated animal, although no breeder ever thinks of breeding for a thick or a thin stomach, or for long or short intestines. The cat of commerce has intestines one-third longer than the wild cat—the same of the pig. Other curious cases of correlation are given. The organs of sight and hearing have a great affinity to each other, and either to the skin. Certain affections of the eyes are invariably accompanied by peculiarities in the dental system, and also with the colour of the hair. What is called "colour-blindness" is frequently associated with an inability to distinguish sounds. White cats, as is well known, are always deaf, if they have blue eyes. If only one eye, however, is blue, the cat hears perfectly. Kittens, while they are blind, are also deaf. Men of a certain kind of skin are more liable to disease of the lungs than others. With horses, it has been found that those of a certain colour are not affected by things which are injurious to those of another colour. White terriers suffer most from distemper, white chickens from the gapes, white pigs by scorching in the sun, and white cattle from flies. Black pigs can eat certain poisonous roots which are fatal to pigs of a lighter complexion. The Hypericum crispum is death to white sheep alone—the black eat it and survive. All these are causes of variability in animals; and they are heightened, confirmed, and made more variable by cultivation. The changed conditions of life tend to modify the organisation:—

"Increased use adds to the size of a muscle, together with the blood-vessels, nerves, ligaments, the crests of bone to which these are attached, the whole bone, and other converted bones. Increased functional activity strengthens the sense organs. Increased and intermittant pressure thickens the epidermis; and a change in the nature of the food sometimes modifies the coats of the stomach, and increases or decreases the length of the intestines. Continued disuse, on the other hand, weakens and diminishes all parts of the organisation. Animals which during many generations have taken but little exercise have their lungs reduced in size, and as a consequence, the bony fabric of the chest, and the whole form of the body, become modified. With our anciently domesticated birds the wings have been little used, and they are slightly reduced; with their decrease, the crest of the sternum, the scapulæ, coracoids, and furcula have all been reduced."

The question whether the varieties produced under domestication are as distinct from each other as what are called natural varieties has been answered most fully by Mr. Darwin. With only one exception, domestic varieties resemble species in all respects. They are capable of transmitting their form and their qualities with perfect correctness to their offspring. They can be classified as strictly in general groups as are the natural species. They would remain permanent for ever, if the power which made them, that, is the hand of man, was to prevent them from crossing. Their tendency to vary is, indeed, greater than that of most natural species, but Mr. Darwin has explained this very satisfactorily. The domestic breeds are of man's selection, the wild breeds are of nature's. The former have been produced for certain particular purposes, and are intended to fit only those purposes. The "struggle for life" in their case is limited and controlled. Not so in nature, where a thousand accidental conditions may determine which are the fittest races to survive. It is indispensable that natural species should have varied also, although not in so great a degree as their descendant domesticated kinds; for how else could we have got at the domestic varieties? If pigeons all had the mouthparts

how else could we have got at the domestic varieties? If pigeons all had the œsophagus of precisely the same size, it would have been impossible for the fancier to have created the pouter. Had some dogs not been fleeter than others, whence could we have derived the greyhound? Had the primeval sheep all possessed wool of the same quality, how should we have arrived at the pure merino? It is only by taking advantage of the variations in nature that man has been able to produce, by slow degrees, the domestic varieties. In some cases the transition has been abrupt and sudden—the breeder having made use of monstrosities for his purpose. But in general the process has been slow and gradual. The improvement of the English game-cock has been the work, as we have seen, of more than two thousand years. The improved pig, through his two ancestors, can boast of a still longer descent. No man ever had in his mind the ideal of a Cochin China fowl when he took to breeding from two especially fluffy and long-legged specimens of the common bird. The perfect breeds, as we have them now, were the result of a continued series of selective efforts; nor is there any reason to believe that these domestic varieties have yet reached their limit. In some cases, as in the almond tumbler, it would be clearly impossible to carry the improvement any further, for if the beak were made shorter, the bird could not feed. The English racehorse has probably reached the extreme of his development, as to speed; but there is no reason why he should not be improved still further in stoutness and in soundness of constitution. Such as our improved breeds are, it is scarcely possible to deny that they exhibit as much difference among members of the same species as there is among natural specimens. If the bones of an improved Dorset pig had been dug up for the first time side by side with those of the wild boar, there is no naturalist but would have pronounced them to be two distinct species. If the skeleton of the pug-dog had to be classified in a museum by one who had never seen pugs in life, who can doubt that it would be made into a new species?

The development of these new species under domestication is the subject of Mr. Darwin's present work. The variation of animals in a state of nature is to be considered by our author in future volumes. His general design is to show us the process by which animal and vegetable life become gradually unfolded in the scheme of creation. Such a design must be admitted to be the noblest ever yet conceived by any natural philosopher; and whatever differences there may be as to the conclusions of Mr. Darwin, it is impossible to deny that he has gone to work in an earnest and reverent spirit—in the spirit of the highest philosophy; and that whether he has succeeded in satisfying the conditions of scientific inquiry or not, he has produced a book of the utmost possible value and interest, in its kind, not only to the lover and student of nature, but to the practical agriculturist and stock-breeder.