DARWIN CHARLES

THE VARIATION OF ANIMALS AND PLANTS UNDER DOMESTICATION — VOLUME 1

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Содержание

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INTRODUCTION

The object of this work is not to describe all the many races of animals which have been domesticated by man, and of the plants which have been cultivated by him; even if I possessed the requisite knowledge, so gigantic an undertaking would be here superfluous. It is my intention to give under the head of each species only such facts as I have been able to collect or observe, showing the amount and nature of the changes which animals and plants have undergone whilst under man's dominion, or which bear on the general principles of variation. In one case alone, namely in that of the domestic pigeon, I will describe fully all the chief races, their history, the amount and nature of their differences, and the probable steps by which they have been formed. I have selected this case, because, as we shall hereafter see, the materials are better than in any other; and one case fully described will in fact illustrate all others. But I

shall also describe domesticated rabbits, fowls, and ducks, with considerable fulness.

The subjects discussed in this volume are so connected that it is not a little difficult to decide how they can be best arranged. I have determined in the first part to give, under the heads of the various animals and plants, a large body of facts, some of which may at first appear but little related to our subject, and to devote the latter part to general discussions. Whenever I have found it necessary to give numerous details, in support of any proposition or conclusion, small type has been used. (Here shown with [].) The reader will, I think, find this plan a convenience, for, if he does not doubt the conclusion or care about the details, he can easily pass them over; yet I may be permitted to say that some of the discussions thus printed deserve attention, at least from the professed naturalist.

It may be useful to those who have read nothing about Natural Selection, if I here give a brief sketch of the whole subject and of its bearing on the origin of species. (Introduction/1. To any one who has attentively read my 'Origin of Species' this Introduction will be superfluous. As I stated in that work that I should soon publish the facts on which the conclusions given in it were founded, I here beg permission to remark that the great delay in publishing this first work has been caused by continued ill- health.) This is the more desirable, as it is impossible in the present work to avoid many allusions to questions which will be fully discussed in future volumes.

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 a man drops a piece of iron into sulphuric acid, it cannot be said strictly that he makes the sulphate of iron, he only allows their elective affinities to come into play. If organic beings had not possessed an inherent tendency to vary, man could have done nothing. (Introduction/2. M. Pouchet has recently ('Plurality of Races' English Translation 1864 page 83 etc.) insisted that variation under domestication throws no light on the natural modification of species. I cannot perceive the force of his arguments, or, to speak more accurately, of his assertions to this effect.) 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.

I shall in this volume treat, as fully as my materials permit, the whole subject of variation under domestication. We may thus hope to obtain some light, little though it be, on the causes of variability, — on the laws which govern it, such as

the direct action of climate and food, the effects of use and disuse, and of correlation of growth, — and on the amount of change to which domesticated organisms are liable. We shall learn something of the laws of inheritance, of the effects of crossing different breeds, and on that sterility which often supervenes when organic beings are removed from their natural conditions of life, and likewise when they are too closely interbred. During this investigation we shall see that the principle of Selection is highly important. 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 almost 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. It can, also, be clearly shown that man, without any intention or thought of improving the breed, by preserving in each successive generation the individuals which he prizes most, and by destroying the worthless individuals, slowly, though surely, induces great changes. As the will of man thus comes into play, we can understand how it is that domesticated breeds show adaptation to his wants and pleasures. We can further understand

how it is that domestic races of animals and cultivated races of plants often exhibit an abnormal character, as compared with natural species; for they have been modified not for their own benefit, but for that of man.

In another work I shall discuss, if time and health permit, the variability of organic beings in a state of nature; namely, the individual differences presented by animals and plants, and those slightly greater and generally inherited differences which are ranked by naturalists as varieties or geographical races. We shall see how difficult, or rather how impossible it often is, to distinguish between races and sub-species, as the less well-marked forms have sometimes been denominated; and again between sub-species and true species. I shall further attempt to show that it is the common and widely ranging, or, as they may be called, the dominant species, which most frequently vary; and that it is the large and flourishing genera which include the greatest number of varying species. Varieties, as we shall see, may justly be called incipient species.

But it may be urged, granting that organic beings in a state of nature present some varieties, — that their organisation is in some slight degree plastic; granting that many animals and plants have varied greatly under domestication, and that man by his power of selection has gone on accumulating such variations until he has made strongly marked and firmly inherited races; granting all this, how, it may be asked, have species arisen in a state of nature? The differences between natural varieties are slight;

whereas the differences are considerable between the species of the same genus, and great between the species of distinct genera. How do these lesser differences become augmented into the greater difference? How do varieties, or as I have called them incipient species, become converted into true and well-defined species? How has each new species been adapted to the surrounding physical conditions, and to the other forms of life on which it in any way depends? We see on every side of us innumerable adaptations and contrivances, which have justly excited the highest admiration of every observer. There is, for instance, a fly (Cecidomyia (Introduction/3. Leon Dufour in 'Annales des Science. Nat.' (3rd series, Zoolog.) tome 5 page 6.)) which deposits its eggs within the stamens of a Scrophularia, and secretes a poison which produces a gall, on which the larva feeds; but there is another insect (Misocampus) which deposits its eggs within the body of the larva within the gall, and is thus nourished by its living prey; so that here a hymenopterous insect depends on a dipterous insect, and this depends on its power of producing a monstrous growth in a particular organ of a particular plant. So it is, in a more or less plainly marked manner, in thousands and tens of thousands of cases, with the lowest as well as with the highest productions of nature.

This problem of the conversion of varieties into species, — that is, the augmentation of the slight differences characteristic of varieties into the greater differences characteristic of species and genera, including the admirable adaptations of each being

to its complex organic and inorganic conditions of life, — has been briefly treated in my 'Origin of Species.' It was there shown that all organic beings, without exception, tend to increase at so high a ratio, that no district, no station, not even the whole surface of the land or the whole ocean, would hold the progeny of a single pair after a certain number of generations. The inevitable result is an ever-recurrent Struggle for Existence. It has truly been said that all nature is at war; the strongest ultimately prevail, the weakest fail; and we well know that myriads of forms have disappeared from the face of the earth. If then organic beings in a state of nature vary even in a slight degree, owing to changes in the surrounding conditions, of which we have abundant geological evidence, or from any other cause; if, in the long course of ages, inheritable variations ever arise in any way advantageous to any being under its excessively complex and changing relations of life; and it would be a strange fact if beneficial variations did never arise, seeing how many have arisen which man has taken advantage of for his own profit or pleasure; if then these contingencies ever occur, and I do not see how the probability of their occurrence can be doubted, then the severe and often-recurrent struggle for existence will determine that those variations, however slight, which are favourable shall be preserved or selected, and those which are unfavourable shall be destroyed.

This preservation, during the battle for life, of varieties which possess any advantage in structure, constitution, or instinct, I

have called Natural Selection; and Mr. Herbert Spencer has well expressed the same idea by the Survival of the Fittest. The term "natural selection" is in some respects a bad one, as it seems to imply conscious choice; but this will be disregarded after a little familiarity. No one objects to chemists speaking of "elective affinity;" and certainly an acid has no more choice in combining with a base, than the conditions of life have in determining whether or not a new form be selected or preserved. The term is so far a good one as it brings into connection the production of domestic races by man's power of selection, and the natural preservation of varieties and species in a state of nature. For brevity sake I sometimes speak of natural selection as an intelligent power; — in the same way as astronomers speak of the attraction of gravity as ruling the movements of the planets, or as agriculturists speak of man making domestic races by his power of selection. In the one case, as in the other, selection does nothing without variability, and this depends in some manner on the action of the surrounding circumstances on the organism. I have, also, often personified the word Nature; for I have found it difficult to avoid this ambiguity; but I mean by nature only the aggregate action and product of many natural laws, — and by laws only the ascertained sequence of events.

It has been shown from many facts that the largest amount of life can be supported on each area, by great diversification or divergence in the structure and constitution of its inhabitants. We have, also, seen that the continued production of new

forms through natural selection, which implies that each new variety has some advantage over others, inevitably leads to the extermination of the older and less improved forms. These latter are almost necessarily intermediate in structure, as well as in descent, between the last-produced forms and their original parent-species. Now, if we suppose a species to produce two or more varieties, and these in the course of time to produce other varieties, the principal of good being derived from diversification of structure will generally lead to the preservation of the most divergent varieties; thus the lesser differences characteristic of varieties come to be augmented into the greater differences characteristic of species, and, by the extermination of the older intermediate forms, new species end by being distinctly defined objects. Thus, also, we shall see how it is that organic beings can be classed by what is called a natural method in distinct groups — species under genera, and genera under families.

As all the inhabitants of each country may be said, owing to their high rate of reproduction, to be striving to increase in numbers; as each form comes into competition with many other forms in the struggle for life, — for destroy any one and its place will be seized by others; as every part of the organisation occasionally varies in some slight degree, and as natural selection acts exclusively by the preservation of variations which are advantageous under the excessively complex conditions to which each being is exposed, no limit exists to the number, singularity, and perfection of the contrivances and co-adaptations which may

thus be produced. An animal or a plant may thus slowly become related in its structure and habits in the most intricate manner to many other animals and plants, and to the physical conditions of its home. Variations in the organisation will in some cases be aided by habit, or by the use and disuse of parts, and they will be governed by the direct action of the surrounding physical conditions and by correlation of growth.

On the principles here briefly sketched out, there is no innate or necessary tendency in each being to its own advancement in the scale of organisation. We are almost compelled to look at the specialisation or differentiation of parts or organs for different functions as the best or even sole standard of advancement; for by such division of labour each function of body and mind is better performed. And as natural selection acts exclusively through the preservation of profitable modifications of structure, and as the conditions of life in each area generally become more and more complex from the increasing number of different forms which inhabit it and from most of these forms acquiring a more and more perfect structure, we may confidently believe, that, on the whole, organisation advances. Nevertheless a very simple form fitted for very simple conditions of life might remain for indefinite ages unaltered or unimproved; for what would it profit an infusorial animalcule, for instance, or an intestinal worm, to become highly organised? Members of a high group might even become, and this apparently has often occurred, fitted for simpler conditions of life; and in this case natural

selection would tend to simplify or degrade the organisation, for complicated mechanism for simple actions would be useless or even disadvantageous.

The arguments opposed to the theory of Natural Selection, have been discussed in my 'Origin of Species,' as far as the size of that work permitted, under the following heads: the difficulty in understanding how very simple organs have been converted by small and graduated steps into highly perfect and complex organs; the marvellous facts of Instinct; the whole question of Hybridity; and, lastly, the absence in our known geological formations of innumerable links connecting all allied species. Although some of these difficulties are of great weight, we shall see that many of them are explicable on the theory of natural selection, and are otherwise inexplicable.

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 undulatory 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 positively know 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 mutual affinities and homologies. 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.

It was the consideration of such large groups of facts as these which first led me to take up the present subject. When I visited during the voyage of H.M.S. "Beagle," the Galapagos Archipelago, situated in the Pacific Ocean about 500 miles from South America, I found myself surrounded by peculiar species of birds, reptiles, and plants, existing nowhere else in the world. Yet they nearly all bore an American stamp. In the song of the mocking- thrush, in the harsh cry of the carrion-hawk, in the great candlestick-like opuntias, I clearly perceived the neighbourhood of America, though the islands were separated by

so many miles of ocean from the mainland, and differed much in their geological constitution and climate. Still more surprising was the fact that most of the inhabitants of each separate island in this small archipelago were specifically different, though most closely related to each other. The archipelago, with its innumerable craters and bare streams of lava, appeared to be of recent origin; and thus I fancied myself brought near to the very act of creation. I often asked myself how these many peculiar animals and plants had been produced: the simplest answer seemed to be that the inhabitants of the several islands had descended from each other, undergoing modification in the course of their descent; and that all the inhabitants of the archipelago were descended from those of the nearest land, namely America, whence colonists would naturally have been derived. But it long remained to me an inexplicable problem how the necessary degree of modification could have been effected, and it would have thus remained for ever, had I not studied domestic productions, and thus acquired a just idea of the power of Selection. As soon as I had fully realised this idea, I saw, on reading Malthus on Population, that Natural Selection was the inevitable result of the rapid increase of all organic beings; for I was prepared to appreciate the struggle for existence by having long studied the habits of animals.

Before visiting the Galapagos I had collected many animals whilst travelling from north to south on both sides of America, and everywhere, under conditions of life as different as it

is possible to conceive, American forms were met with — species replacing species of the same peculiar genera. Thus it was when the Cordilleras were ascended, or the thick tropical forests penetrated, or the fresh waters of America searched. Subsequently I visited other countries, which in all their conditions of life were incomparably more like parts of South America, than the different parts of that continent are to each other; yet in these countries, as in Australia or Southern Africa, the traveller cannot fail to be struck with the entire difference of their productions. Again the reflection was forced on me that community of descent from the early inhabitants of South America would alone explain the wide prevalence of American types throughout that immense area.

To exhume with one's own hands the bones of extinct and gigantic quadrupeds brings the whole question of the succession of species vividly before one's mind; and I found in South America great pieces of tesselated armour exactly like, but on a magnificent scale, that covering the pigmy armadillo; I had found great teeth like those of the living sloth, and bones like those of the cavy. An analogous succession of allied forms had been previously observed in Australia. Here then we see the prevalence, as if by descent, in time as in space, of the same types in the same areas; and in neither the case does the similarity of the conditions by any means seem sufficient to account for the similarity of the forms of life. It is notorious that the fossil remains of closely consecutive formations are

closely allied in structure, and we can at once understand the fact if they are closely allied by descent. The succession of the many distinct species of the same genus throughout the long series of geological formations seems to have been unbroken or continuous. New species come in gradually one by one. Ancient and extinct forms of life are often intermediate in character, like the words of a dead language with respect to its several offshoots or living tongues. All these facts seemed to me to point to descent with modification as the means of production of new species.

The innumerable past and present inhabitants of the world are connected together by the most singular and complex affinities, and can be classed in groups under groups, in the same manner as varieties can be classed under species and sub-varieties under varieties, but with much higher grades of difference. These complex affinities and the rules for classification, receive a rational explanation on the theory of descent, combined with the principle of natural selection, which entails divergence of character and the extinction of intermediate forms. How inexplicable is the similar pattern of the hand of a man, the foot of a dog, the wing of a bat, the flipper of a seal, on the doctrine of independent acts of creation! how simply explained on the principle of the natural selection of successive slight variations in the diverging descendants from a single progenitor! So it is with certain parts or organs in the same individual animal or plant, for instance, the jaws and legs of a crab, or the petals, stamens, and pistils of a flower. During the many changes to which in

the course of time organic beings have been subjected, certain organs or parts have occasionally become at first of little use and ultimately superfluous; and the retention of such parts in a rudimentary and useless condition is intelligible on the theory of descent. It can be shown that modifications of structure are generally inherited by the offspring at the same age at which each successive variation appeared in the parents; it can further be shown that variations do not commonly supervene at a very early period of embryonic growth, and on these two principles we can understand that most wonderful fact in the whole circuit of natural history, namely, the close similarity of the embryos within the same great class — for instance, those of mammals, birds, reptiles, and fish.

It is the consideration and explanation of such facts as these which has convinced me that the theory of descent with modification by means of natural selection is in the main true. These facts have as yet received no explanation on the theory of independent Creation; they cannot be grouped together under one point of view, but each has to be considered as an ultimate fact. As the first origin of life on this earth, as well as the continued life of each individual, is at present quite beyond the scope of science, I do not wish to lay much stress on the greater simplicity of the view of a few forms or of only one form having been originally created, instead of innumerable miraculous creations having been necessary at innumerable periods; though this more simple view accords well

with Maupertuis's philosophical axiom of "least action."

In considering how far the theory of natural selection may be extended, — that is, in determining from how many progenitors the inhabitants of the world have descended, — we may conclude that at least all the members of the same class have descended from a single ancestor. A number of organic beings are included in the same class, because they present, independently of their habits of life, the same fundamental type of structure, and because they graduate into each other. Moreover, members of the same class can in most cases be shown to be closely alike at an early embryonic age. These facts can be explained on the belief of their descent from a common form; therefore it may be safely admitted that all the members of the same class are descended from one progenitor. But as the members of quite distinct classes have something in common in structure and much in common in constitution, analogy would lead us one step further, and to infer as probable that all living creatures are descended from a single prototype.

I hope that the reader will pause before coming to any final and hostile conclusion on the theory of natural selection. The reader may consult my 'Origin of Species' for a general sketch of the whole subject; but in that work he has to take many statements on trust. In considering the theory of natural selection, he will assuredly meet with weighty difficulties, but these difficulties relate chiefly to subjects — such as the degree of perfection of the geological record, the means of distribution,

the possibility of transitions in organs, etc. — on which we are confessedly ignorant; nor do we know how ignorant we are. If we are much more ignorant than is generally supposed, most of these difficulties wholly disappear. Let the reader reflect on the difficulty of looking at whole classes of facts from a new point of view. Let him observe how slowly, but surely, the noble views of Lyell on the gradual changes now in progress on the earth's surface have been accepted as sufficient to account for all that we see in its past history. The present action of natural selection may seem more or less probable; but I believe in the truth of the theory, because it collects, under one point of view, and gives a rational explanation of, many apparently independent classes of facts. (Introduction/4. In treating the several subjects included in the present and my other works I have continually been led to ask for information from many zoologists, botanists, geologists, breeders of animals, and horticulturists, and I have invariably received from them the most generous assistance. Without such aid I could have effected little. I have repeatedly applied for information and specimens to foreigners, and to British merchants and officers of the Government residing in distant lands, and, with the rarest exceptions, I have received prompt, open-handed, and valuable assistance. I cannot express too strongly my obligations to the many persons who have assisted me, and who, I am convinced, would be equally willing to assist others in any scientific investigation.)

CHAPTER 1.I

DOMESTIC DOGS AND CATS.

ANCIENT VARIETIES OF THE DOG. RESEMBLANCE OF DOMESTIC DOGS IN VARIOUS COUNTRIES TO NATIVE CANINE SPECIES. ANIMALS NOT ACQUAINTED WITH MAN AT FIRST FEARLESS. DOGS RESEMBLING WOLVES AND JACKALS. HABIT OF BARKING ACQUIRED AND LOST. FERAL DOGS. TAN-COLOURED EYE-SPOTS. PERIOD OF GESTATION. OFFENSIVE ODOUR. FERTILITY OF THE RACES WHEN CROSSED. DIFFERENCES IN THE SEVERAL RACES IN PART DUE TO DESCENT FROM DISTINCT SPECIES. DIFFERENCES IN THE SKULL AND TEETH. DIFFERENCES IN THE BODY, IN CONSTITUTION. FEW IMPORTANT DIFFERENCES HAVE BEEN FIXED BY SELECTION. DIRECT ACTION OF CLIMATE. WATER-DOGS WITH PALMATED FEET. HISTORY OF THE CHANGES WHICH CERTAIN ENGLISH RACES OF THE DOG HAVE GRADUALLY UNDERGONE THROUGH SELECTION. EXTINCTION OF THE LESS IMPROVED SUB-BREEDS.

CATS, CROSSED WITH SEVERAL SPECIES. DIFFERENT BREEDS FOUND ONLY IN SEPARATED

COUNTRIES. DIRECT EFFECTS OF THE CONDITIONS OF LIFE. FERAL CATS. INDIVIDUAL VARIABILITY.

The first and chief point of interest in this chapter is, whether the numerous domesticated varieties of the dog have descended from a single wild species, or from several. Some authors believe that all have descended from the wolf, or from the jackal, or from an unknown and extinct species. Others again believe, and this of late has been the favourite tenet, that they have descended from several species, extinct and recent, more or less commingled together. We shall probably never be able to ascertain their origin with certainty. Palaeontology (1/1. Owen 'British Fossil Mammals' pages 123 to 133. Pictet 'Traite de Pal.' 1853 tome 1 page 202. De Blainville in his 'Osteographie, Canidae' page 142 has largely discussed the whole subject, and concludes that the extinct parent of all domesticated dogs came nearest to the wolf in organisation, and to the jackal in habits. See also Boyd Dawkins, 'Cave Hunting' 1874 page 131 etc. and his other publications. Jeitteles has discussed in great detail the character of the breeds of pre-historic dogs: 'Die vorgeschichtlichen Alterthumer der Stadt Olmutz' II. Theil, 1872 page 44 to end.) does not throw much light on the question, owing, on the one hand, to the close similarity of the skulls of extinct as well as living wolves and jackals, and owing, on the other hand, to the great dissimilarity of the skulls of the several breeds of the domestic dogs. It seems, however, that remains

have been found in the later tertiary deposits more like those of a large dog than of a wolf, which favours the belief of De Blainville that our dogs are the descendants of a single extinct species. On the other hand, some authors go so far as to assert that every chief domestic breed must have had its wild prototype. This latter view is extremely improbable: it allows nothing for variation; it passes over the almost monstrous character of some of the breeds; and it almost necessarily assumes that a large number of species have become extinct since man domesticated the dog; whereas we plainly see that wild members of the dog-family are extirpated by human agency with much difficulty; even so recently as 1710 the wolf existed in so small an island as Ireland.

The reasons which have led various authors to infer that our dogs have descended from more than one wild species are as follows. (1/2. Pallas, I believe, originated this doctrine in 'Act. Acad. St. Petersburgh' 1780 Part 2. Ehrenberg has advocated it, as may be seen in De Blainville's 'Osteographie' page 79. It has been carried to an extreme extent by Col. Hamilton Smith in the 'Naturalist Library' volumes 9 and 10. Mr. W.C. Martin adopts it in his excellent 'History of the Dog' 1845; as does Dr. Morton, as well as Nott and Gliddon, in the United States. Prof. Low, in his 'Domesticated Animals' 1845 page 666, comes to this same conclusion. No one has argued on this side with more clearness and force than the late James Wilson, of Edinburgh, in various papers read before the Highland Agricultural and Wernerian Societies. Isidore Geoffroy Saint-Hilaire ('Hist. Nat.

Gen.' 1860 tome 3 page 107), though he believes that most dogs have descended from the jackal, yet inclines to the belief that some are descended from the wolf. Prof. Gervais ('Hist. Nat. Mamm.' 1855 tome 2 page 69, referring to the view that all the domestic races are the modified descendants of a single species, after a long discussion, says, "Cette opinion est, suivant nous du moins, la moins probable.") Firstly, the great difference between the several breeds; but this will appear of comparatively little weight, after we shall have seen how great are the differences between the several races of various domesticated animals which certainly have descended from a single parent-form. Secondly, the more important fact, that, at the most anciently known historical periods, several breeds of the dog existed, very unlike each other, and closely resembling or identical with breeds still alive.

We will briefly run back through the historical records. The materials are remarkably deficient between the fourteenth century and the Roman classical period. (1/3. Berjeau 'The Varieties of the Dog; in old Sculptures and Pictures' 1863. 'Der Hund' von Dr. F.L. Walther, Giessen 1817 s. 48: this author seems carefully to have studied all classical works on the subject. See also Volz 'Beitrage zur Kulturgeschichte' Leipzig 1852 s. 115, 'Youatt on the Dog' 1845 page 6. A very full history is given by De Blainville in his 'Osteographie, Canidae.') At this latter period various breeds, namely hounds, house-dogs, lapdogs, etc, existed; but, as Dr. Walther has remarked, it is

impossible to recognise the greater number with any certainty. Youatt, however, gives a drawing of a beautiful sculpture of two greyhound puppies from the Villa of Antoninus. On an Assyrian monument, about 640 B.C.,an enormous mastiff (1/4. I have seen drawings of this dog from the tomb of the son of Esar Haddon, and clay models in the British Museum. Nott and Gliddon, in their 'Types of Mankind' 1854 page 393, give a copy of these drawings. This dog has been called a Thibetan mastiff, but Mr. H.A. Oldfield, who is familiar with the so-called Thibet mastiff, and has examined the drawings in the British Museum, informs me that he considers them different.) is figured; and according to Sir H. Rawlinson (as I was informed at the British Museum), similar dogs are still imported into this same country. I have looked through the magnificent works of Lepsius and Rosellini, and on the Egyptian monuments from the fourth to the twelfth dynasties (i.e. from about 3400 B.C. to 2100 B.C.) several varieties of the dog are represented; most of them are allied to greyhounds; at the later of these periods a dog resembling a hound is figured, with drooping ears, but with a longer back and more pointed head than in our hounds. There is, also, a turnspit, with short and crooked legs, closely resembling the existing variety; but this kind of monstrosity is so common with various animals, as with the ancon sheep, and even, according to Rengger, with jaguars in Paraguay, that it would be rash to look at the monumental animal as the parent of all our turnspits: Colonel Sykes (1/5. 'Proc. Zoolog. Soc.' July 12,

1831.) also has described an Indian pariah dog as presenting the same monstrous character. The most ancient dog represented on the Egyptian monuments is one of the most singular; it resembles a greyhound, but has long pointed ears and a short curled tail: a closely allied variety still exists in Northern Africa; for Mr. E. Vernon Harcourt (1/6. 'Sporting in Algeria' page 51.) states that the Arab boar-hound is "an eccentric hieroglyphic animal, such as Cheops once hunted with, somewhat resembling the rough Scotch deer-hound; their tails are curled tight round on their backs, and their ears stick out at right angles." With this most ancient variety a pariah-like dog coexisted.

We thus see that, at a period between four and five thousand years ago, various breeds, viz. pariah dogs, greyhounds, common hounds, mastiffs, house-dogs, lapdogs, and turnspits, existed, more or less closely resembling our present breeds. But there is not sufficient evidence that any of these ancient dogs belonged to the same identical sub-varieties with our present dogs. (1/7. Berjeau gives facsimiles of the Egyptian drawings. Mr. C.L. Martin in his 'History of the Dog' 1845 copies several figures from the Egyptian monuments, and speaks with much confidence with respect to their identity with still living dogs. Messrs. Nott and Gliddon ('Types of Mankind' 1854 page 388) give still more numerous figures. Mr. Gliddon asserts that a curl-tailed greyhound, like that represented on the most ancient monuments, is common in Borneo; but the Rajah, Sir J. Brooke, informs me that no such dog exists there.) As long as man was

believed to have existed on this earth only about 6000 years, this fact of the great diversity of the breeds at so early a period was an argument of much weight that they had proceeded from several wild sources, for there would not have been sufficient time for their divergence and modification. But now that we know, from the discovery of flint tools embedded with the remains of extinct animals in districts which have since undergone great geographical changes, that man has existed for an incomparably longer period, and bearing in mind that the most barbarous nations possess domestic dogs, the argument from insufficient time falls away greatly in value.

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 embedded, 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 on trial dogs cannot devour. (1/8. These, and the following facts on the Danish remains, are taken from M. Morlot's most interesting memoir in 'Soc. Vaudoise des Sc. Nat.' tome 6 1860 pages 281, 299, 320.) 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 Prof. Rutimeyer (1/9. 'Die Fauna der Pfahlbauten' 1861 s. 117, 162.), that during the Neolithic period a domesticated dog of middle

size existed, which in its skull was about equally remote from the wolf and jackal, and partook of the characters of our hounds and setters or spaniels (Jagdhund und Wachtelhund). Rutimeyer insists strongly on the constancy of form 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. Remains of two notably distinct varieties of the dog were found by Schmerling in a cave (1/10. De Blainville 'Osteographie, Canidae.'); but their age cannot be positively determined.

The existence of a single race, remarkably constant in form during the whole Neolithic period, is an interesting fact in contrast with what we see of the changes which the races underwent during the period of the successive Egyptian monuments, and in contrast with our existing dogs. The character of this animal during the Neolithic period, as given by Rutimeyer, supports De Blainville's view that our varieties have descended from an unknown and extinct form. But we should not forget that we know nothing with respect to the antiquity of man in the warmer parts of the world. The succession of the different kinds of dogs in Switzerland and Denmark is thought to be due to the immigration of conquering tribes bringing with them their dogs; and this view accords with the belief that different wild canine animals were domesticated in different regions. Independently of the immigration of new races of man, we know from the wide-spread presence of bronze,

composed of an alloy of tin, how much commerce there must have been throughout Europe at an extremely remote period, and dogs would then probably have been bartered. At the present time, amongst the savages of the interior of Guiana, the Taruma Indians are considered the best trainers of dogs, and possess a large breed which they barter at a high price with other tribes. (1/11. Sir R. Schomburgk has given me information on this head. See also 'Journal of R. Geographical Soc.' volume 13 1843 page 65.)

The main argument in favour of the several breeds of the dog being the descendants of distinct wild stocks, is their resemblance in various countries to distinct species still existing there. It must, however, be admitted that the comparison between the wild and domesticated animal has been made but in few cases with sufficient exactness. Before entering on details, it will be well to show that there is no a priori difficulty in the belief that several canine species have been domesticated. Members of the dog family inhabit nearly the whole world; and several species agree pretty closely in habits and structure with our several domesticated dogs. Mr. Galton has shown (1/12. 'Domestication of Animals' Ethnological Soc. December 22, 1863.) how fond savages are of keeping and taming animals of all kinds. Social animals are the most easily subjugated by man, and several species of Canidae hunt in packs. It deserves notice, as bearing on other animals as well as on the dog, that at an extremely ancient period, when man first entered any country, the animals

living there would have felt no instinctive or inherited fear of him, and would consequently have been tamed far more easily than at present. For instance, when the Falkland Islands were first visited by man, the large wolf-like dog (Canis antarcticus) fearlessly came to meet Byron's sailors, who, mistaking this ignorant curiosity for ferocity, ran into the water to avoid them: even recently a man, by holding a piece of meat in one hand and a knife in the other, could sometimes stick them at night. On a island in the Sea of Aral, when first discovered by Butakoff, the saigak antelopes, which are "generally very timid and watchful, did not fly from us, but on the contrary looked at us with a sort of curiosity." So, again, on the shores of the Mauritius, the manatee was not at first in the least afraid of man, and thus it has been in several quarters of the world with seals and the morse. I have elsewhere shown (1/13. 'Journal of Researches' etc. 1845 page 393. With respect to Canis antarcticus, see page 193. For the case of the antelope, see 'Journal Royal Geographical Soc.' volume 23 page 94.) how slowly the native birds of several islands have acquired and inherited a salutary dread of man: at the Galapagos Archipelago I pushed with the muzzle of my gun hawks from a branch, and held out a pitcher of water for other birds to alight on and drink. Quadrupeds and birds which have seldom been disturbed by man, dread him no more than do our English birds, the cows, or horses grazing in the fields.

It is a more important consideration that several canine species evince (as will be shown in a future chapter) no strong

repugnance or inability to breed under confinement; and the incapacity to breed under confinement is one of the commonest bars to domestication. Lastly, savages set the highest value, as we shall see in the chapter on Selection, on dogs: even half- tamed animals are highly useful to them: the Indians of North America cross their half-wild dogs with wolves, and thus render them even wilder than before, but bolder: the savages of Guiana catch and partially tame and use the whelps of two wild species of Canis, as do the savages of Australia those of the wild Dingo. Mr. Philip King informs me that he once trained a wild Dingo puppy to drive cattle, and found it very useful. From these several considerations we see that there is no difficulty in believing that man might have domesticated various canine species in different countries. It would indeed have been a strange fact if one species alone had been domesticated throughout the world.

We will now enter into details. The accurate and sagacious Richardson says, "The resemblance between the Northern American wolves (Canis lupus, var. occidentalis) and the domestic dogs of the Indians is so great that the size and strength of the wolf seems to be the only difference. I have more than once mistaken a band of wolves for the dogs of a party of Indians; and the howl of the animals of both species is prolonged so exactly in the same key that even the practised ear of the Indian fails at times to discriminate them.' He adds that the more northern Esquimaux dogs are not only extremely like the grey wolves of the Arctic circle in form and colour, but also nearly equal

them in size. Dr. Kane has often seen in his teams of sledge-dogs the oblique eye (a character on which some naturalists lay great stress), the drooping tail, and scared look of the wolf. In disposition the Esquimaux dogs differ little from wolves, and, according to Dr. Hayes, they are capable of no attachment to man, and are so savage that when hungry they will attack even their masters. According to Kane they readily become feral. Their affinity is so close with wolves that they frequently cross with them, and the Indians take the whelps of wolves "to improve the breed of their dogs." The half-bred wolves sometimes (Lamare- Picquot) cannot be tamed, "though this case is rare;" but they do not become thoroughly well broken in till the second or third generation. These facts show that there can be but little, if any, sterility between the Esquimaux dog and the wolf, for otherwise they would not be used to improve the breed. As Dr. Hayes says of these dogs, "reclaimed wolves they doubtless are." (1/14. The authorities for the foregoing statements are as follow: — Richardson in 'Fauna Boreali-Americana' 1829 pages 64, 75; Dr. Kane 'Arctic Explorations' 1856 volume 1 pages 398, 455; Dr. Hayes 'Arctic Boat Journey' 1860 page 167. Franklin's 'Narrative' volume 1 page 269, gives the case of three whelps of a black wolf being carried away by the Indians. Parry, Richardson, and others, give accounts of wolves and dogs naturally crossing in the eastern parts of North America. Seeman in his 'Voyage of H.M.S. "Herald"' 1853 volume 2 page 26, says the wolf is often caught by the Esquimaux for the purpose of crossing with

their dogs, and thus adding to their size and strength. M. Lamare-Picquot in 'Bull. de la Soc. d'Acclimat.' tome 7 1860 page 148, gives a good account of the half- bred Esquimaux dogs.)

North America is inhabited by a second kind of wolf, the prairie-wolf (Canis latrans), which is now looked at by all naturalists as specifically distinct from the common wolf; and is, according to Mr. J.K. Lord, in some respects intermediate in habits between a wolf and a fox. Sir J. Richardson, after describing the Hare Indian dog, which differs in many respects from the Esquimaux dog, says, "It bears the same relation to the prairie-wolf that the Esquimaux dog does to the great grey wolf." He could, in fact, detect no marked difference between them; and Messrs. Nott and Gliddon give additional details showing their close resemblance. The dogs derived from the above two aboriginal sources cross together and with the wild wolves, at least with the C. occidentalis, and with European dogs. In Florida, according to Bartram, the black wolf-dog of the Indians differs in nothing from the wolves of that country except in barking. (1/15. 'Fauna Boreali-Americana' 1829 pages 73, 78, 80. Nott and Gliddon, 'Types of Mankind' page 383. The naturalist and traveller Bartram is quoted by Hamilton Smith in 'Naturalist Lib.' volume 10 page 156. A Mexican domestic dog seems also to resemble a wild dog of the same country; but this may be the prairie-wolf. Another capable judge, Mr. J.K. Lord ('The Naturalist in Vancouver Island' 1866 volume 2 page 218), says that the Indian dog of the Spokans, near the Rocky

Mountains, "is beyond all question nothing more than a tamed Cayote or prairie-wolf," or Canis latrans.)

Turning to the southern parts of the new world, Columbus found two kinds of dogs in the West Indies; and Fernandez (1/16. I quote this from Mr. R. Hill's excellent account of the Alco or domestic dog of Mexico, in Gosse's 'Naturalist's Sojourn in Jamaica' 1851 page 329.) describes three in Mexico: some of these native dogs were dumb — that is, did not bark. In Guiana it has been known since the time of Buffon that the natives cross their dogs with an aboriginal species, apparently the Canis cancrivorus. Sir R. Schomburgk, who has so carefully explored these regions, writes to me, "I have been repeatedly told by the Arawaak Indians, who reside near the coast, that they cross their dogs with a wild species to improve the breed, and individual dogs have been shown to me which certainly resembled the C. cancrivorus much more than the common breed. It is but seldom that the Indians keep the C. cancrivorus for domestic purposes, nor is the Ai, another species of wild dog, and which I consider to be identical with the Dusicyon silvestris of H. Smith, now much used by the Arecunas for the purpose of hunting. The dogs of the Taruma Indians are quite distinct, and resemble Buffon's St. Domingo greyhound." It thus appears that the natives of Guiana have partially domesticated two aboriginal species, and still cross their dogs with them; these two species belong to a quite different type from the North American and European wolves. A careful observer, Rengger (1/17. 'Naturgeschichte

der Saugethiere von Paraguay' 1830 s. 151.), gives reasons for believing that a hairless dog was domesticated when America was first visited by Europeans: some of these dogs in Paraguay are still dumb, and Tschudi (1/18. Quoted in Humboldt 'Aspects of Nature' (English translation) volume 1 page 108.) states that they suffer from cold in the Cordillera. This naked dog is, however quite distinct from that found preserved in the ancient Peruvian burial-places, and described by Tschudi, under the name of Canis ingae, as withstanding cold well and as barking. It is not known whether these two distinct kinds of dog are the descendants of native species, and it might be argued that when man first migrated into America he brought with him from the Asiatic continent dogs which had not learned to bark; but this view does not seem probable, as the natives along the line of their march from the north reclaimed, as we have seen, at least two N. American species of Canidae.

Turning to the Old World, some European dogs closely resemble the wolf; thus the shepherd dog of the plains of Hungary is white or reddish-brown, has a sharp nose, short, erect ears, shaggy coat, and bushy tail, and so much resembles a wolf that Mr. Paget, who gives this description, says he has known a Hungarian mistake a wolf for one of his own dogs. Jeitteles, also, remarks on the close similarity of the Hungarian dog and wolf. Shepherd dogs in Italy must anciently have closely resembled wolves, for Columella (vii. 12) advises that white dogs be kept, adding, "pastor album probat, ne pro lupo canem feriat." Several

accounts have been given of dogs and wolves crossing naturally; and Pliny asserts that the Gauls tied their female dogs in the woods that they might cross with wolves. (1/19. Paget 'Travels in Hungary and Transylvania' volume 1 page 501. Jeitteles 'Fauna Hungariae Superioris' 1862 s. 13. See Pliny 'History of the World' (English translation) 8th book ch. 40 about the Gauls crossing their dogs. See also Aristotle 'Hist. Animal.' Lib. 8 c. 28. For good evidence about wolves and dogs naturally crossing near the Pyrenees, see M. Mauduyt 'Du Loup et de ses Races' Poitiers, 1851; also Pallas in 'Acta Acad. St. Petersburgh' 1780 part 2 page 94.) The European wolf differs slightly from that of North America, and has been ranked by many naturalists as a distinct species. The common wolf of India is also by some esteemed as a third species, and here again we find a marked resemblance between the pariah dogs of certain districts of India and the Indian wolf. (1/20. I give this on excellent authority, namely Mr. Blyth (under the signature of Zoophilus) in the 'Indian Sporting Review' October 1856 page 134. Mr. Blyth states that he was struck with the resemblance between a brush-tailed race of pariah-dogs, north-west of Cawnpore, and the Indian wolf. He gives corroborative evidence with respect to the dogs of the valley of the Nerbudda.)

With respect to Jackals, Isidore Geoffroy Saint-Hilaire (1/21. For numerous and interesting details on the resemblance of dogs and jackals see Isid. Geoffroy St. — Hilaire 'Hist. Nat. Gen.' 1860 tome 3 page 101. See also 'Hist. Nat. des Mammiferes' par

Prof. Gervais, 1855 tome 2 page 60.) says that not one constant difference can be pointed out between their structure and that of the smaller races of dogs. They agree closely in habits: jackals, when tamed and called by their master, wag their tails, lick his hands, crouch, and throw themselves on their backs; they smell at the tails of other dogs, and void their urine sideways; they roll on carrion or on animals which they have killed; and, lastly, when in high spirits, they run round in circles or in a figure of eight, with their tails between their legs. (1/22. Also Guldenstadt 'Nov. Comment. Acad. Petrop.' tome 20 pro anno 1775 page 449. Also Salvin in 'Land and Water' October 1869.) A number of excellent naturalists, from the time of Guldenstadt to that of Ehrenberg, Hemprich, and Cretzschmar, have expressed themselves in the strongest terms with respect to the resemblance of the half-domestic dogs of Asia and Egypt to jackals. M. Nordmann, for instance, says, "Les chiens d'Awhasie ressemblent etonnamment a des chacals." Ehrenberg (1/23. Quoted by De Blainville in his 'Osteographie, Canidae' pages 79, 98.) asserts that the domestic dogs of Lower Egypt, and certain mummied dogs, have for their wild type a species of wolf (C. lupaster) of the country; whereas the domestic dogs of Nubia and certain other mummied dogs have the closest relation to a wild species of the same country, viz. C. sabbar, which is only a form of the common jackal. Pallas asserts that jackals and dogs sometimes naturally cross in the East; and a case is on record in Algeria. (1/24. See Pallas in 'Act. Acad. St. Petersburgh' 1780 part 2 page 91. For Algeria, see Isid.

Geoffroy St. — Hilaire 'Hist. Nat. Gen.' tome 3 page 177. In both countries it is the male jackal which pairs with female domestic dogs.) The greater number of naturalists divide the jackals of Asia and Africa into several species, but some few rank them all as one.

I may add that the domestic dogs on the coast of Guinea are fox-like animals, and are dumb. (1/25. John Barbut 'Description of the Coast of Guinea in 1746.') On the east coast of Africa, between latitude 4 deg and 6 deg south, and about ten days' journey in the interior, a semi-domestic dog, as the Rev. S. Erhardt informs me, is kept, which the natives assert is derived from a similar wild animal. Lichtenstein (1/26. 'Travels in South Africa' volume 2 page 272.) says that the dogs of the Bosjemans present a striking resemblance even in colour (excepting the black stripe down the back) with the C. mesomelas of South Africa. Mr. E. Layard informs me that he has seen a Caffre dog which closely resembled an Esquimaux dog. In Australia the Dingo is both domesticated and wild; though this animal may have been introduced aboriginally by man, yet it must be considered as almost an endemic form, for its remains have been found in a similar state of preservation and associated with extinct mammals, so that its introduction must have been ancient. (1/27. Selwyn, Geology of Victoria; 'Journal of Geolog. Soc.' volume 14 1858 page 536 and volume 16 1860 page 148; and Prof. M'Coy in 'Annals and Mag. of Nat. Hist.' (3rd series) volume 9 1862 page 147. The Dingo differs from the dogs of

the central Polynesian islands. Dieffenbach remarks ('Travels' volume 2 page 45) that the native New Zealand dog also differs from the Dingo.)

From this resemblance of the half-domesticated dogs in several countries to the wild species still living there, — from the facility with which they can often be crossed together, — from even half-tamed animals being so much valued by savages, — and from the other circumstances previously remarked on which favour their domestication, it is highly probable that the domestic dogs of the world are descended from two well-defined species of wolf (viz. C. lupus and C. latrans), and from two or three other doubtful species (namely, the European, Indian, and North African wolves); from at least one or two South American canine species; from several races or species of jackal; and perhaps from one or more extinct species. Although it is possible or even probable that domesticated dogs, introduced into any country and bred there for many generations, might acquire some of the characters proper to the aboriginal Canidae of the country, we can hardly thus account for introduced dogs having given rise to two breeds in the same country, resembling two of its aboriginal species, as in the above- given cases of Guiana and of North America. (1/28. These latter remarks afford, I think, a sufficient answer to some criticisms by Mr. Wallace, on the multiple origin of dogs, given in Lyell's 'Principles of Geology' 1872 volume 2 page 295.)

It cannot be objected to the view of several canine species

having been anciently domesticated, that these animals are tamed with difficulty: facts have been already given on this head, but I may add that the young of the Canis primaevus of India were tamed by Mr. Hodgson (1/29. 'Proceedings Zoological Soc.' 1833 page 112. See also on the taming of the common wolf, L. Lloyd 'Scandinavian Adventures' 1854 volume 1 page 460. With respect to the jackal, see Prof. Gervais 'Hist. Nat. Mamm.' tome 2 page 61. With respect to the aguara of Paraguay see Rengger's work.), and became as sensible of caresses, and manifested as much intelligence, as any sporting dog of the same age. There is not much difference, as we have already shown and shall further see, in habits between the domestic dogs of the North American Indians and the wolves of that country, or between the Eastern pariah dogs and jackals, or between the dogs which have run wild in various countries and the several natural species of the family. The habit of barking, however, which is almost universal with domesticated dogs, forms an exception, as it does not characterise a single natural species of the family, though I am assured that the Canis latrans of North America utters a noise which closely approaches a bark. But this habit is soon lost by dogs when they become feral and is soon reacquired when they are again domesticated. The case of the wild dogs on the island of Juan Fernandez having become dumb has often been quoted, and there is reason to believe (130. Roulin, in 'Mem. present. par divers Savans' tome 6 page 341.) that the dumbness ensued in the course of thirty-three years; on the other hand, dogs taken from

this island by Ulloa slowly reacquired the habit of barking. The Mackenzie-river dogs, of the Canis latrans type, when brought to England, never learned to bark properly; but one born in the Zoological Gardens (1/31. Martin 'History of the Dog' page 14.) "made his voice sound as loudly as any other dog of the same age and size." According to Professor Nillson (1/32. Quoted by L. Lloyd in 'Field Sports of North of Europe' volume 1 page 387.), a wolf-whelp reared by a bitch barks. I. Geoffroy Saint-Hilaire exhibited a jackal which barked with the same tone as any common dog. (1/33. Quatrefages 'Soc. d'Acclimat.' May 11, 1863 page 7.) An interesting account has been given by Mr. G. Clarke (1/34. 'Annals and Mag of Nat. Hist.' volume 15 1845 page 140.) of some dogs run wild on Juan de Nova, in the Indian Ocean; "they had entirely lost the faculty of barking; they had no inclination for the company of other dogs, nor did they acquire their voice" during a captivity of several months. On the island they "congregate in vast packs, and catch sea-birds with as much address as foxes could display." The feral dogs of La Plata have not become dumb; they are of large size, hunt singly or in packs, and burrow holes for their young. (1/35. Azara 'Voyages dans l'Amer. Merid.' tome 1 page 381; his account is fully confirmed by Rengger. Quatrefages gives an account of a bitch brought from Jerusalem to France which burrowed a hole and littered in it. See 'Discours, Exposition des Races Canines' 1865 page 3.) In these habits the feral dogs of La Plata resemble wolves and jackals; both of which hunt either singly or in packs, and

burrow holes. (1/36. With respect to wolves burrowing holes see Richardson 'Fauna Boreali-Americana' page 64; and Bechstein 'Naturgeschichte Deutschlands' b. 1 s. 617.) These feral dogs have not become uniform in colour on Juan Fernandez, Juan de Nova, or La Plata. (1/37. See Poeppig 'Reise in Chile' b. 1 s. 290; Mr. G. Clarke, as above; and Rengger, s. 155.) In Cuba the feral dogs are described by Poeppig as nearly all mouse-coloured, with short ears and light-blue eyes. In St. Domingo, Col. Ham. Smith says (1/38. Dogs, 'Nat. Library' volume 10 page 121; an endemic South American dog seems also to have become feral in this island. See Gosse 'Jamaica' page 340.) that the feral dogs are very large, like greyhounds, of a uniform pale blue-ash, with small ears, and large light-brown eyes. Even the wild Dingo, though so anciently naturalised in Australia, "varies considerably in colour," as I am informed by Mr. P.P. King: a half-bred Dingo reared in England (1/39. Low 'Domesticated Animals' page 650.) showed signs of wishing to burrow.

[From the several foregoing facts we see that reversion in the feral state gives no indication of the colour or size of the aboriginal parent-species. One fact, however, with respect to the colouring of domestic dogs, I at one time hoped might have thrown some light on their origin; and it is worth giving, as showing how colouring follows laws, even in so anciently and thoroughly domesticated an animal as the dog. Black dogs with tan-coloured feet, whatever breed they may belong to, almost invariably have a tan- coloured spot on the upper and inner

corners of each eye, and their lips are generally thus coloured. I have seen only two exceptions to this rule, namely, in a spaniel and terrier. Dogs of a light-brown colour often have a lighter, yellowish-brown spot over the eyes; sometimes the spot is white, and in a mongrel terrier the spot was black. Mr. Waring kindly examined for me a stud of fifteen greyhounds in Suffolk: eleven of them were black, or black and white, or brindled, and these had no eye-spots; but three were red and one slaty-blue, and these four had dark-coloured spots over their eyes. Although the spots thus sometimes differ in colour, they strongly tend to be tan-coloured; this is proved by my having seen four spaniels, a setter, two Yorkshire shepherd dogs, a large mongrel, and some fox-hounds, coloured black and white, with not a trace of tan-colour, excepting the spots over the eyes, and sometimes a little on the feet. These latter cases, and many others, show plainly that the colour of the feet and the eye-spots are in some way correlated. I have noticed, in various breeds, every gradation, from the whole face being tan-coloured, to a complete ring round the eyes, to a minute spot over the inner and upper corners. The spots occur in various sub-breeds of terriers and spaniels; in setters; in hounds of various kinds, including the turnspit-like German badger-hound; in shepherd dogs; in a mongrel, of which neither parent had the spots; in one pure bulldog, though the spots were in this case almost white; and in greyhounds, — but true black-and-tan greyhounds are excessively rare; nevertheless I have been assured by Mr. Warwick, that one ran at the Caledonian Champion

meeting of April 1860, and was "marked precisely like a black-and-tan terrier." This dog, or another exactly the same colour, ran at the Scottish National Club on the 21st of March, 1865; and I hear from Mr. C.M. Browne, that "there was no reason either on the sire or dam side for the appearance of this unusual colour." Mr. Swinhoe at my request looked at the dogs in China, at Amoy, and he soon noticed a brown dog with yellow spots over the eyes. Colonel H. Smith (1/40. 'The Naturalist Library' Dogs, volume 10 pages 4, 19.) figures the magnificent black mastiff of Thibet with a tan-coloured stripe over the eyes, feet, and chaps; and what is more singular, he figures the Alco, or native domestic dog of Mexico, as black and white, with narrow tan-coloured rings round the eyes; at the Exhibition of dogs in London, May 1863, a so-called forest dog from North-West Mexico was shown, which had pale tan-coloured spots over the eyes. The occurrence of these tan-coloured spots in dogs of such extremely different breeds, living in various parts of the world, makes the fact highly remarkable.

We shall hereafter see, especially in the chapter on Pigeons, that coloured marks are strongly inherited, and that they often aid us in discovering the primitive forms of our domestic races. Hence, if any wild canine species had distinctly exhibited the tan-coloured spots over the eyes, it might have been argued that this was the parent-form of nearly all our domestic races. But after looking at many coloured plates, and through the whole collection of skins in the British Museum, I can find no species

thus marked. It is no doubt possible that some extinct species was thus coloured. On the other hand, in looking at the various species, there seems to be a tolerably plain correlation between tan-coloured legs and face; and less frequently between black legs and a black face; and this general rule of colouring explains to a certain extent the above-given cases of correlation between the eye-spots and the colour of the feet. Moreover, some jackals and foxes have a trace of a white ring round their eyes, as in C. mesomelas, C. aureus, and (judging from Colonel H. Smith's drawing) in C. alopex, and C. thaleb. Other species have a trace of a black line over the corners of the eyes, as in C. variegatus, cinereo-variegatus, and fulvus, and the wild Dingo. Hence I am inclined to conclude that a tendency for tan-coloured spots to appear over the eyes in the various breeds of dogs, is analogous to the case observed by Desmarest, namely, that when any white appears on a dog the tip of the tail is always white, "de maniere a rappeler la tache terminale de meme couleur, qui caracterise la plupart des Canides sauvages." (1/41. Quoted by Prof. Gervais 'Hist. Nat. Mamm.' tome 2 page 66.) This rule, however, as I am assured by Mr. Jesse, does not invariably hold good.]

It has been objected that our domestic dogs cannot be descended from wolves or jackals, because their periods of gestation are different. The supposed difference rests on statements made by Buffon, Gilibert, Bechstein, and others; but these are now known to be erroneous; and the period is found to agree in the wolf, jackal, and dog, as closely as could be

expected, for it is often in some degree variable. (1/42. J. Hunter shows that the long period of seventy-three days given by Buffon is easily explained by the bitch having received the dog many times during a period of sixteen days ('Phil. Transact.' 1787 page 353). Hunter found that the gestation of a mongrel from wolf and dog ('Phil. Transact.' 1789 page 160) apparently was sixty-three days, for she received the dog more than once. The period of a mongrel dog and jackal was fifty-nine days. Fred. Cuvier found the period of gestation of the wolf to be ('Dict. Class. d'Hist. Nat.' tome 4 page 8) two months and a few days, which agrees with the dog. Isid G. St. — Hilaire, who has discussed the whole subject, and from whom I quote Bellingeri, states ('Hist. Nat. Gen.' tome 3 page 112) that in the Jardin des Plantes the period of the jackal has been found to be from sixty to sixty-three days, exactly as with the dog.) Tessier, who has closely attended to this subject, allows a difference of four days in the gestation of the dog. The Rev. W.D. Fox has given me three carefully recorded cases of retrievers, in which the bitch was put only once to the dog; and not counting this day, but counting that of parturition, the periods were fifty-nine, sixty-two, and sixty-seven days. The average period is sixty-three days; but Bellingeri states that this applies only to large dogs; and that for small races it is from sixty to sixty-three days; Mr. Eyton of Eyton, who has had much experience with dogs, also informs me that the time is apt to be longer with large than with small dogs.

F. Cuvier has objected that the jackal would not have been

domesticated on account of its offensive smell; but savages are not sensitive in this respect. The degree of odour, also, differs in the different kinds of jackal (1/43. See Isid. Geoffroy St. — Hilaire 'Hist. Nat. Gen.' tome 3 page 112, on the odour of jackals. Col. Ham. Smith in 'Nat. Lib.' volume 10 page 289.); and Colonel H. Smith makes a sectional division of the group with one character dependent on not being offensive. On the other hand, dogs — for instance, rough and smooth terriers — differ much in this respect; and M. Godron states that the hairless so-called Turkish dog is more odoriferous than other dogs. Isidore Geoffroy (1/44. Quoted by Quatrefages in 'Bull. Soc. d'Acclimat.' May 11, 1863.) gave to a dog the same odour as that from a jackal by feeding it on raw flesh.

The belief that our dogs are descended from wolves, jackals, South American Canidae, and other species, suggests a far more important difficulty. These animals in their undomesticated state, judging from a widely-spread analogy, would have been in some degree sterile if intercrossed; and such sterility will be admitted as almost certain by all those who believe that the lessened fertility of crossed forms is an infallible criterion of specific distinctness. Anyhow these animals keep distinct in the countries which they inhabit in common. On the other hand, all domestic dogs, which are here supposed to be descended from several distinct species, are, as far as is known, mutually fertile together. But, as Broca has well remarked (1/45. 'Journal de la Physiologie' tome 2 page 385.), the fertility of successive

generations of mongrel dogs has never been scrutinised with that care which is thought indispensable when species are crossed. The few facts leading to the conclusion that the sexual feelings and reproductive powers differ in the several races of the dog when crossed are (passing over mere size as rendering propagation difficult) as follows: the Mexican Alco (1/46. See Mr. R. Hill's excellent account of this breed in Gosse's 'Jamaica' page 338; Rengger 'Saugethiere von Paraguay' s. 153. With respect to Spitz dogs, see Bechstein's 'Naturgesch. Deutschlands' 1801 b. 1 s. 638. With respect to Dr. Hodgkin's statement made before Brit. Assoc. see 'The Zoologist' volume 4 for 1845-46 page 1097.) apparently dislikes dogs of other kinds, but this perhaps is not strictly a sexual feeling; the hairless endemic dog of Paraguay, according to Rengger, mixes less with the European races than these do with each other; the Spitz dog in Germany is said to receive the fox more readily than do other breeds; and Dr. Hodgkin states that a female Dingo in England attracted the male wild foxes. If these latter statements can be trusted, they prove some degree of sexual difference in the breeds of the dog. But the fact remains that our domestic dogs, differing so widely as they do in external structure, are far more fertile together than we have reason to believe their supposed wild parents would have been. Pallas assumes (1/47. 'Acta Acad. St. Petersburgh' 1780 part 2 pages 84, 100.) that a long course of domestication eliminates that sterility which the parent-species would have exhibited if only lately captured; no distinct facts are

recorded in support of this hypothesis; but the evidence seems to me so strong (independently of the evidence derived from other domesticated animals) in favour of our domestic dogs having descended from several wild stocks, that I am inclined to admit the truth of this hypothesis.

There is another and closely allied difficulty consequent on the doctrine of the descent of our domestic dogs from several wild species, namely, that they do not seem to be perfectly fertile with their supposed parents. But the experiment has not been quite fairly tried; the Hungarian dog, for instance, which in external appearance so closely resembles the European wolf, ought to be crossed with this wolf: and the pariah dogs of India with Indian wolves and jackals; and so in other cases. That the sterility is very slight between certain dogs and wolves and other Canidae is shown by savages taking the trouble to cross them. Buffon got four successive generations from the wolf and dog, and the mongrels were perfectly fertile together. (1/48. M. Broca has shown ('Journal de Physiologie' tome 2 page 353) that Buffon's experiments have been often misrepresented. Broca has collected (pages 390-395) many facts on the fertility of crossed dogs, wolves, and jackals.) But more lately M. Flourens states positively as the result of his numerous experiments that hybrids from the wolf and dog, crossed inter se, become sterile at the third generation, and those from the jackal and dog at the fourth generation. (1/49. 'De la Longevite Humaine' par M. Flourens 1855 page 143. Mr. Blyth says ('Indian Sporting

Review' volume 2 page 137) that he has seen in India several hybrids from the pariah-dog and jackal; and between one of these hybrids and a terrier. The experiments of Hunter on the jackal are well-known. See also Isid. Geoffroy St. — Hilaire, 'Hist. Nat. Gen.' tome 3 page 217, who speaks of the hybrid offspring of the jackal as perfectly fertile for three generations.) But these animals were closely confined; and many wild animals, as we shall see in a future chapter, are rendered by confinement in some degree or even utterly sterile. The Dingo, which breeds freely in Australia with our imported dogs, would not breed though repeatedly crossed in the Jardin des Plantes. (1/50. On authority of F. Cuvier quoted in Bronn's 'Geschichte der Natur' b. 2 s. 164.) Some hounds from Central Africa, brought home by Major Denham, never bred in the Town of London (1/51. W.C.L. Martin 'History of the Dog' 1845 page 203. Mr. Philip P. King, after ample opportunities of observation, informs me that the Dingo and European dogs often cross in Australia.); and a similar tendency to sterility might be transmitted to the hybrid offspring of a wild animal. Moreover, it appears that in M. Flourens' experiments the hybrids were closely bred in and in for three or four generations; and this circumstance would most certainly increase the tendency to sterility. Several years ago I saw confined in the Zoological Gardens of London a female hybrid from an English dog and jackal, which even in this the first generation was so sterile that, as I was assured by her keeper, she did not fully exhibit her proper periods; but this case was

certainly exceptional, as numerous instances have occurred of fertile hybrids from these two animals. In almost all experiments on the crossing of animals there are so many causes of doubt, that it is extremely difficult to come to any positive conclusion. It would, however, appear, that those who believe that our dogs are descended from several species will have not only to admit that their offspring after a long course of domestication generally lose all tendency to sterility when crossed together; but that between certain breeds of dogs and some of their supposed aboriginal parents a certain degree of sterility has been retained or possibly even acquired.

Notwithstanding the difficulties in regard to fertility given in the last two paragraphs, when we reflect on the inherent improbability of man having domesticated throughout the world one single species alone of so widely distributed, so easily tamed, and so useful a group as the Canidae; when we reflect on the extreme antiquity of the different breeds; and especially when we reflect on the close similarity, both in external structure and habits, between the domestic dogs of various countries and the wild species still inhabiting these same countries, the balance of evidence is strongly in favour of the multiple origin of our dogs.

DIFFERENCES BETWEEN THE SEVERAL BREEDS OF THE DOG.

If the several breeds have descended from several wild stocks, their difference can obviously in part be explained by that of their parent species. For instance, the form of the greyhound

may be partly accounted for by descent from some such animal as the slim Abyssinian Canis simensis (1/52. Ruppel 'Neue Wirbelthiere von Abyssinien' 1835-40 'Mammif.' s. 39 pl. 14. There is a specimen of this fine animal in the British Museum.), with its elongated muzzle; that of the larger dogs from the larger wolves, and the smaller and slighter dogs from the jackals: and thus perhaps we may account for certain constitutional and climatal differences. But it would be a great error to suppose that there has not been in addition (1/53. Even Pallas admits this; see 'Act. Acad. St. Petersburgh' 1780 page 93.) a large amount of variation. The intercrossing of the several aboriginal wild stocks, and of the subsequently formed races, has probably increased the total number of breeds, and, as we shall presently see, has greatly modified some of them. But we cannot explain by crossing the origin of such extreme forms as thoroughbred greyhounds, bloodhounds, bulldogs, Blenheim spaniels, terriers, pugs, etc., unless we believe that forms equally or more strongly characterised in these different respects once existed in nature. But hardly any one has been bold enough to suppose that such unnatural forms ever did or could exist in a wild state. When compared with all known members of the family of Canidae they betray a distinct and abnormal origin. No instance is on record of such dogs as bloodhounds, spaniels, true greyhounds having been kept by savages: they are the product of long-continued civilisation.

[The number of breeds and sub-breeds of the dog is great;

Youatt for instance, describes twelve kinds of greyhounds. I will not attempt to enumerate or describe the varieties, for we cannot discriminate how much of their difference is due to variation, and how much to descent from different aboriginal stocks. But it may be worth while briefly to mention some points. Commencing with the skull, Cuvier has admitted (1/54. Quoted by I. Geoffroy 'Hist. Nat. Gen.' tome 3 page 453.) that in form the differences are "plus fortes que celles d'aucunes especes sauvages d'un meme genre naturel." The proportions of the different bones; the curvature of the lower jaw, the position of the condyles with respect to the plane of the teeth (on which F. Cuvier founded his classification), and in mastiffs the shape of its posterior branch; the shape of the zygomatic arch, and of the temporal fossae; the position of the occiput — all vary considerably. (1/55. F. Cuvier in 'Annales du Museum' tome 18 page 337; Godron 'De l'Espece' tome 1 page 342; and Col. H. Smith in 'Nat. Library' volume 9 page 101. See also some observations on the degeneracy of the skull in certain breeds, by Prof. Bianconi 'La Theorie Darwinienne' 1874 page 279.) The difference in size between the brains of dogs belonging to large and small breeds "is something prodigious." "Some dogs' brains are high and rounded, while others are low, long, and narrow in front." In the latter, "the olfactory lobes are visible for about half their extent, when the brain is seen from above, but they are wholly concealed by the hemispheres in other breeds." (1/56. Dr. Burt Wilder 'American Assoc. Advancement of Science' 1873 pages 236, 239.) The

dog has properly six pairs of molar teeth in the upper jaw, and seven in the lower; but several naturalists have seen not rarely an additional pair in the upper jaw (1/57. Isid. Geoffroy Saint-Hilaire 'Hist. des Anomalies' 1832 tome 1 page 660, Gervais 'Hist. Nat. des Mammiferes' tome 2 1855 page 66. De Blainville ('Osteographie, Canidae' page 137) has also seen an extra molar on both sides.); and Professor Gervais says that there are dogs "qui ont sept paires de dents superieures et huit inferieures." De Blainville (1/58. 'Osteographie, Canidae' page 137.) has given full particulars on the frequency of these deviations in the number of the teeth, and has shown that it is not always the same tooth which is supernumerary. In short- muzzled races, according to H. Muller (1/59. Wurzburger 'Medecin. Zeitschrift' 1860 b. 1 s. 265.), the molar teeth stand obliquely, whilst in long-muzzled races they are placed longitudinally, with open spaces between them. The naked, so-called Egyptian or Turkish dog is extremely deficient in its teeth (1/60. Mr. Yarrell in 'Proc. Zoological Soc.' October 8, 1833. Mr. Waterhouse showed me a skull of one of these dogs, which had only a single molar on each side and some imperfect incisors.), — sometimes having none except one molar on each side; but this, though characteristic of the breed, must be considered as a monstrosity. M. Girard (1/61. Quoted in 'The Veterinary' London volume 8 page 415.), who seems to have attended closely to the subject, says that the period of the appearance of the permanent teeth differs in different dogs, being earlier in large dogs; thus the mastiff assumes its adult

teeth in four or five months, whilst in the spaniel the period is sometimes more than seven or eight months. On the other hand small dogs are mature, and the females have arrived at the best age for breeding, when one year old, whereas large dogs "are still in their puppyhood at this time, and take fully twice as long to develop their proportions." (1/62. This is quoted from Stonehenge, a great authority, 'The Dog' 1867 page 187.)

With respect to minor differences little need be said. Isidore Geoffroy has shown (1/63. 'Hist. Nat. General' tome 3 page 448.) that in size some dogs are six times as long (the tail being excluded) as others; and that the height relatively to the length of the body varies from between one to two, and one to nearly four. In the Scotch deer-hound there is a striking and remarkable difference in the size of the male and female. (1/64. W. Scrope 'Art of Deer-Stalking' page 354.) Every one knows how the ears vary in size in different breeds, and with their great development their muscles become atrophied. Certain breeds of dogs are described as having a deep furrow between the nostrils and lips. The caudal vertebrae, according to F. Cuvier, on whose authority the two last statements rest, vary in number; and the tail in English cattle and some shepherd dogs is almost absent. The mammae vary from seven to ten in number; Daubenton, having examined twenty- one dogs, found eight with five mammae on each side; eight with four on each side; and the others with an unequal number on the two sides. (1/65. Quoted by Col. Ham. Smith in 'Nat. Lib.' volume 10 page 79.) Dogs have properly

five toes in front and four behind, but a fifth toe is often added; and F. Cuvier states that, when a fifth toe is present, a fourth cuneiform bone is developed; and, in this case, sometimes the great cuneiform bone is raised, and gives on its inner side a large articular surface to the astragalus; so that even the relative connection of the bones, the most constant of all characters, varies. These modifications, however, in the feet of dogs are not important, because they ought to be ranked, as De Blainville has shown (1/66. De Blainville 'Osteographie, Canidae' page 134. F. Cuvier 'Annales du Museum' tome 18 page 342. In regard to mastiffs, see Col. H. Smith 'Nat. Lib.' volume 10 page 218. For the Thibet mastiff, see Mr. Hodgson in 'Journal of As. Soc. of Bengal' volume 1 1832 page 342.) as monstrosities. Nevertheless they are interesting from being correlated with the size of the body, for they occur much more frequently with mastiffs and other large breeds than with small dogs. Closely allied varieties, however, sometimes differ in this respect; thus Mr. Hodgson states that the black-and-tan Lassa variety of the Thibet mastiff has the fifth digit, whilst the Mustang sub-variety is not thus characterised. The extent to which the skin is developed between the toes varies much; but we shall return to this point. The degree to which the various breeds differ in the perfection of their senses, dispositions, and inherited habits is notorious to every one. The breeds present some constitutional differences: the pulse, says Youatt (1/67. 'The Dog' 1845 page 186. With respect to diseases Youatt asserts (page 167) that the Italian

greyhound is "strongly subject" to polypi in the matrix or vagina. The spaniel and pug (page 182) are most liable to bronchocele. The liability to distemper (page 232) is extremely different in different breeds. On the distemper, see also Col. Hutchinson on 'Dog Breaking' 1850 page 279.) "varies materially according to the breed, as well as to the size of the animal." Different breeds of dogs are subject in different degrees to various diseases. They certainly become adapted to different climates under which they have long existed. It is notorious that most of our best European breeds deteriorate in India. (1/68. See 'Youatt on the Dog' page 15; 'The Veterinary' London volume 11 page 235.) The Rev R. Everest (1/69. 'Journal of As. Soc. of Bengal' volume 3 page 19.) believes that no one has succeeded in keeping the Newfoundland dog long alive in India; so it is, according to Lichtenstein (1/70. 'Travels' volume 2 page 15.), even at the Cape of Good Hope. The Thibet mastiff degenerates on the plains of India, and can live only on the mountains. (1/71. Hodgson in 'Journal of As. Soc. of Bengal' volume 1 page 342.) Lloyd (1/72. 'Field Sports of the North of Europe' volume 2 page 165.) asserts that our bloodhounds and bulldogs have been tried, and cannot withstand the cold of the northern European forests.]

Seeing in how many characters the races of the dog differ from each other, and remembering Cuvier's admission that their skulls differ more than do those of the species of any natural genus, and bearing in mind how closely the bones of wolves, jackals, foxes, and other Canidae agree, it is remarkable that we meet with the

statement, repeated over and over again, that the races of the dog differ in no important characters. A highly competent judge, Prof. Gervais (1/73. 'Hist. Nat. des Mammif.' 1855 tome 2 pages 66, 67.), admits "si l'on prenait sans controle les alterations dont chacun de ces organes est susceptible, on pourrait croire qu'il y a entre les chiens domestiques des differences plus grandes que celles qui separent ailleurs les especes, quelquefois meme les genres." Some of the differences above enumerated are in one respect of comparatively little value, for they are not characteristic of distinct breeds: no one pretends that such is the case with the additional molar teeth or with the number of mammae; the additional digit is generally present with mastiffs, and some of the more important differences in the skull and lower jaw are more or less characteristic of various breeds. But we must not forget that the predominant power of selection has not been applied in any of these cases; we have variability in important parts, but the differences have not been fixed by selection. Man cares for the form and fleetness of his greyhounds, for the size of his mastiffs, and formerly for the strength of the jaw in his bulldogs, etc.; but he cares nothing about the number of their molar teeth or mammae or digits; nor do we know that differences in these organs are correlated with, or owe their development to, differences in other parts of the body about which man does care. Those who have attended to the subject of selection will admit that, nature having given variability, man, if he so chose, could fix five toes to the hinder

feet of certain breeds of dogs, as certainly as to the feet of his Dorking fowls: he could probably fix, but with much more difficulty, an additional pair of molar teeth in either jaw, in the same way as he has given additional horns to certain breeds of sheep; if he wished to produce a toothless breed of dogs, having the so-called Turkish dog with its imperfect teeth to work on, he could probably do so, for he has succeeded in making hornless breeds of cattle and sheep.

With respect to the precise causes and steps by which the several races of dogs have come to differ so greatly from each other, we are, as in most other cases, profoundly ignorant. We may attribute part of the difference in external form and constitution to inheritance from distinct wild stocks, that is to changes effected under nature before domestication. We must attribute something to the crossing of the several domestic and natural races. I shall, however, soon recur to the crossing of races. We have already seen how often savages cross their dogs with wild native species; and Pennant gives a curious account (1/74. 'History of Quadrupeds' 1793 volume 1 page 238.) of the manner in which Fochabers, in Scotland, was stocked "with a multitude of curs of a most wolfish aspect" from a single hybrid-wolf brought into that district.

It would appear that climate to a certain extent directly modifies the forms of dogs. We have lately seen that several of our English breeds cannot live in India, and it is positively asserted that when bred there for a few generations they

degenerate not only in their mental faculties, but in form. Captain Williamson (1/75. 'Oriental Field Sports' quoted by Youatt 'The Dog' page 15.), who carefully attended to this subject, states that "hounds are the most rapid in their decline;" "greyhounds and pointers, also, rapidly decline." But spaniels, after eight or nine generations, and without a cross from Europe, are as good as their ancestors. Dr. Falconer informs me that bulldogs, which have been known, when first brought into the country, to pin down even an elephant by its trunk, not only fall off after two or three generations in pluck and ferocity, but lose the under-hung character of their lower jaws; their muzzles become finer and their bodies lighter. English dogs imported into India are so valuable that probably due care has been taken to prevent their crossing with native dogs; so that the deterioration cannot be thus accounted for. The Rev. R. Everest informs me that he obtained a pair of setters, born in India, which perfectly resembled their Scotch parents: he raised several litters from them in Delhi, taking the most stringent precautions to prevent a cross, but he never succeeded, though this was only the second generation in India, in obtaining a single young dog like its parents in size or make; their nostrils were more contracted, their noses more pointed, their size inferior, and their limbs more slender. So again on the coast of Guinea, dogs, according to Bosman, "alter strangely; their ears grow long and stiff like those of foxes, to which colour they also incline, so that in three or four years, they degenerate into very ugly creatures; and in three or four

broods their barking turns into a howl." (1/76. A. Murray gives this passage in his 'Geographical Distribution of Mammals' 4to 1866 page 8.) This remarkable tendency to rapid deterioration in European dogs subjected to the climate of India and Africa, may be largely accounted for by reversion to a primordial condition which many animals exhibit, as we shall hereafter see, when their constitutions are in any way disturbed.

Some of the peculiarities characteristic of the several breeds of the dog have probably arisen suddenly, and, though strictly inherited, may be called monstrosities; for instance, the shape of the legs and body in the turnspit of Europe and India; the shape of the head and the under-hanging jaw in the bull- and pug-dog, so alike in this one respect and so unlike in all others. A peculiarity suddenly arising, and therefore in one sense deserving to be called a monstrosity, may, however, be increased and fixed by man's selection. We can hardly doubt that long-continued training, as with the greyhound in coursing hares, as with water-dogs in swimming — and the want of exercise, in the case of lapdogs — must have produced some direct effect on their structure and instincts. But we shall immediately see that the most potent cause of change has probably been the selection, both methodical and unconscious, of slight individual differences, — the latter kind of selection resulting from the occasional preservation, during hundreds of generations, of those individual dogs which were the most useful to man for certain purposes and under certain conditions of life. In a future chapter

on Selection I shall show that even barbarians attend closely to the qualities of their dogs. This unconscious selection by man would be aided by a kind of natural selection; for the dogs of savages have partly to gain their own subsistence: for instance, in Australia, as we hear from Mr. Nind (1/77. Quoted by Mr. Galton 'Domestication of Animals' page 13.), the dogs are sometimes compelled by want to leave their masters and provide for themselves; but in a few days they generally return. And we may infer that dogs of different shapes, sizes, and habits, would have the best chance of surviving under different circumstances, — on open sterile plains, where they have to run down their own prey, — on rocky coasts, where they have to feed on crabs and fish left in the tidal pools, as in the case of New Guinea and Tierra del Fuego. In this latter country, as I am informed by Mr. Bridges, the Catechist to the Mission, the dogs turn over the stones on the shore to catch the crustaceans which lie beneath, and they "are clever enough to knock off the shell-fish at a first blow;" for if this be not done, shell-fish are well-known to have an almost invincible power of adhesion.

It has already been remarked that dogs differ in the degree to which their feet are webbed. In dogs of the Newfoundland breed, which are eminently aquatic in their habits, the skin, according to Isidore Geoffroy (1/78. 'Hist. Nat. Gen.' tome 3 page 450.), extends to the third phalanges whilst in ordinary dogs it extends only to the second. In two Newfoundland dogs which I examined, when the toes were stretched apart and viewed on the under

side, the skin extended in a nearly straight line between the outer margins of the balls of the toes; whereas, in two terriers of distinct sub- breeds, the skin viewed in the same manner was deeply scooped out. In Canada there is a dog which is peculiar to the country and common there, and this has "half-webbed feet and is fond of the water." (1/79. Mr. Greenhow on the Canadian Dog in Loudon's 'Mag. of Nat. Hist.' volume 6 1833 page 511.) English otter-hounds are said to have webbed feet: a friend examined for me the feet of two, in comparison with the feet of some harriers and bloodhounds; he found the skin variable in extent in all, but more developed in the otter-hounds than in the others. (1/80. See Mr. C.O. Groom-Napier on the webbing of the hind feet of Otterhounds in 'Land and Water' October 13, 1866 page 270.) As aquatic animals which belong to quite different orders have webbed feet, there can be no doubt that this structure would be serviceable to dogs that frequent the water. We may confidently infer that no man ever selected his water-dogs by the extent to which the skin was developed between their toes; but what he does, is to preserve and breed from those individuals which hunt best in the water, or best retrieve wounded game, and thus he unconsciously selects dogs with feet slightly better webbed. The effects of use from the frequent stretching apart of the toes will likewise aid in the result. Man thus closely imitates Natural Selection. We have an excellent illustration of this same process in North America, where, according to Sir J. Richardson (1/81. 'Fauna Boreali-Americana' 1829 page 62.), all

the wolves, foxes, and aboriginal domestic dogs have their feet broader than in the corresponding species of the Old World, and "well calculated for running on the snow." Now, in these Arctic regions, the life or death of every animal will often depend on its success in hunting over the snow when soft; and this will in part depend on the feet being broad; yet they must not be so broad as to interfere with the activity of the animal when the ground is sticky, or with its power of burrowing holes, or with other necessary habits of life.

As changes in domestic breeds which take place so slowly are not to be noticed at any one period, whether due to the selection of individual variations or of differences resulting from crosses, are most important in understanding the origin of our domestic productions, and likewise in throwing indirect light on the changes effected under nature, I will give in detail such cases as I have been able to collect. Lawrence (1/82. 'The Horse in all his Varieties, etc.' 1829 pages 230, 234.), who paid particular attention to the history of the foxhound, writing in 1829, says that between eighty and ninety years before "an entirely new foxhound was raised through the breeder's art," the ears of the old southern hound being reduced, the bone and bulk lightened, the waist increased in length, and the stature somewhat added to. It is believed that this was effected by a cross with a greyhound. With respect to this latter dog, Youatt (1/83. 'The Dog' 1845 pages 31, 35; with respect to King Charles' spaniel page 45; for the setter page 90.), who is generally cautious in his statements,

says that the greyhound within the last fifty years, that is before the commencement of the present century, "assumed a somewhat different character from that which he once possessed. He is now distinguished by a beautiful symmetry of form, of which he could not once boast, and he has even superior speed to that which he formerly exhibited. He is no longer used to struggle with deer, but contends with his fellows over a shorter and speedier course." An able writer (1/84. In the 'Encyclop. of Rural Sports' page 557.) believes that our English greyhounds are the descendants, PROGRESSIVELY IMPROVED, of the large rough greyhounds which existed in Scotland so early as the third century. A cross at some former period with the Italian greyhound has been suspected; but this seems hardly probable, considering the feebleness of this latter breed. Lord Orford, as is well-known, crossed his famous greyhounds, which failed in courage, with a bulldog — this breed being chosen from being erroneously supposed to be 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 bulldog, but his courage and indomitable perseverance remained."

Youatt infers, from a comparison of an old picture of King Charles's spaniels with the living dog, that "the breed of the present day is materially altered for the worse: " the muzzle has become shorter, the forehead more prominent, and the eyes larger; the changes in this case have probably been due to simple selection. The setter, as this author remarks in another place,

"is evidently the large spaniel improved to his present peculiar size and beauty, and taught another way of marking his game. If the form of the dog were not sufficiently satisfactory on this point, we might have recourse to history: " he then refers to a document dated 1685 bearing on this subject, and adds that the pure Irish setter shows no signs of a cross with the pointer, which some authors suspect has been the case with the English setter. The bulldog is an English breed, and as I hear from Mr. G.R. Jesse (1/85. Author of 'Researches into the History of the British Dog.), seems to have originated from the mastiff since the time of Shakspeare; but certainly existed in 1631, as shown by Prestwick Eaton's letters. There can be no doubt that the fancy bulldogs of the present day, now that they are not used for bull-baiting, have become greatly reduced in size, without any express intention on the part of the breeder. Our pointers are certainly descended from a Spanish breed, as even their present names, Don, Ponto, Carlos, etc., show; it is said that they were not known in England before the Revolution in 1688 (1/86. See Col. Hamilton Smith on the antiquity of the Pointer, in 'Nat. Lib.' volume 10 page 196.); but the breed since its introduction has been much modified, for Mr. Borrow, who is a sportsman and knows Spain intimately well, informs me that he has not seen in that country any breed "corresponding in figure with the English pointer; but there are genuine pointers near Xeres which have been imported by English gentlemen." A nearly parallel case is offered by the Newfoundland dog, which was certainly brought

into England from that country, but which has since been so much modified that, as several writers have observed, it does not now closely resemble any existing native dog in Newfoundland. (1/87. The Newfoundland dog is believed to have originated from a cross between the Esquimaux dog and a large French hound. See Dr. Hodgkin 'British Assoc.' 1844; Bechstein 'Naturgesch. Deutschland' b. 1 s. 574; 'Nat. Lib.' volume 10 page 132; also Mr. Jukes 'Excursion in and about Newfoundland.')

These several cases 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 alter circumstances, it would tend to supplant the older and less improved strains. For instance, as soon as the old foxhound was improved by a cross with the greyhound, or by simple selection, and assumed its present character — and the change was probably desired owing to 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. Through this process of gradual substitution the old English hound has been

lost; and so it has been with the Irish wolf-dog, the old English bulldog, and several other breeds, such as the alaunt, as I am informed by Mr. Jesse. But the extinction of former breeds is apparently aided by another cause; for whenever a breed is kept in scanty numbers, as at present with the bloodhound, it is reared with some difficulty, apparently from the evil effects of long-continued close interbreeding. As several breeds of the dog have been slightly but sensibly modified within so short a period as the last one or two centuries, by the selection of the best individuals, modified in many cases by crosses with other breeds; and as we shall hereafter see that the breeding of dogs was attended to in ancient times, as it still is by savages, we may conclude that we have in selection, even if only occasionally practised, a potent means of modification.

DOMESTIC CATS.

Cats have been domesticated in the East from an ancient period; Mr. Blyth informs me that they are mentioned in a Sanskrit writing 2000 years old, and in Egypt their antiquity is known to be even greater, as shown by monumental drawings and their mummied bodies. These mummies, according to De Blainville (1/88. De Blainville 'Osteographie, Felis' page 65 on the character of F. caligulata; pages 85, 89, 90, 175, on the other mummied species. He quotes Ehrenberg on F. maniculata being mummied.), who has particularly studied the subject, belong to no less than three species, namely, F. caligulata, bubastes, and chaus. The two former species are said to be still found, both

wild and domesticated, in parts of Egypt. F. caligulata presents a difference in the first inferior milk molar tooth, as compared with the domestic cats of Europe, which makes De Blainville conclude that it is not one of the parent-forms of our cats. Several naturalists, as Pallas, Temminck, Blyth, believe that domestic cats are the descendants of several species commingled: it is certain that cats cross readily with various wild species, and it would appear that the character of the domestic breeds has, at least in some cases, been thus affected. Sir W. Jardine has no doubt that, "in the north of Scotland, there has been occasional crossing with our native species (F. sylvestris), and that the result of these crosses has been kept in our houses. I have seen," he adds, "many cats very closely resembling the wild cat, and one or two that could scarcely be distinguished from it." Mr. Blyth (1/89. Asiatic Soc. of Calcutta; Curator's Report, August 1856. The passage from Sir W. Jardine is quoted from this Report. Mr. Blyth, who has especially attended to the wild and domestic cats of India, has given in this Report a very interesting discussion on their origin.) remarks on this passage, "but such cats are never seen in the southern parts of England; still, as compared with any Indian tame cat, the affinity of the ordinary British cat to F. sylvestris is manifest; and due I suspect to frequent intermixture at a time when the tame cat was first introduced into Britain and continued rare, while the wild species was far more abundant than at present." In Hungary, Jeitteles (1/90. 'Fauna Hungariae Sup.' 1862 s. 12.) was assured on trustworthy authority that a

wild male cat crossed with a female domestic cat, and that the hybrids long lived in a domesticated state. In Algiers the domestic cat has crossed with the wild cat (F. lybica) of that country. (1/91. Isid. Geoffroy Saint-Hilaire 'Hist. Nat. Gen.' tome 3 page 177.) In South Africa as Mr. E. Layard informs me, the domestic cat intermingles freely with the wild F. caffra; he has seen a pair of hybrids which were quite tame and particularly attached to the lady who brought them up; and Mr. Fry has found that these hybrids are fertile. In India the domestic cat, according to Mr. Blyth, has crossed with four Indian species. With respect to one of these species, F. chaus, an excellent observer, Sir W. Elliot, informs me that he once killed, near Madras, a wild brood, which were evidently hybrids from the domestic cat; these young animals had a thick lynx-like tail and the broad brown bar on the inside of the forearm characteristic of F. chaus. Sir W. Elliot adds that he has often observed this same mark on the forearms of domestic cats in India. Mr. Blyth states that domestic cats coloured nearly like F. chaus, but not resembling that species in shape, abound in Bengal; he adds, "such a colouration is utterly unknown in European cats, and the proper tabby markings (pale streaks on a black ground, peculiarly and symmetrically disposed), so common in English cats, are never seen in those of India." Dr. D. Short has assured Mr. Blyth (1/92. 'Proc. Zoolog. Soc.' 1863 page 184.) that, at Hansi, hybrids between the common cat and F. ornata (or torquata) occur, "and that many of the domestic cats of that part of India were undistinguishable

from the wild F. ornata." Azara states, but only on the authority of the inhabitants, that in Paraguay the cat has crossed with two native species. From these several cases we see that in Europe, Asia, Africa, and America, the common cat, which lives a freer life than most other domesticated animals, has crossed with various wild species; and that in some instances the crossing has been sufficiently frequent to affect the character of the breed.

Whether domestic cats have descended from several distinct species, or have only been modified by occasional crosses, their fertility, as far as is known, is unimpaired. The large Angora or Persian cat is the most distinct in structure and habits of all the domestic breeds; and is believed by Pallas, but on no distinct evidence, to be descended from the F. manul of middle Asia; and I am assured by Mr. Blyth that the Angora cat breeds freely with Indian cats, which, as we have already seen, have apparently been much crossed with F. chaus. In England half-bred Angora cats are perfectly fertile with one another.

Within the same country we do not meet with distinct races of the cat, as we do of dogs and of most other domestic animals; though the cats of the same country present a considerable amount of fluctuating variability. The explanation obviously is that, from their nocturnal and rambling habits, indiscriminate crossing cannot without much trouble be prevented. Selection cannot be brought into play to produce distinct breeds, or to keep those distinct which have been imported from foreign lands. On the other hand, in islands and in countries completely separated

from each other, we meet with breeds more or less distinct; and these cases are worth giving, showing that the scarcity of distinct races in the same country is not caused by a deficiency of variability in the animal. The tailless cats of the Isle of Man are said to differ from common cats not only in the want of a tail, but in the greater length of their hind legs, in the size of their heads, and in habits. The Creole cat of Antigua, as I am informed by Mr. Nicholson, is smaller, and has a more elongated head, than the British cat. In Ceylon, as Mr. Thwaites writes to me, every one at first notices the different appearance of the native cat from the English animal; it is of small size, with closely lying hairs; its head is small, with a receding forehead; but the ears are large and sharp; altogether it has what is there called a "low-caste" appearance. Rengger (1/93. 'Saugethiere von Paraguay' 1830 s. 212.) says that the domestic cat, which has been bred for 300 years in Paraguay, presents a striking difference from the European cat; it is smaller by a fourth, has a more lanky body, its hair is short, shining, scanty and lies close, especially on the tail: he adds that the change has been less at Ascension, the capital of Paraguay, owing to the continual crossing with newly imported cats; and this fact well illustrates the importance of separation. The conditions of life in Paraguay appear not to be highly favourable to the cat, for, though they have run half-wild, they do not become thoroughly feral, like so many other European animals. In another part of South America, according to Roulin (1/94. 'Mem. presentes par divers Savans: Acad. Roy.

des Sciences' tome 6 page 346. Gomara first noticed this fact in 1554.), the introduced cat has lost the habit of uttering its hideous nocturnal howl. The Rev. W.D. Fox purchased a cat in Portsmouth, which he was told came from the coast of Guinea; its skin was black and wrinkled, fur bluish-grey and short, its ears rather bare, legs long, and whole aspect peculiar. This "negro" cat was fertile with common cats. On the opposite coast of Africa, at Mombas, Captain Owen, R.N. (1/95. 'Narrative of Voyages' volume 2 page 180.) states that all the cats are covered with short stiff hair instead of fur: he gives a curious account of a cat from Algoa Bay, which had been kept for some time on board and could be identified with certainty; this animal was left for only eight weeks at Mombas, but during that short period it "underwent a complete metamorphosis, having parted with its sandy-coloured fur." A cat from the Cape of Good Hope has been described by Desmarest as remarkable from a red stripe extending along the whole length of its back. Throughout an immense area, namely, the Malayan archipelago, Siam, Pegu, and Burmah, all the cats have truncated tails about half the proper length (1/96. J. Crawfurd 'Descript. Dict. of the Indian Islands' page 255. The Madagascar cat is said to have a twisted tail; see Desmarest in 'Encyclop. Nat. Mamm.' 1820 page 233, for some of the other breeds.), often with a sort of knot at the end. In the Caroline archipelago the cats have very long legs, and are of a reddish-yellow colour. (1/97. Admiral Lutke's Voyage volume 3 page 308.) In China a breed has drooping ears. At

Tobolsk, according to Gmelin, there is a red-coloured breed. In Asia, also, we find the well-known Angora or Persian breed.

The domestic cat has run wild in several countries, and everywhere assumes, as far as can be judged by the short recorded descriptions, a uniform character. Near Maldonado, in La Plata, I shot one which seemed perfectly wild; it was carefully examined by Mr. Waterhouse (1/98. 'Zoology of the Voyage of the Beagle, Mammalia' page 20. Dieffenbach 'Travels in New Zealand' volume 2 page 185. Ch. St. John 'Wild Sports of the Highlands' 1846 page 40.), who found nothing remarkable in it, excepting its great size. In New Zealand according to Dieffenbach, the feral cats assume a streaky grey colour like that of wild cats; and this is the case with the half-wild cats of the Scotch Highlands.

We have seen that distant countries possess distinct domestic races of the cat. The differences may be in part due to descent from several aboriginal species, or at least to crosses with them. In some cases, as in Paraguay, Mombas, and Antigua, the differences seem due to the direct action of different conditions of life. In other cases some slight effect may possibly be attributed to natural selection, as cats in many cases have largely to support themselves and to escape diverse dangers. But man, owing to the difficulty of pairing cats, has done nothing by methodical selection; and probably very little by unintentional selection; though in each litter he generally saves the prettiest, and values most a good breed of mouse- or rat-catchers. Those

cats which have a strong tendency to prowl after game, generally get destroyed by traps. As cats are so much petted, a breed bearing the same relation to other cats, that lapdogs bear to larger dogs, would have been much valued; and if selection could have been applied, we should certainly have had many breeds in each long-civilised country, for there is plenty of variability to work upon.

We see in this country considerable diversity in size, some in the proportions of the body, and extreme variability in colouring. I have only lately attended to this subject, but have already heard of some singular cases of variation; one of a cat born in the West Indies toothless, and remaining so all its life. Mr. Tegetmeier has shown me the skull of a female cat with its canines so much developed that they protruded uncovered beyond the lips; the tooth with the fang being .95, and the part projecting from the gum .6 of an inch in length. I have heard of several families of six-toed cats, in one of which the peculiarity had been transmitted for at least three generations. The tail varies greatly in length; I have seen a cat which always carried its tail flat on its back when pleased. The ears vary in shape, and certain strains, in England, inherit a pencil-like tuft of hairs, above a quarter of an inch in length, on the tips of their ears; and this same peculiarity, according to Mr. Blyth, characterises some cats in India. The great variability in the length of the tail and the lynx-like tufts of hairs on the ears are apparently analogous to differences in certain wild species of the genus. A much more

important difference, according to Daubenton (1/99. Quoted by Isid. Geoffroy 'Hist. Nat. Gen.' tome 3 page 427.), is that the intestines of domestic cats are wider, and a third longer, than in wild cats of the same size; and this apparently has been by their less strictly carnivorous diet.

CHAPTER 1.II

HORSES AND ASSES.

HORSE. DIFFERENCES IN THE BREEDS. INDIVIDUAL VARIABILITY OF. DIRECT EFFECTS OF THE CONDITIONS OF LIFE. CAN WITHSTAND MUCH COLD. BREEDS MUCH MODIFIED BY SELECTION. COLOURS OF THE HORSE. DAPPLING. DARK STRIPES ON THE SPINE, LEGS, SHOULDERS, AND FOREHEAD. DUN-COLOURED HORSES MOST FREQUENTLY STRIPED. STRIPES PROBABLY DUE TO REVERSION TO THE PRIMITIVE STATE OF THE HORSE.

ASSES. BREEDS OF. COLOUR OF. LEG- AND SHOULDER-STRIPES. SHOULDER-STRIPES SOMETIMES ABSENT, SOMETIMES FORKED.

The history of the Horse is lost in antiquity. Remains of this animal in a domesticated condition have been found in the Swiss lake-dwellings, belonging to the Neolithic period. (2/1. Rutimeyer 'Fauna der Pfahlbauten' 1861 s. 122.) At the present time the number of breeds is great, as may be seen by consulting any treatise on the Horse. (2/2. See 'Youatt on the Horse': J. Lawrence on the Horse 1829; W.C.L. Martin 'History of the Horse' 1845: Col. H. Smith in 'Nat. Library, Horses' 1841 volume 12: Prof. Veith 'Die naturgesch. Haussaugethiere' 1856.)

Looking only to the native ponies of Great Britain, those of the Shetland Isles, Wales, the New Forest, and Devonshire are distinguishable; and so it is, amongst other instances, with each separate island in the great Malay archipelago. (2/3. Crawfurd 'Descript. Dict. of Indian Islands' 1856 page 153. "There are many different breeds, every island having at least one peculiar to it." Thus in Sumatra there are at least two breeds; in Achin and Batubara one; in Java several breeds; one in Bali, Lomboc, Sumbawa (one of the best breeds), Tambora, Bima, Gunung-api, Celebes, Sumba, and Philippines. Other breeds are specified by Zollinger in the 'Journal of the Indian Archipelago' volume 5 page 343 etc.) Some of the breeds present great differences in size, shape of ears, length of mane, proportions of the body, form of the withers and hind quarters, and especially in the head. Compare the race- horse, dray-horse, and a Shetland pony in size, configuration, and disposition; and see how much greater the difference is than between the seven or eight other living species of the genus Equus.

Of individual variations not known to characterise particular breeds, and not great or injurious enough to be called monstrosities, I have not collected many cases. Mr. G. Brown, of the Cirencester Agricultural College, who has particularly attended to the dentition of our domestic animals, writes to me that he has "several times noticed eight permanent incisors instead of six in the jaw." Male horses only should have canines, but they are occasionally found in the mare, though a small size.

(2/4. 'The Horse' etc. by John Lawrence 1829 page 14.) The number of ribs on each side is properly eighteen, but Youatt (2/5. 'The Veterinary' London volume 5 page 543.) asserts that not unfrequently there are nineteen, the additional one being always the posterior rib. It is a remarkable fact that the ancient Indian horse is said in the Rig-Veda to have only seventeen ribs; and M. Pietrement (2/6. 'Memoire sur les chevaux a trente-quatre cotes' 1871.), who has called attention to this subject, gives various reasons for placing full trust in this statement, more especially as during former times the Hindoos carefully counted the bones of animals. I have seen several notices of variations in the bones of the leg; thus Mr. Price (2/7. 'Proc. Veterinary Assoc.' in 'The Veterinary' volume 13 page 42.) speaks of an additional bone in the hock, and of certain abnormal appearances between the tibia and astragalus, as quite common in Irish horses, and not due to disease. Horses have often been observed, according to M. Gaudry (2/8. 'Bulletin de la Soc. Geolog.' tome 22 1866 page 22.), to possess a trapezium and a rudiment of a fifth metacarpal bone, so that "one sees appearing by monstrosity, in the foot of the horse, structures which normally exist in the foot of the Hipparion," — an allied and extinct animal. In various countries horn-like projections have been observed on the frontal bones of the horse: in one case described by Mr. Percival they arose about two inches above the orbital processes, and were "very like those in a calf from five to six months old," being from half to three- quarters of an inch in length. (2/9. Mr. Percival of the

Enniskillen Dragoons in 'The Veterinary' volume 1 page 224: see Azara, 'Des Quadrupedes du Paraguay' tome 2 page 313. The French translator of Azara refers to other cases mentioned by Huzard as having occurred in Spain.) Azara has described two cases in South America in which the projections were between three and four inches in length: other instances have occurred in Spain.

That there has been much inherited variation in the horse cannot be doubted, when we reflect on the number of the breeds existing throughout the world or even within the same country, and when we know that they have largely increased in number since the earliest known records. (2/10. Godron, 'De l'Espece' tome 1 page 378.) Even in so fleeting a character as colour, Hofacker (2/11. 'Ueber die Eigenschaften' etc. 1828 s. 10.) found that, out of 216 cases in which horses of the same colour were paired, only eleven pairs produced foals of a quite different colour. As Professor Low (2/12. 'Domesticated Animals of the British Islands' pages 527, 532. In all the veterinary treatises and papers which I have read, the writers insist in the strongest terms on the inheritance by the horse of all good and bad tendencies and qualities. Perhaps the principle of inheritance is not really stronger in the horse than in any other animal; but, from its value, the tendency has been more carefully observed.) has remarked, the English race-horse offers the best possible evidence of inheritance. The pedigree of a race-horse is of more value in judging of its probable success than its appearance:

"King Herod" gained in prizes 201,505 pounds sterling, and begot 497 winners; "Eclipse" begot 334 winners.

Whether the whole amount of difference between the various breeds has arisen under domestication is doubtful. From the fertility of the most distinct breeds (2/13. Andrew Knight crossed breeds so different in size as a dray-horse and Norwegian pony: see A. Walker on 'Intermarriage' 1838 page 205.) when crossed, naturalists have generally looked at all the breeds as having descended from a single species. Few will agree with Colonel H. Smith, who believes that they have descended from no less than five primitive and differently coloured stocks. (2/14. 'Nat. Library, Horses' volume 12 page 208.) But as several species and varieties of the horse existed (2/15. Gervais 'Hist. Nat. Mamm.' tome 2 page 143. Owen 'British Fossil Mammals' page 383.) during the later tertiary periods, and as Rutimeyer found differences in the size and form of the skull in the earliest known domesticated horses (2/16. 'Kenntniss der fossilen Pferde' 1863 s. 131.), we ought not to feel sure that all our breeds are descended from a single species. The savages of North and South America easily reclaim the feral horses, so that there is no improbability in savages in various quarters of the world having domesticated more than one native species or natural race. M. Sanson (2/17. 'Comptes rendus' 1866 page 485 and 'Journal de l'Anat. et de la Phys.' Mai 1868.) thinks that he has proved that two distinct species have been domesticated, one in the East, and one in North Africa; and that these differed in the number of their

lumbar vertebra and in various other parts; but M. Sanson seems to believe that osteological characters are subject to very little variation, which is certainly a mistake. At present no aboriginal or truly wild horse is positively known to exist; for it is commonly believed that the wild horses of the East are escaped domestic animals. (2/18. Mr. W.C.L. Martin, 'The Horse' 1845 page 34, in arguing against the belief that the wild Eastern horses are merely feral, has remarked on the improbability of man in ancient times having extirpated a species in a region where it can now exist in numbers.) If therefore our domestic breeds are descended from several species or natural races, all have become extinct in the wild state.

With respect to the causes of the modifications which horses have undergone, the conditions of life seem to produce a considerable direct effect. Mr. D. Forbes, who has had excellent opportunities of comparing the horses of Spain with those of South America, informs me that the horses of Chile, which have lived under nearly the same conditions as their progenitors in Andalusia, remain unaltered, whilst the Pampas horses and the Puno horses are considerably modified. There can be no doubt that horses become greatly reduced in size and altered in appearance by living on mountains and islands; and this apparently is due to want of nutritious or varied food. Every one knows how small and rugged the ponies are on the Northern islands and on the mountains of Europe. Corsica and Sardinia have their native ponies; and there were (2/19. 'Transact.

Maryland Academy' volume 1 part 1 page 28.), or still are, on some islands on the coast of Virginia, ponies like those of the Shetland Islands, which are believed to have originated through exposure to unfavourable conditions. The Puno ponies, which inhabit the lofty regions of the Cordillera, are, as I hear from Mr. D. Forbes, strange little creatures, very unlike their Spanish progenitors. Further south, in the Falkland Islands, the offspring of the horses imported in 1764 have already so much deteriorated in size (2/20. Mr. Mackinnon 'The Falkland Islands' page 25. The average height of the Falkland horses is said to be 14 hands 2 inches. See also my 'Journal of Researches.') and strength that they are unfitted for catching wild cattle with the lasso; so that fresh horses have to be brought for this purpose from La Plata at a great expense. The reduced size of the horses bred on both southern and northern islands, and on several mountain-chains, can hardly have been caused by the cold, as a similar reduction has occurred on the Virginian and Mediterranean islands. The horse can withstand intense cold, for wild troops live on the plains of Siberia under lat. 56 deg, (2/21. Pallas 'Act. Acad. St. Petersburgh' 1777 part 2 page 265. With respect to the tarpans scraping away the snow see Col. Hamilton Smith in 'Nat. Lib.' volume 12 page 165.) and aboriginally the horses must have inhabited countries annually covered with snow, for he long retains the instinct of scraping it away to get at the herbage beneath. The wild tarpans in the East have this instinct; and so it is, as I am informed by Admiral Sulivan, with

the horses recently and formerly introduced into the Falkland Islands from La Plata, some of which have run wild; this latter fact is remarkable, as the progenitors of these horses could not have followed this instinct during many generations in La Plata. On the other hand, the wild cattle of the Falklands never scrape away the snow, and perish when the ground is long covered. In the northern parts of America the horses descended from those introduced by the Spanish conquerors of Mexico, have the same habit, as have the native bisons, but not so the cattle introduced from Europe. (2/22. Franklin 'Narrative' volume 1 page 87 note by Sir J. Richardson.)

The horse can flourish under intense heat as well as under intense cold, for he is known to come to the highest perfection, though not attaining a large size, in Arabia and northern Africa. Much humidity is apparently more injurious to the horse than heat or cold. In the Falkland Islands, horses suffer much from the dampness; and this circumstance may perhaps partly account for the singular fact that to the eastward of the Bay of Bengal (2/23. Mr. J.H. Moor 'Notices of the Indian Archipelago' Singapore 1837 page 189. A pony from Java was sent ('Athenaeum' 1842 page 718) to the Queen only 28 inches in height. For the Loo Choo Islands, see Beechey 'Voyage' 4th. edition volume 1 page 499.), over an enormous and humid area, in Ava, Pegu, Siam, the Malayan archipelago, the Loo Choo Islands, and a large part of China, no full-sized horse is found. When we advance as far eastward as Japan, the horse reacquires his full size. (2/24.

J. Crawfurd, 'History of the Horse' 'Journal of Royal United Service Institution' volume 4.)

With most of our domesticated animals, some breeds are kept on account of their curiosity or beauty; but the horse is valued almost solely for its utility. Hence semi-monstrous breeds are not preserved; and probably all the existing breeds have been slowly formed either by the direct action of the conditions of life, or through the selection of individual differences. No doubt semi-monstrous breeds might have been formed: thus Mr. Waterton records (2/25. 'Essays on Natural History' 2nd series page 161.) the case of a mare which produced successively three foals without tails; so that a tailless race might have been formed like the tailless races of dogs and cats. A Russian breed of horses is said to have curled hair, and Azara (2/26. 'Quadrupedes du Paraguay' tome 2 page 333. Dr. Canfield informs me that a breed with curly hair was formed by selection at Los Angeles in North America.) relates that in Paraguay horses are occasionally born, but are generally destroyed, with hair like that on the head of a negro; and this peculiarity is transmitted even to half-breeds: it is a curious case of correlation that such horses have short manes and tails, and their hoofs are of a peculiar shape like those of a mule.

It is scarcely possible to doubt that the long-continued selection of qualities serviceable to man has been the chief agent in the formation of the several breeds of the horse. Look at a dray-horse, and see how well adapted he is to draw

heavy weights, and how unlike in appearance to any allied wild animal. The English race-horse is known to be derived from the commingled blood of Arabs, Turks, and Barbs; but selection, which was carried on during very early times in England (2/27. See the evidence on this head in 'Land and Water' May 2, 1868.), together with training, have made him a very different animal from his parent-stocks. As a writer in India, who evidently knows the pure Arab well, asks, who now, "looking at our present breed of race-horses, could have conceived that they were the result of the union of the Arab horse and African mare?" The improvement is so marked that in running for the Goodwood Cup "the first descendants of Arabian, Turkish, and Persian horses, are allowed a discount of 18 pounds weight; and when both parents are of these countries a discount of 36 pounds (2/28. Prof. Low 'Domesticated Animals' page 546. With respect to the writer in India see 'India Sporting Review' volume 2 page 181. As Lawrence has remarked ('The Horse' page 9), "perhaps no instance has ever occurred of a three-part bred horse (i.e. a horse, one of whose grandparents was of impure blood) saving his distance in running two miles with thoroughbred racers." Some few instances are on record of seven-eights racers having been successful.) It is notorious that the Arabs have long been as careful about the pedigree of their horses as we are, and this implies great and continued care in breeding. Seeing what has been done in England by careful breeding, can we doubt that the Arabs must likewise have produced during the course of

centuries a marked effect on the qualities of their horses? But we may go much farther back in time, for in the Bible we hear of studs carefully kept for breeding, and of horses imported at high prices from various countries. (2/29. Prof. Gervais 'Hist. Nat. Mamm.' tome 2 page 144 has collected many facts on this head. For instance Solomon (1 Kings x. 28) bought horses in Egypt at a high price.) We may therefore conclude that, whether or not the various existing breeds of the horse have proceeded from one or more aboriginal stocks, yet that a great amount of change has resulted from the direct action of the conditions of life, and probably a still greater amount from the long-continued selection by man of slight individual differences.

With several domesticated quadrupeds and birds, certain coloured marks are either strongly inherited or tend to reappear after having been lost for a long time. As this subject will hereafter be seen to be of importance, I will give a full account of the colouring of horses. All English breeds, however unlike in size and appearance, and several of those in India and the Malay archipelago, present a similar range and diversity of colour. The English race-horse, however, is said (2/30. 'The Field' July 13, 1861 page 42.) never to be dun-coloured; but as dun and cream-coloured horses are considered by the Arabs as worthless, "and fit only for Jews to ride" (2/31. E. Vernon Harcourt 'Sporting in Algeria' page 26.), these tints may have been removed by long-continued selection. Horses of every colour, and of such widely different kinds as dray-horses, cobs, and ponies, are all

occasionally dappled (2/32. I state this from my own observations made during several years on the colours of horses. I have seen cream-coloured, light-dun and mouse-dun horses dappled, which I mention because it has been stated (Martin 'History of the Horse' page 134) that duns are never dappled. Martin (page 205) refers to dappled asses. In the 'Farrier' (London 1828 pages 453, 455) there are some good remarks on the dappling of horses; and likewise in Col. Hamilton Smith on 'The Horse.'), in the same manner as is so conspicuous with grey horses. This fact does not throw any clear light on the colouring of the aboriginal horse, but is a case of analogous variation, for even asses are sometimes dappled, and I have seen, in the British Museum, a hybrid from the ass and zebra dappled on its hinder quarters. By the expression analogous variation (and it is one that I shall often have occasion to use) I mean a variation occurring in a species or variety which resembles a normal character in another and distinct species or variety. Analogous variations may arise, as will be explained in a future chapter, from two or more forms with a similar constitution having been exposed to similar conditions, — or from one of two forms having reacquired through reversion a character inherited by the other form from their common progenitor, — or from both forms having reverted to the same ancestral character. We shall immediately see that horses occasionally exhibit a tendency to become striped over a large part of their bodies; and as we know that in the varieties of the domestic cat and in several feline species stripes readily pass

into spots and cloudy marks — even the cubs of the uniformly-coloured lion being spotted with dark marks on a lighter ground — we may suspect that the dappling of the horse, which has been noticed by some authors with surprise, is a modification or vestige of a tendency to become striped.

(FIGURE 1. DUN DEVONSHIRE PONY, with shoulder, spinal, and leg stripes.)

[This tendency in the horse to become striped is in several respects an interesting fact. Horses of all colours, of the most diverse breeds, in various parts of the world, often have a dark stripe extending along the spine, from the mane to the tail; but this is so common that I need enter into no particulars. (2/33. Some details are given in 'The Farrier' 1828 pages 452, 455. One of the smallest ponies I ever saw, of the colour of a mouse, had a conspicuous spinal stripe. A small Indian chestnut pony had the same stripe, as had a remarkably heavy chestnut cart-horse. Race-horses often have the spinal stripe.) Occasionally horses are transversely barred on the legs, chiefly on the under side; and more rarely they have a distinct stripe on the shoulder, like that on the shoulder of the ass, or a broad dark patch representing a stripe. Before entering on any details I must premise that the term dun-coloured is vague, and includes three groups of colours, viz., that between cream-colour and reddish-brown, which graduates into light-bay or light-chestnut — this, I believe is often called fallow-dun; secondly, leaden or slate-colour or mouse-dun, which graduates into an ash-colour; and, lastly, dark-

dun, between brown and black. In England I have examined a rather large, lightly-built, fallow-dun Devonshire pony (Figure 1), with a conspicuous stripe along the back, with light transverse stripes on the under sides of its front legs, and with four parallel stripes on each shoulder. Of these four stripes the posterior one was very minute and faint; the anterior one, on the other hand, was long and broad, but interrupted in the middle, and truncated at its lower extremity, with the anterior angle produced into a long tapering point. I mention this latter fact because the shoulder-stripe of the ass occasionally presents exactly the same appearance. I have had an outline and description sent to me of a small, purely-bred, light fallow-dun Welch pony, with a spinal stripe, a single transverse stripe on each leg, and three shoulder-stripes; the posterior stripe corresponding with that on the shoulder of the ass was the longest, whilst the two anterior parallel stripes, arising from the mane, decreased in length, in a reversed manner as compared with the shoulder-stripes on the above-described Devonshire pony. I have seen a bright fallow-dun cob, with its front legs transversely barred on the under sides in the most conspicuous manner; also a dark- leaden mouse-coloured pony with similar leg stripes, but much less conspicuous; also a bright fallow-dun colt, fully three-parts thoroughbred, with very plain transverse stripes on the legs; also a chestnut-dun cart- horse with a conspicuous spinal stripe, with distinct traces of shoulder- stripes, but none on the legs; I could add other cases. My son made a sketch for me

of a large, heavy, Belgian cart-horse, of a fallow-dun, with a conspicuous spinal stripe, traces of leg-stripes, and with two parallel (three inches apart) stripes about seven or eight inches in length on both shoulders. I have seen another rather light cart-horse, of a dirty dark cream-colour, with striped legs, and on one shoulder a large ill-defined dark cloudy patch, and on the opposite shoulder two parallel faint stripes. All the cases yet mentioned are duns of various tints; but Mr. W.W. Edwards has seen a nearly thoroughbred chestnut horse which had the spinal stripe, and distinct bars on the legs; and I have seen two bay carriage-horses with black spinal stripes; one of these horses had on each shoulder a light shoulder-stripe, and the other had a broad back ill-defined stripe, running obliquely half-way down each shoulder; neither had leg-stripes.

The most interesting case which I have met with occurred in a colt of my own breeding. A bay mare (descended from a dark-brown Flemish mare by a light grey Turcoman horse) was put to Hercules, a thoroughbred dark bay, whose sire (Kingston) and dam were both bays. The colt ultimately turned out brown; but when only a fortnight old it was a dirty bay, shaded with mouse-grey, and in parts with a yellowish tint: it had only a trace of the spinal stripe, with a few obscure transverse bars on the legs; but almost the whole body was marked with very narrow dark stripes, in most parts so obscure as to be visible only in certain lights, like the stripes which may be seen on black kittens. These stripes were distinct on the hind-quarters, where

they diverged from the spine, and pointed a little forwards; many of them as they diverged became a little branched, exactly in the same manner as in some zebrine species. The stripes were plainest on the forehead between the ears, where they formed a set of pointed arches, one under the other, decreasing in size downwards towards the muzzle; exactly similar marks may be seen on the forehead of the quagga and Burchell's zebra. When this foal was two or three months old all the stripes entirely disappeared. I have seen similar marks on the forehead of a fully grown, fallow-dun, cob-like horse, having a conspicuous spinal stripe, and with its front legs well barred.

In Norway the colour of the native horse or pony is dun, varying from almost cream-colour to dark-mouse dun; and an animal is not considered purely bred unless it has the spinal and leg-stripes. (2/34. I have received information, through the kindness of the Consul-General, Mr. J.R. Crowe, from Prof. Boeck, Rasck, and Esmarck, on the colours of the Norwegian ponies. See also 'The Field' 1861 page 431.) My son estimated that about a third of the ponies which he saw there had striped legs; he counted seven stripes on the fore-legs and two on the hind-legs of one pony; only a few of them exhibited traces of shoulder stripes; but I have heard of a cob imported from Norway which had the shoulder as well as the other stripes well developed. Colonel H. Smith (2/35. Col. Hamilton Smith 'Nat. Lib.' volume 12 page 275.) alludes to dun-horses with the spinal stripe in the Sierras of Spain; and the horses originally derived

from Spain, in some parts of South America, are now duns. Sir W. Elliot informs me that he inspected a herd of 300 South American horses imported into Madras, and many of these had transverse stripes on the legs and short shoulder-stripes; the most strongly marked individual, of which a coloured drawing was sent me, was a mouse-dun, with the shoulder-stripes slightly forked.

In the North-Western parts of India striped horses of more than one breed are apparently commoner than in any other part of the world; and I have received information respecting them from several officers, especially from Colonel Poole, Colonel Curtis, Major Campbell, Brigadier St. John, and others. The Kattywar horses are often fifteen or sixteen hands in height, and are well but lightly built. They are of all colours, but the several kinds of duns prevail; and these are so generally striped, that a horse without stripes is not considered pure. Colonel Poole believes that all the duns have the spinal stripe, the leg-stripes are generally present, and he thinks that about half the horses have the shoulder-stripe; this stripe is sometimes double or treble on both shoulders. Colonel Poole has often seen stripes on the cheeks and sides of the nose. He has seen stripes on the grey and bay Kattywars when first foaled, but they soon faded away. I have received other accounts of cream-coloured, bay, brown, and grey Kattywar horses being striped. Eastward of India, the Shan (north of Burmah) ponies, as I am informed by Mr. Blyth, have spinal, leg, and shoulder stripes. Sir W. Elliot informs me

that he saw two bay Pegu ponies with leg-stripes. Burmese and Javanese ponies are frequently dun-coloured, and have the three kinds of stripes, "in the same degree as in England." (2/36. Mr. G. Clark in 'Annal and Mag. of Nat. History' 2nd series volume 2 1848 page 363. Mr. Wallace informs me that he saw in Java a dun and clay-coloured horse with spinal and leg stripes.) Mr. Swinhoe informs me that he examined two light- dun ponies of two Chinese breeds, viz., those of Shanghai and Amoy; both had the spinal stripe, and the latter an indistinct shoulder-stripe.

We thus see that in all parts of the world breeds of the horse as different as possible, when of a dun-colour (including under this term a wide range of tint from cream to dusty black), and rarely when almost white tinged with yellow, grey, bay, and chestnut, have the several above-specified stripes. Horses which are of a yellow colour with white mane and tail, and which are sometimes called duns, I have never seen with stripes. (2/37. See also on this point 'The Field' July 27, 1861 page 91.)

From reasons which will be apparent in the chapter on Reversion, I have endeavoured, but with poor success, to discover whether duns, which are so much oftener striped than other coloured horses, are ever produced from the crossing of two horses, neither of which are duns. Most persons to whom I have applied believe that one parent must be dun; and it is generally asserted that, when this is the case, the dun-colour and the stripes are strongly inherited. (2/38. 'The Field' 1861 pages 431, 493, 545.) One case, however, has fallen under my own observation of

a foal from a black mare by a bay horse, which when fully grown was a dark fallow-dun and had a narrow but plain spinal stripe. Hofacker (2/39. 'Ueber die Eigenschaften' etc. 1828 s. 13, 14.) gives two instances of mouse-duns (Mausrapp) being produced from two parents of different colours and neither duns.

The stripes of all kinds are generally plainer in the foal than in the adult horse, being commonly lost at the first shedding of the hair. (2/40. Von Nathusius 'Vortrage uber Viehzucht' 1872 135.) Colonel Poole believes that "the stripes in the Kattywar breed are plainest when the colt is first foaled; they then become less and less distinct till after the first coat is shed, when they come out as strongly as before; but certainly often fade away as the age of the horse increases." Two other accounts confirm this fading of the stripes in old horses in India. One writer, on the other hand, states that colts are often born without stripes, but that they appear as the colt grows older. Three authorities affirm that in Norway the stripes are less plain in the foal than in the adult. In the case described by me of the young foal which was narrowly striped over nearly all its body, there was no doubt about the early and complete disappearance of the stripes. Mr. W.W. Edwards examined for me twenty-two foals of race-horses, and twelve had the spinal stripe more or less plain; this fact, and some other accounts which I have received, lead me to believe that the spinal stripe often disappears in the English race-horse when old. With natural species, the young often exhibit characters which disappear at maturity.]

The stripes are variable in colour, but are always darker than the rest of the body. They do not by any means always coexist on the different parts of the body: the legs may be striped without any shoulder-stripe, or the converse case, which is rarer, may occur; but I have never heard of either shoulder or leg-stripes without the spinal stripe. The latter is by far the commonest of all the stripes, as might have been expected, as it characterises the other seven or eight species of the genus. It is remarkable that so trifling a character as the shoulder-stripe being double or triple should occur in such different breeds as Welch and Devonshire ponies, the Shan pony, heavy cart-horses, light South American horses, and the lanky Kattywar breed. Colonel Hamilton Smith believes that one of his five supposed primitive stocks was dun-coloured and striped; and that the stripes in all the other breeds result from ancient crosses with this one primitive dun; but it is extremely improbable that different breeds living in such distant quarters of the world should all have been crossed with any one aboriginally distinct stock. Nor have we any reason to believe that the effects of a cross at a very remote period would be propagated for so many generations as is implied on this view.

With respect to the primitive colour of the horse having been dun, Colonel Hamilton Smith (2/41. 'Nat. Library' volume 12 1841 pages 109, 156 to 163, 280, 281. Cream-colour, passing into Isabella (i.e. the colour of the dirty linen of Queen Isabella), seems to have been common in ancient times. See also Pallas's account of the wild horses of the East, who speaks of dun and

brown as the prevalent colours. In the Icelandic sagas, which were committed to writing in the twelfth century, dun-coloured horses with a black spinal stripe are mentioned; see Dasent's translation volume 1 page 169.) has collected a large body of evidence showing that this tint was common in the East as far back as the time of Alexander, and that the wild horses of Western Asia and Eastern Europe now are, or recently were, of various shades of dun. It seems that not very long ago a wild breed of dun-coloured horses with a spinal stripe was preserved in the royal parks in Prussia. I hear from Hungary that the inhabitants of that country look at the duns with a spinal stripe as the aboriginal stock, and so it is in Norway. Dun-coloured ponies are not rare in the mountainous parts of Devonshire, Wales, and Scotland, where the aboriginal breed would have the best chance of being preserved. In South America in the time of Azara, when the horse had been feral for about 250 years, 90 out of 100 horses were "bai-chatains," and the remaining ten were "zains," that is brown; not more than one in 2000 being black. In North America the feral horses show a strong tendency to become roans of various shades; but in certain parts, as I hear from Dr. Canfield, they are mostly duns and striped. (2/42. Azara 'Quadrupedes du Paraguay' tome 2 page 307. In North America Catlin (volume 2 page 57) describes the wild horses, believed to have descended from the Spanish horses of Mexico, as of all colours, black, grey, roan, and roan pied with sorrel. F. Michaux 'Travels in North America' English translation page 235, describes two wild horses

from Mexico as roan. In the Falkland Islands, where the horse has been feral only between 60 and 70 years, I was told that roans and iron-greys were the prevalent colours. These several facts show that horses do not soon revert to any uniform colour.)

In the following chapters on the Pigeon we shall see that a blue bird is occasionally produced by pure breeds of various colours and that when this occurs certain black marks invariably appear on the wings and tail; so again, when variously coloured breeds are crossed, blue birds with the same black marks are frequently produced. We shall further see that these facts are explained by, and afford strong evidence in favour of, the view that all the breeds are descended from the rock-pigeon, or Columba livia, which is thus coloured and marked. But the appearance of the stripes on the various breeds of the horse, when of a dun colour, does not afford nearly such good evidence of their descent from a single primitive stock as in the case of the pigeon: because no horse certainly wild is known as a standard of comparison; because the stripes when they appear are variable in character; because there is far from sufficient evidence that the crossing of distinct breeds produces stripes, and lastly, because all the species of the genus Equus have the spinal stripe, and several species have shoulder and leg stripes. Nevertheless the similarity in the most distinct breeds in their general range of colour, in their dappling, and in the occasional appearance, especially in duns, of leg-stripes and of double or triple shoulder-stripes, taken together, indicate the probability of the descent of all the existing

races from a single, dun-coloured, more or less striped, primitive stock, to which our horses occasionally revert.

THE ASS.

Four species of Asses, besides three zebras, have been described by naturalists. There is now little doubt that our domesticated animal is descended from the Equus taeniopus of Abyssinia. (2/43. Dr. Sclater in 'Proc. Zoolog. Soc.' 1862 page 164. Dr. Hartmann says ('Annalen der Landw.' b. 44 page 222) that this animal in its wild state is not always striped across the legs.) The ass is sometimes advanced as an instance of an animal domesticated, as we know by the Old Testament, from an ancient period, which has varied only in a very slight degree. But this is by no means strictly true; for in Syria alone there are four breeds (2/44. W.C. Martin 'History of the Horse' 1845 page 207.); first, a light and graceful animal, with an agreeable gait, used by ladies; secondly, an Arab breed reserved exclusively for the saddle; thirdly, a stouter animal used for ploughing and various purposes; and lastly, the large Damascus breed, with a peculiarly long body and ears. In the South of France also there are several breeds, and one of extraordinary size, some individuals being as tall as full-sized horses. Although the ass in England is by no means uniform in appearance, distinct breeds have not been formed. This may probably be accounted for by the animal being kept chiefly by poor persons, who do not rear large numbers, nor carefully match and select the young. For, as we shall see in a future chapter, the ass can with ease be greatly improved in

size and strength by careful selection, combined no doubt with good food; and we may infer that all its other characters would be equally amenable to selection. The small size of the ass in England and Northern Europe is apparently due far more to want of care in breeding than to cold; for in Western India, where the ass is used as a beast of burden by some of the lower castes, it is not much larger than a Newfoundland dog, "being generally not more than from twenty to thirty inches high." (2/45. Col. Sykes Cat. of Mammalia 'Proc. Zoolog. Soc.' July 12, 1831. Williamson 'Oriental Field Sports' volume 2 quoted by Martin page 206.)

The ass varies greatly in colour; and its legs, especially the fore-legs, both in England and other countries — for instance, in China — are occasionally barred more plainly than those of dun-coloured horses. Thirteen or fourteen transverse stripes have been counted on both the fore and hind legs. With the horse the occasional appearance of leg-stripes was accounted for by reversion to a supposed parent-form, and in the case of the ass we may confidently believe in this explanation, as E. taeniopus is known to be barred, though only in a slight degree, and not quite invariably. The stripes are believed to occur most frequently and to be plainest on the legs of the domestic ass during early youth (2/46. Blyth in 'Charlesworth's Mag. of Nat. Hist.' vol 4 1840 page 83. I have also been assured by a breeder that this is the case.), as likewise occurs with the horse. The shoulder-stripe, which is so eminently characteristic of the species, is nevertheless

variable in breadth, length, and manner of termination. I have measured one four times as broad as another, and some more than twice as long as others. In one light-grey ass the shoulder-stripe was only six inches in length, and as thin as a piece of string; and in another animal of the same colour there was only a dusky shade representing a stripe. I have heard of three white asses, not albinoes, with no trace of shoulder or spinal stripes (2/47. One case is given by Martin 'The Horse' page 205.); and I have seen nine other asses with no shoulder-stripe, and some of them had no spinal stripe. Three of the nine were light-greys, one a dark-grey, another grey passing into reddish-roan, and the others were brown, two being tinted on parts of their bodies with a reddish or bay shade. If therefore grey and reddish-brown asses had been steadily selected and bred from, the shoulder stripe would probably have been lost almost as generally and completely as in the case of the horse.

The shoulder stripe on the ass is sometimes double, and Mr. Blyth has seen even three or four parallel stripes. (2/48. 'Journal As. Soc. of Bengal' volume 28 1860 page 231. Martin on the Horse page 205.) I have observed in ten cases shoulder-stripes abruptly truncated at the lower end, with the anterior angle produced into a tapering point, precisely as in the above dun Devonshire pony. I have seen three cases of the terminal portion abruptly and angularly bent; and have seen and heard of four cases of a distinct though slight forking of the stripe. In Syria, Dr. Hooker and his party observed for me no less than five similar

instances of the shoulder- stripe plainly bifurcating over the fore leg. In the common mule it likewise sometimes bifurcates. When I first noticed the forking and angular bending of the shoulder-stripe, I had seen enough of the stripes in the various equine species to feel convinced that even a character so unimportant as this had a distinct meaning, and was thus led to attend to the subject. I now find that in the E. burchellii and quagga, the stripe which corresponds with the shoulder-stripe of the ass, as well as some of the stripes on the neck, bifurcate, and that some of those near the shoulder have their extremities bent angularly backwards. The bifurcation and angular bending of the stripes on the shoulders apparently are connected with the nearly upright stripes on the sides of the body and neck changing their direction and becoming transverse on the legs. Finally, we see that the presence of shoulder, leg, and spinal stripes in the horse, — their occasional absence in the ass, — the occurrence of double and triple shoulder-stripes in both animals, and the similar manner in which these stripes terminate downwards, — are all cases of analogous variation in the horse and ass. These cases are probably not due to similar conditions acting on similar constitutions, but to a partial reversion in colour to the common progenitor of the genus. We shall hereafter return to this subject, and discuss it more fully.

CHAPTER 1.III

PIGS — CATTLE — SHEEP — GOATS.

PIGS BELONG TO TWO DISTINCT TYPES, SUS SCROFA AND INDICUS. TORFSCHWEIN. JAPAN PIGS. FERTILITY OF CROSSED PIGS. CHANGES IN THE SKULL OF THE HIGHLY CULTIVATED RACES. CONVERGENCE OF CHARACTER. GESTATION. SOLID-HOOFED SWINE. CURIOUS APPENDAGES TO THE JAWS. DECREASE IN SIZE OF THE TUSKS. YOUNG PIGS LONGITUDINALLY STRIPED. FERAL PIGS. CROSSED BREEDS.

CATTLE. ZEBU A DISTINCT SPECIES. EUROPEAN CATTLE PROBABLY DESCENDED FROM THREE WILD FORMS. ALL THE RACES NOW FERTILE TOGETHER. BRITISH PARK CATTLE. ON THE COLOUR OF THE ABORIGINAL SPECIES. CONSTITUTIONAL DIFFERENCES. SOUTH AFRICAN RACES. SOUTH AMERICAN RACES. NIATA CATTLE. ORIGIN OF THE VARIOUS RACES OF CATTLE.

SHEEP. REMARKABLE RACES OF. VARIATIONS ATTACHED TO THE MALE SEX. ADAPTATIONS TO VARIOUS CONDITIONS. GESTATION OF. CHANGES IN THE WOOL. SEMI-MONSTROUS BREEDS.

GOATS. REMARKABLE VARIATIONS OF.

The breeds of the pig have recently been more closely studied, though much still remains to be done, than those of almost any other domesticated animal. This has been effected by Hermann von Nathusius in two admirable works, especially in the later one on the Skulls of the several races, and by Rutimeyer in his celebrated Fauna of the ancient Swiss lake-dwellings. (3/1. Hermann von Nathusius 'Die Racen des Schweines' Berlin 1860; and 'Vorstudien fur Geschichte' etc. 'Schweineschadel' Berlin 1864. Rutimeyer 'Die Fauna der Pfahlbauten' Basel 1861.) Nathusius has shown that all the known breeds may be divided into two great groups: one resembling in all important respects and no doubt descended from the common wild boar; so that this may be called the Sus scrofa group. The other group differs in several important and constant osteological characters; its wild parent- form is unknown; the name given to it by Nathusius, according to the law of priority, is Sus indicus, of Pallas. This name must now be followed, though an unfortunate one, as the wild aboriginal does not inhabit India, and the best-known domesticated breeds have been imported from Siam and China.

First for the Sus scrofa breeds, or those resembling the common wild boar. These still exist, according to Nathusius ('Schweineschadel' s. 75), in various parts of central and northern Europe; formerly every kingdom (3/2. Nathusius 'Die Racen des Schweines' Berlin 1860. An excellent appendix is given with references to published and trustworthy drawings of the breeds

of each country), and almost every province in Britain, possessed its own native breed; but these are now everywhere rapidly disappearing, being replaced by improved breeds crossed with the S. indicus form. The skull in the breeds of the S. scrofa type resembles, in all important respects, that of the European wild boar; but it has become ('Schweineschadel' s. 63-68) higher and broader relatively to its length; and the hinder part is more upright. The differences, however, are all variable in degree. The breeds which thus resemble S. scrofa in their essential skull characters differ conspicuously from each other in other respects, as in the length of the ears and legs, curvature of the ribs, colour, hairiness, size and proportions of the body.

The wild Sus scrofa has a wide range, namely, Europe, North Africa, as identified by osteological characters by Rutimeyer, and Hindostan, as similarly identified by Nathusius. But the wild boars inhabiting these several countries differ so much from each other in external characters, that they have been ranked by some naturalists as specifically distinct. Even within Hindostan these animals, according to Mr. Blyth, form very distinct races in the different districts; in the N. Western provinces, as I am informed by the Rev. R. Everest, the boar never exceeds 36 inches in height, whilst in Bengal one has been measured 44 inches in height. In Europe, Northern Africa, and Hindostan, domestic pigs have been known to cross with the wild native species (3/3. For Europe see Bechstein 'Naturgesch. Deutschlands' 1801 b. 1 s. 505. Several accounts have been

published on the fertility of the offspring from wild and tame swine. See Burdach 'Physiology' and Godron 'De l'Espece' tome 1 page 370. For Africa 'Bull. de la Soc. d'Acclimat.' tome 4 page 389. For India see Nathusius 'Schweineschadel' s. 148.); and in Hindostan an accurate observer (3/4. Sir W. Elliot Catalogue of Mammalia 'Madras Journal of Lit. and Science' volume 10 page 219.), Sir Walter Elliot, after describing the differences between wild Indian and wild German boars, remarks that "the same differences are perceptible in the domesticated individuals of the two countries." We may therefore conclude that the breeds of the Sus scrofa type are descended from, or have been modified by crossing with, forms which may be ranked as geographical races, but which, according to some naturalists, ought to be ranked as distinct species.

Pigs of the Sus indicus type are best known to Englishmen under the form of the Chinese breed. The skull of S. indicus, as described by Nathusius, differs from that of S. scrofa in several minor respects, as in its greater breadth and in some details in the teeth; but chiefly in the shortness of the lachrymal bones, in the greater width of the fore part of the palate- bones, and in the divergence of the premolar teeth. It deserves especial notice that these latter characters are not gained, even in the least degree, by the domesticated forms of S. scrofa. After reading the remarks and descriptions given by Nathusius, it seems to me to be merely playing with words to doubt whether S. indicus ought to be ranked as a species; for the above-specified differences are more

strongly marked than any that can be pointed out between, for instance, the fox and the wolf, or the ass and the horse. As already stated, S. indicus is not known in a wild state; but its domesticated forms, according to Nathusius, come near to S. vittatus of Java and some allied species. A pig found wild in the Aru islands ('Schweineschadel' s. 169) is apparently identical with S. indicus; but it is doubtful whether this is a truly native animal. The domesticated breeds of China, Cochin-China, and Siam belong to this type. The Roman or Neapolitan breed, the Andalusian, the Hungarian, and the "Krause" swine of Nathusius, inhabiting south-eastern Europe and Turkey, and having fine curly hair, and the small Swiss "Bundtnerschwein" of Rutimeyer, all agree in their more important skull-characters with S. indicus, and, as is supposed, have all been largely crossed with this form. Pigs of this type have existed during a long period on the shores of the Mediterranean, for a figure ('Schweineschadel' s. 142) closely resembling the existing Neapolitan pig was found in the buried city of Herculaneum.

Rutimeyer has made the remarkable discovery that there lived contemporaneously in Switzerland, during the Neolithic period, two domesticated forms, the S. scrofa, and the S. scrofa palustris or Torfschwein. Rutimeyer perceived that the latter approached the Eastern breeds, and, according to Nathusius, it certainly belongs to the S. indicus group; but Rutimeyer has subsequently shown that it differs in some well- marked characters. This author was formerly convinced that his Torfschwein existed as

a wild animal during the first part of the Stone period, and was domesticated during a later part of the same period. (3/5. 'Pfahlbauten' s. 163 et passim.) Nathusius, whilst he fully admits the curious fact first observed by Rutimeyer, that the bones of domesticated and wild animals can be distinguished by their different aspect, yet, from special difficulties in the case of the bones of the pig ('Schweineschadel' s. 147), is not convinced of the truth of the above conclusion; and Rutimeyer himself seems now to feel some doubt. Other naturalists have also argued strongly on the same side as Nathusius. (3/6. See J.W. Schutz' interesting essay 'Zur Kenntniss des Torfschweins' 1868. This author believes that the Torfschwein is descended from a distinct species, the S. sennariensis of Central Africa.)

Several breeds, differing in the proportions of the body, in the length of the ears, in the nature of the hair, in colour, etc., come under the S. indicus type. Nor is this surprising, considering how ancient the domestication of this form has been both in Europe and in China. In this latter country the date is believed by an eminent Chinese scholar (3/7. Stan. Julien quoted by de Blainville 'Osteographie' page 163.) to go back at least 4900 years from the present time. This same scholar alludes to the existence of many local varieties of the pig in China; and at the present time the Chinese take extraordinary pains in feeding and tending their pigs, not even allowing them to walk from place to place. (3/8. Richardson 'Pigs, their Origin' etc. page 26.) Hence these pigs, as Nathusius has remarked (3/9. 'Die

Racen des Schweines' s. 47, 64.), display in an eminent degree the characters of a highly-cultivated race, and hence, no doubt, their high value in the improvement of our European breeds. Nathusius makes a remarkable statement ('Schweineschadel' s. 138), that the infusion of the 1/32nd, or even of the 1/64th, part of the blood of S. indicus into a breed of S. scrofa, is sufficient plainly to modify the skull of the latter species. This singular fact may perhaps be accounted for by several of the chief distinctive characters of S. indicus, such as the shortness of the lachrymal bones, etc., being common to several species of the genus; for in crosses characters which are common to many species apparently tend to be prepotent over those appertaining to only a few species.

(FIGURE 2. HEAD OF JAPAN OR MASKED PIG. (Copied from Mr. Bartlett's paper in 'Proc. Zoolog. Soc.' 1861 page 263.))

The Japan pig (S. pliciceps of Gray), which was formerly exhibited in the Zoological Gardens, has an extraordinary appearance from its short head, broad forehead and nose, great fleshy ears, and deeply furrowed skin. Figure 2 is copied from that given by Mr. Bartlett. (3/10. 'Proc. Zoolog. Soc.' 1861 page 263.) Not only is the face furrowed, but thick folds of skin, which are harder than the other parts, almost like the plates on the Indian rhinoceros, hang about the shoulders and rump. It is coloured black, with white feet, and breeds true. That it has long been domesticated there can be little doubt; and this

might have been inferred even from the fact that its young are not longitudinally striped; for this is a character common to all the species included within the genus Sus and the allied genera whilst in their natural state. (3/11. Sclater in 'Proc. Zoolog. Soc.' February 26, 1861.) Dr. Gray (3/12. 'Proc. Zoolog. Soc.' 1862 page 13. The skull has since been described much more fully by Professor Lucae in a very interesting essay, 'Der Schadel des Maskenschweines' 1870. He confirms the conclusion of von Nathusius on the relationship of this kind of pig.) has described the skull of this animal, which he ranks not only as a distinct species, but places it in a distinct section of the genus. Nathusius, however, after his careful study of the whole group, states positively ('Schweineschadel' s. 153-158). that the skull in all essential characters closely resembles that of the short-eared Chinese breed of the S. indicus type. Hence Nathusius considers the Japan pig as only a domesticated variety of S. indicus: if this really be the case, it is a wonderful instance of the amount of modification which can be effected under domestication.

Formerly there existed in the central islands of the Pacific Ocean a singular breed of pigs. These are described by the Rev. D. Tyerman and G. Bennett (3/13. 'Journal of Voyages and Travels from 1821 to 1829' volume 1 page 300.) as of small size, hump-backed, with a disproportionately long head, with short ears turned backwards, with a bushy tail not more than two inches in length, placed as if it grew from the back. Within half a century after the introduction of European and

Chinese pigs into these islands, the native breed, according to the above authors, became almost completely lost by being repeatedly crossed with them. Secluded islands, as might have been expected, seem favourable for the production or retention of peculiar breeds; thus, in the Orkney Islands, the hogs have been described as very small, with erect and sharp ears, and "with an appearance altogether different from the hogs brought from the south." (3/14. Rev. G. Low 'Fauna Orcadensis' page 10. See also Dr. Hibbert's account of the pig of the Shetland Islands.)

Seeing how different the Chinese pigs, belonging to the Sus indicus type, are in their osteological characters and in external appearance from the pigs of the S. scrofa type, so that they must be considered specifically distinct, it is a fact well deserving attention, that Chinese and common pigs have been repeatedly crossed in various manners, with unimpaired fertility. One great breeder who had used pure Chinese pigs assured me that the fertility of the half-breeds inter se and of their recrossed progeny was actually increased; and this is the general belief of agriculturists. Again, the Japan pig or S. pliciceps of Gray is so distinct in appearance from all common pigs, that it stretches one's belief to the utmost to admit that it is simply a domestic variety; yet this breed has been found perfectly fertile with the Berkshire breed; and Mr. Eyton informs me that he paired a half-bred brother and sister and found them quite fertile together.

(FIGURE 3. HEAD OF WILD BOAR, AND OF "GOLDEN DAYS," a pig of the Yorkshire Large Breed; the latter from

a photograph. (Copied from Sidney's edition of 'The Pig' by Youatt.))

The modification of the skull in the most highly cultivated races is wonderful. To appreciate the amount of change, Nathusius' work, with its excellent figures, should be studied. The whole of the exterior in all its parts has been altered: the hinder surface, instead of sloping backwards, is directed forwards, entailing many changes in other parts; the front of the head is deeply concave; the orbits have a different shape; the auditory meatus has a different direction and shape; the incisors of the upper and lower jaws do not touch each other, and they stand in both jaws beyond the plane of the molars; the canines of the upper jaw stand in front of those of the lower jaw, and this is a remarkable anomaly: the articular surfaces of the occipital condyles are so greatly changed in shape, that, as Nathusius remarks (s. 133), no naturalist, seeing this important part of the skull by itself, would suppose that it belonged to the genus Sus. These and various other modifications, as Nathusius observes, can hardly be considered as monstrosities, for they are not injurious, and are strictly inherited. The whole head is much shortened; thus, whilst in common breeds its length to that of the body is as 1 to 6, in the "cultur-racen" the proportion is as 1 to 9, and even recently as 1 to 11. (3/15. 'Die Racen des Schweines' s. 70.) Figure 3 (3/16. These woodcuts are copied from engravings given in Mr. S. Sidney's excellent edition of 'The Pig' by Youatt 1860. See pages 1, 16, 19.) of the head of a wild boar and of a

sow from a photograph of the Yorkshire Large Breed, may aid in showing how greatly the head in a highly cultivated race has been modified and shortened.

Nathusius has well discussed the causes of the remarkable changes in the skull and shape of the body which the highly cultivated races have undergone. These modifications occur chiefly in the pure and crossed races of the S. indicus type; but their commencement may be clearly detected in the slightly improved breeds of the S. scrofa type. (3/17. 'Schweineschadel' s. 74, 135.) Nathusius states positively (s. 99, 103), as the result of common experience and of his experiments, that rich and abundant food, given during youth, tends by some direct action to make the head broader and shorter; and that poor food works a contrary result. He lays much stress on the fact that all wild and semi-domesticated pigs, in ploughing up the ground with their muzzles, have, whilst young, to exert the powerful muscles fixed to the hinder part of the head. In highly cultivated races this habit is no longer followed, and consequently the back of the skull becomes modified in shape, entailing other changes in other parts. There can hardly be a doubt that so great a change in habits would affect the skull; but it seems rather doubtful how far this will account for the greatly reduced length of the skull and for its concave front. It is well known (Nathusius himself advancing many cases, s. 104) that there is a strong tendency in many domestic animals — in bull- and pug-dogs, in the niata cattle, in sheep, in Polish fowls, short- faced tumbler pigeons, and

in one variety of the carp — for the bones of the face to become greatly shortened. In the case of the dog, as H. Muller has shown, this seems caused by an abnormal state of the primordial cartilage. We may, however, readily admit that abundant and rich food supplied during many generations would give an inherited tendency to increased size of body, and that, from disuse, the limbs would become finer and shorter. (3/18. Nathusius 'Die Racen des Schweines' s. 71.) We shall in a future chapter see also that the skull and limbs are apparently in some manner correlated, so that any change in the one tends to affect the other.

Nathusius has remarked, and the observation is an interesting one, that the peculiar form of the skull and body in the most highly cultivated races is not characteristic of any one race, but is common to all when improved up to the same standard. Thus the large-bodied, long-eared, English breeds with a convex back, and the small-bodied, short-eared, Chinese breeds with a concave back, when bred to the same state of perfection, nearly resemble each other in the form of the head and body. This result, it appears, is partly due to similar causes of change acting on the several races, and partly to man breeding the pig for one sole purpose, namely, for the greatest amount of flesh and fat; so that selection has always tended towards one and the same end. With most domestic animals the result of selection has been divergence of character, here it has been convergence. (3/19. 'Die Racen des Schweines' s. 47. 'Schweineschadel' s. 104. Compare also the figures of the old Irish and the improved Irish breeds in

Richardson on 'The Pig' 1847.)

The nature of the food supplied during many generations has apparently affected the length of the intestines; for, according to Cuvier (3/20. Quoted by Isid. Geoffroy 'Hist. Nat. Gen.' tome 3 page 441.), their length to that of the body in the wild boar is as 9 to 1, — in the common domestic boar as 13.5 to 1, — and in the Siam breed as 16 to 1. In this latter breed the greater length may be due either to descent from a distinct species or to more ancient domestication. The number of mammae vary, as does the period of gestation. The latest authority says (3/21. S. Sidney 'The Pig' page 61.) that "the period averages from 17 to 20 weeks," but I think there must be some error in this statement: in M. Tessier's observations on 25 sows it varied from 109 to 123 days. The Rev. W.D. Fox has given me ten carefully recorded cases with well-bred pigs, in which the period varied from 101 to 116 days. According to Nathusius the period is shortest in the races which come early to maturity; but the course of their development does not appear to be actually shortened, for the young animal is born, judging from the state of the skull, less fully developed, or in a more embryonic condition (3/22. 'Schweineschadel' s. 2, 20.) than in the case of common swine. In the highly cultivated and early matured races the teeth, also, are developed earlier.

The difference in the number of the vertebrae and ribs in different kinds of pigs, as observed by Mr. Eyton (3/23. 'Proc. Zoolog. Soc.' 1837 page 23. I have not given the caudal vertebrae, as Mr. Eyton says some might possibly have been lost.

I have added together the dorsal and lumbar vertebrae, owing to Prof. Owen's remarks ('Journal Linn. Soc.' volume 2 page 28) on the difference between dorsal and lumbar vertebrae depending only on the development of the ribs. Nevertheless the difference in the number of the ribs in pigs deserves notice. M. Sanson gives the number of lumbar vertebrae in various pigs; 'Comptes Rendus' 93 page 843.), and as given in the following table, has often been quoted. The African sow probably belongs to the S. scrofa type; and Mr. Eyton informs me that, since the publication of this paper, cross-bred animals from the African and English races were found by Lord Hill to be perfectly fertile.

TABLE 2: NUMBER OF VERTEBRAE IN VARIOUS PIGS:

ENGLISH LONG-LEGGED MALE.

Dorsal 15. Lumbar 6. Dorsal plus Lumbar 21. Sacral 5. Total 26.

AFRICAN FEMALE.

Dorsal 13. Lumbar 6. Dorsal plus Lumbar 19. Sacral 5. Total 24.

CHINESE MALE.

Dorsal 15. Lumbar 4. Dorsal plus Lumbar 19. Sacral 4. Total 23.

WILD BOAR FROM CUVIER.

Dorsal 14. Lumbar 5. Dorsal plus Lumbar 19. Sacral 4. Total 23.

FRENCH DOMESTIC BOAR, FROM CUVIER.

Dorsal 14. Lumbar 5. Dorsal plus Lumbar 19. Sacral 4. Total 23.

Some semi-monstrous breeds deserve notice. From the time of Aristotle to the present time solid-hoofed swine have occasionally been observed in various parts of the world. Although this peculiarity is strongly inherited, it is hardly probable that all the animals with solid hoofs have descended from the same parents; it is more probable that the same peculiarity has reappeared at various times and places. Dr. Struthers has lately described and figured (3/24. 'Edinburgh New Philosoph. Journal' April 1863. See also De Blainville 'Osteographie' page 128 for various authorities on this subject.) the structure of the feet; in both front and hind feet the distal phalanges of the two greater toes are represented by a single, great, hoof-bearing phalanx; and in the front feet, the middle phalanges are represented by a bone which is single towards the lower end, but bears two separate articulations towards the upper end. From other accounts it appears that an intermediate toe is likewise sometimes superadded.

(FIGURE 4. OLD IRISH PIG, with jaw appendages. (Copied from H.D. Richardson on Pigs.))

Another curious anomaly is offered by the appendages, described by M. Eudes-Deslongchamps as often characterizing the Normandy pigs. These appendages are always attached to the same spot, to the corners of the jaw; they are cylindrical, about three inches in length, covered with bristles, and with a pencil of

bristles rising out of a sinus on one side: they have a cartilaginous centre, with two small longitudinal muscles they occur either symmetrically on both sides of the face or on one side alone. Richardson figures them on the gaunt old "Irish Greyhound pig;" and Nathusius states that they occasionally appear in all the long eared races, but are not strictly inherited, for they occur or fail in animals of the same litter. (3/25. Eudes-Deslongchamps 'Memoires de la Soc. Linn. de Normandie' volume 7 1842 page 41. Richardson 'Pigs, their Origin, etc.' 1847 page 30. Nathusius 'Die Racen des Schweines' 1863 s. 54.) As no wild pigs are known to have analogous appendages, we have at present no reason to suppose that their appearance is due to reversion; and if this be so, we are forced to admit that a somewhat complex, though apparently useless, structure may be suddenly developed without the aid of selection.

It is a remarkable fact that the boars of all domesticated breeds have much shorter tusks than wild boars. Many facts show that with many animals the state of the hair is much affected by exposure to, or protection from, climate; and as we see that the state of the hair and teeth are correlated in Turkish dogs (other analogous facts will be hereafter given), may we not venture to surmise that the reduction of the tusks in the domestic boar is related to his coat of bristles being diminished from living under shelter? On the other hand, as we shall immediately see, the tusks and bristles reappear with feral boars, which are no longer protected from the weather. It is not surprising that the tusks

should be more affected than the other teeth; as parts developed to serve as secondary sexual characters are always liable to much variation.

It is a well-known fact that the young of wild European and Indian pigs (3/26. D. Johnson 'Sketches of Indian Field Sports' page 272. Mr. Crawfurd informs me that the same fact holds good with the wild pigs of the Malay peninsula.), for the first six months, are longitudinally banded with light-coloured stripes. This character generally disappears under domestication. The Turkish domestic pigs, however, have striped young, as have those of Westphalia, "whatever may be their hue" (3/27. For Turkish pigs see Desmarest 'Mammalogie' 1820 page 391. For those of Westphalia see Richardson 'Pigs, their Origin, etc.' 1847 page 41.); whether these latter pigs belong to the same curly-haired race as the Turkish swine, I do not know. The pigs which have run wild in Jamaica and the semi-feral pigs of New Granada, both those which are black and those which are black with a white band across the stomach, often extending over the back, have resumed this aboriginal character and produce longitudinally-striped young. This is likewise the case, at least occasionally, with the neglected pigs in the Zambesi settlement on the coast of Africa. (3/28. With respect to the several foregoing and following statements on feral pigs see Roulin in 'Mem. presentes par divers Savans a l'Acad.' etc. Paris tome 6 1835 page 326. It should be observed that his account does not apply to truly feral pigs; but to pigs long introduced into

the country and living in a half- wild state. For the truly feral pigs of Jamaica see Gosse 'Sojourn in Jamaica' 1851 page 386; and Col Hamilton Smith in 'Nat. Library' volume 9 page 93. With respect to Africa see Livingstone 'Expedition to the Zambesi' 1865 page 153. The most precise statement with respect to the tusks of the West Indian feral boars is by P. Labat quoted by Roulin; but this author attributes the state of these pigs to descent from a domestic stock which he saw in Spain. Admiral Sulivan, R.N., had ample opportunities of observing the wild pigs on Eagle Islet in the Falklands; and he informs me that they resembled wild boars with bristly ridged backs and large tusks. The pigs which have run wild in the province of Buenos Ayres (Rengger 'Saugethiere' s. 331) have not reverted to the wild type. De Blainville 'Osteographie' page 132 refers to two skulls of domestic pigs sent from Patagonia by Al. d'Orbigny, and he states that they have the occipital elevation of the wild European boar, but that the head altogether is "plus courte et plus ramassee." He refers also to the skin of a feral pig from North America, and says "il ressemble tout a fait a un petit sanglier, mais il est presque tout noir, et peut-etre un peu plus ramasse dans ses formes."

The common belief that all domesticated animals, when they run wild, revert completely to the character of their parent-stock, is chiefly founded, as far as I can discover, on feral pigs. But even in this case the belief is not grounded on sufficient evidence; for the two main types, namely, S. scrofa and indicus, have not been distinguished. The young, as we have just seen, reacquire

their longitudinal stripes, and the boars invariably reassume their tusks. They revert also in the general shape of their bodies, and in the length of their legs and muzzles, to the state of the wild animal, as might have been expected from the amount of exercise which they are compelled to take in search of food. In Jamaica the feral pigs do not acquire the full size of the European wild boar, "never attaining a greater height than 20 inches at the shoulder." In various countries they reassume their original bristly covering, but in different degrees, dependent on the climate; thus, according to Roulin, the semi-feral pigs in the hot valleys of New Granada are very scantily clothed; whereas, on the Paramos, at the height of 7000 to 8000 feet, they acquire a thick covering of wool lying under the bristles, like that on the truly wild pigs of France. These pigs on the Paramos are small and stunted. The wild boar of India is said to have the bristles at the end of its tail arranged like the plumes of an arrow, whilst the European boar has a simple tuft; and it is a curious fact that many, but not all, of the feral pigs in Jamaica, derived from a Spanish stock, have a plumed tail. (3/29. Gosse 'Jamaica' page 386 with a quotation from Williamson 'Oriental Field Sports.' Also Col. Hamilton Smith in 'Naturalist Library' volume 9 page 94.) With respect to colour, feral pigs generally revert to that of the wild boar; but in certain parts of S. America, as we have seen, some of the semi-feral pigs have a curious white band across their stomachs; and in certain other hot places the pigs are red, and this colour has likewise occasionally been observed in the

feral pigs of Jamaica. From these several facts we see that with pigs when feral there is a strong tendency to revert to the wild type; but that this tendency is largely governed by the nature of the climate, amount of exercise, and other causes of change to which they have been subjected.

The last point worth notice is that we have unusually good evidence of breeds of pigs now keeping perfectly true, which have been formed by the crossing of several distinct breeds. The Improved Essex pigs, for instance, breed very true; but there is no doubt that they largely owe their present excellent qualities to crosses originally made by Lord Western with the Neapolitan race, and to subsequent crosses with the Berkshire breed (this also having been improved by Neapolitan crosses), and likewise, probably, with the Sussex breed. (3/30. S. Sidney's edition of 'Youatt on the Pig' 1860 pages 7, 26, 27, 29, 30.) In breeds thus formed by complex crosses, the most careful and unremitting selection during many generations has been found to be indispensable. Chiefly in consequence of so much crossing, some well-known breeds have undergone rapid changes; thus, according to Nathusius (3/31. 'Schweineschadel' s 140.), the Berkshire breed of 1780 is quite different from that of 1810; and, since this latter period, at least two distinct forms have borne the same name.

CATTLE.

Domestic cattle are certainly the descendants of more than one wild form, in the same manner as has been shown to be

the case with our dogs and pigs. Naturalists have generally made two main divisions of cattle: the humped kinds inhabiting tropical countries, called in India Zebus, to which the specific name of Bos indicus has been given; and the common non-humped cattle, generally included under the name of Bos taurus. The humped cattle were domesticated, as may be seen on the Egyptian monuments, at least as early as the twelfth dynasty, that is 2100 B.C. They differ from common cattle in various osteological characters, even in a greater degree, according to Rutimeyer (3/32. 'Die Fauna der Pfahlbauten' 1861 s. 109, 149, 222. See also Geoffroy Saint-Hilaire in 'Mem. du Mus. d'Hist. Nat.' tome 10 page 172; and his son Isidore in 'Hist. Nat. Gen.' tome 3 page 69. Vasey in his 'Delineations of the Ox Tribe' 1851 page 127, says the zebu has four, and common ox five, sacral vertebrae. Mr. Hodgson found the ribs either thirteen or fourteen in number; see a note in 'Indian Field' 1858 page 62.) than do the fossil and prehistoric European species, namely, Bos primigenius and longifrons, from each other. They differ, also, as Mr. Blyth (3/33. 'The Indian Field' 1858 page 74 where Mr. Blyth gives his authorities with respect to the feral humped cattle. Pickering also in his 'Races of Man' 1850 page 274 notices the peculiar grunt-like character of the voice of the humped cattle.), who has particularly attended to this subject, remarks, in general configuration, in the shape of their ears, in the point where the dewlap commences, in the typical curvature of their horns, in their manner of carrying their heads when at rest, in their

ordinary variations of colour, especially in the frequent presence of "nilgau-like markings on their feet," and "in the one being born with teeth protruding through the jaws, and the other not so." They have different habits, and their voice is entirely different. The humped cattle in India "seldom seek shade, and never go into the water and there stand knee-deep, like the cattle of Europe." They have run wild in parts of Oude and Rohilcund, and can maintain themselves in a region infested by tigers. They have given rise to many races differing greatly in size, in the presence of one or two humps, in length of horns, and other respects. Mr. Blyth sums up emphatically that the humped and humpless cattle must be considered as distinct species. When we consider the number of points in external structure and habits, independently of important osteological differences, in which they differ from each other; and that many of these points are not likely to have been affected by domestication, there can hardly be a doubt, notwithstanding the adverse opinion of some naturalists, that the humped and non-humped cattle must be ranked as specifically distinct.

The European breeds of humpless cattle are numerous. Professor Low enumerates 19 British breeds, only a few of which are identical with those on the Continent. Even the small Channel islands of Guernsey, Jersey, and Alderney possess their own sub-breeds (3/34. Mr. H.E. Marquand in 'The Times' June 23, 1856.); and these again differ from the cattle of the other British islands, such as Anglesea, and the western isles of Scotland.

Desmarest, who paid attention to the subject, describes 15 French races, excluding sub-varieties and those imported from other countries. In other parts of Europe there are several distinct races, such as the pale-coloured Hungarian cattle, with their light and free step, and enormous horns sometimes measuring above five feet from tip to tip (3/35. Vasey 'Delineations of the Ox-Tribe' page 124. Brace 'Hungary' 1851 page 94. The Hungarian cattle descend according to Rutimeyer 'Zahmen Europ. Rindes' 1866 s. 13 from Bos primigenius.): the Podolian cattle also are remarkable from the height of their fore-quarters. In the most recent work on Cattle (3/36. Moll and Gayot 'La Connaissance Gen. du Boeuf' Paris 1860. Fig. 82 is that of the Podolian breed.), engravings are given of fifty-five European breeds; it is, however, probable that several of these differ very little from each other, or are merely synonyms. It must not be supposed that numerous breeds of cattle exist only in long-civilised countries, for we shall presently see that several kinds are kept by the savages of Southern Africa.

[With respect to the parentage of the several European breeds, we already know much from Nilsson's Memoir (3/37. A translation appeared in three parts in the 'Annals and Mag. of Nat. Hist.' 2nd series volume 4 1849.), and more especially from Rutimeyer's works and those of Boyd Dawkins. Two or three species or forms of Bos, closely allied to still living domestic races, have been found in the more recent tertiary deposits or amongst prehistoric remains in Europe. Following Rutimeyer,

we have: Bos primigenius.

This magnificent, well known species was domesticated in Switzerland during the Neolithic period; even at this early period it varied a little, having apparently been crossed with other races. Some of the larger races on the Continent, as the Friesland, etc., and the Pembroke race in England, closely resemble in essential structure B. primigenius, and no doubt are its descendants. This is likewise the opinion of Nilsson. Bos primigenius existed as a wild animal in Caesar's time, and is now semi-wild, though much degenerated in size, in the park of Chillingham; for I am informed by Professor Rutimeyer, to whom Lord Tankerville sent a skull, that the Chillingham cattle are less altered from the true primigenius type than any other known breed. (3/38. See also Rutimeyer 'Beitrage pal. Gesch. der Wiederkauer' Basel 1865 s. 54.)

Bos trochoceros.

This form is not included in the three species above mentioned, for it is now considered by Rutimeyer to be the female of an early domesticated form of B. primigenius, and as the progenitor of his frontosus race. I may add that specific names have been given to four other fossil oxen, now believed to be identical with B. primigenius. (3/39. Pictet 'Palaeontologie' tome 1 page 365 2nd edition. With respect to B. trochoceros see Rutimeyer 'Zahmen Europ. Rindes' 1866 s. 26.)

Bos longifrons (or brachyceros) of Owen.

This very distinct species was of small size, and had a short

body with fine legs. According to Boyd Dawkins (3/40. W. Boyd Dawkins on the British Fossil Oxen 'Journal of the Geolog. Soc.' August 1867 page 182. Also 'Proc. Phil. Soc. of Manchester' November 14, 1871 and 'Cave Hunting' 1875 page 27, 138.) it was introduced as a domesticated animal into Britain at a very early period, and supplied food to the Roman legionaries. (3/41. 'British Pleistocene Mammalia' by W.B. Dawkins and W.A. Sandford 1866 page 15.) Some remains have been found in Ireland in certain crannoges, of which the dates are believed to be from 843-933 A.D. (3/42. W.R. Wilde 'An Essay on the Animal Remains, etc. Royal Irish Academy' 1860 page 29. Also 'Proc. of R. Irish Academy' 1858 page 48.) It was also the commonest form in a domesticated condition in Switzerland during the earliest part of the Neolithic period. Professor Owen (3/43. 'Lecture: Royal Institution of G. Britain' May 2, 1856 page 4. 'British Fossil Mammals' page 513.) thinks it probable that the Welsh and Highland cattle are descended from this form; as likewise is the case, according to Rutimeyer, with some of the existing Swiss breeds. These latter are of different shades of colour from light- grey to blackish-brown, with a lighter stripe along the spine, but they have no pure white marks. The cattle of North Wales and the Highlands, on the other hand, are generally black or dark-coloured.

Bos frontosus of Nilsson.

This species is allied to B. longifrons, and, according to the high authority of Mr. Boyd Dawkins, is identical with it, but in

the opinion of some judges is distinct. Both co-existed in Scania during the same late geological period (3/44. Nilsson in 'Annals and Mag. of Nat. Hist.' 1849 volume 4 page 354.), and both have been found in the Irish crannoges. (3/45. See W.R. Wilde ut supra; and Mr. Blyth in 'Proc. Irish Academy' March 5, 1864.) Nilsson believes that his B. frontosus may be the parent of the mountain cattle of Norway, which have a high protuberance on the skull between the base of the horns. As Professor Owen and others believe that the Scotch Highland cattle are descended from his B. longifrons, it is worth notice that a capable judge (3/46. Laing 'Tour in Norway' page 110.) has remarked that he saw no cattle in Norway like the Highland breed, but that they more nearly resembled the Devonshire breed.]

On the whole we may conclude, more especially from the researches of Boyd Dawkins, that European cattle are descended from two species; and there is no improbability in this fact, for the genus Bos readily yields to domestication. Besides these two species and the zebu, the yak, the gayal, and the arni (3/47. Isid. Geoffroy Saint-Hilaire 'Hist. Nat. Gen.' tome 3, 96.) (not to mention the buffalo or genus Bubalus) have been domesticated; making altogether six species of Bos. The zebu and the two European species are now extinct in a wild state. Although certain races of cattle were domesticated at a very ancient period in Europe, it does not follow that they were first domesticated here. Those who place much reliance on philology argue that they were imported from the East. (3/48. Idem tome 3 pages

82, 91.) It is probable that they originally inhabited a temperate or cold climate, but not a land long covered with snow; for our cattle, as we have seen in the chapter on Horses, have not the instinct of scraping away the snow to get at the herbage beneath. No one could behold the magnificent wild bulls on the bleak Falkland Islands in the southern hemisphere, and doubt about the climate being admirably suited to them. Azara has remarked that in the temperate regions of La Plata the cows conceive when two years old, whilst in the much hotter country of Paraguay they do not conceive till three years old; "from which fact," as he adds, "one may conclude that cattle do not succeed so well in warm countries." (3/49. 'Quadrupedes du Paraguay' tome 2 page 360.)

Bos primigenius and longifrons have been ranked by nearly all palaeontologists as distinct species; and it would not be reasonable to take a different view simply because their domesticated descendants now intercross with the utmost freedom. All the European breeds have so often been crossed both intentionally and unintentionally, that, if any sterility had ensued from such unions, it would certainly have been detected. As zebus inhabit a distant and much hotter region, and as they differ in so many characters from our European cattle, I have taken pains to ascertain whether the two forms are fertile when crossed. The late Lord Powis imported some zebus and crossed them with common cattle in Shropshire; and I was assured by his steward that the cross-bred animals were perfectly fertile with both parent-stocks. Mr. Blyth informs me that in India hybrids,

with various proportions of either blood, are quite fertile; and this can hardly fail to be known, for in some districts (3/50. Walther 'Das Rindvieh' 1817 s. 30.) the two species are allowed to breed freely together. Most of the cattle which were first introduced into Tasmania were humped, so that at one time thousands of crossed animals existed there; and Mr. B. O'Neile Wilson, M.A., writes to me from Tasmania that he has never heard of any sterility having been observed. He himself formerly possessed a herd of such crossed cattle, and all were perfectly fertile; so much so, that he cannot remember even a single cow failing to calve. These several facts afford an important confirmation of the Pallasian doctrine that the descendants of species which when first domesticated would if crossed have been in all probability in some degree sterile, become perfectly fertile after a long course of domestication. In a future chapter we shall see that this doctrine throws some light on the difficult subject of Hybridism.

I have alluded to the cattle in Chillingham Park, which, according to Rutimeyer, have been very little changed from the Bos primigenius type. This park is so ancient that it is referred to in a record of the year 1220. The cattle in their instincts and habits are truly wild. They are white, with the inside of the ears reddish-brown, eyes rimmed with black, muzzles brown, hoofs black, and horns white tipped with black. Within a period of thirty-three years about a dozen calves were born with "brown and blue spots upon the cheeks or necks; but these, together with any defective animals, were always destroyed." According

to Bewick, about the year 1770 some calves appeared with black ears; but these were also destroyed by the keeper, and black ears have not since reappeared. The wild white cattle in the Duke of Hamilton's park, where I have heard of the birth of a black calf, are said by Lord Tankerville to be inferior to those at Chillingham. The cattle kept until the year 1780 by the Duke of Queensberry, but now extinct, had their ears, muzzle, and orbits of the eyes black. Those which have existed from time immemorial at Chartley, closely resemble the cattle at Chillingham, but are larger, "with some small difference in the colour of the ears." "They frequently tend to become entirely black; and a singular superstition prevails in the vicinity that, when a black calf is born, some calamity impends over the noble house of Ferrers. All the black calves are destroyed." The cattle at Burton Constable in Yorkshire, now extinct, had ears, muzzle, and the tip of the tail black. Those at Gisburne, also in Yorkshire, are said by Bewick to have been sometimes without dark muzzles, with the inside alone of the ears brown; and they are elsewhere said to have been low in stature and hornless. (3/51. I am much indebted to the present Earl of Tankerville for information about his wild cattle; and for the skull which was sent to Prof. Rutimeyer. The fullest account of the Chillingham cattle is given by Mr. Hindmarsh, together with a letter by the late Lord Tankerville, in 'Annals and Mag. of Nat. Hist.' volume 2 1839 page 274. See Bewick 'Quadrupeds' 2nd edition 1791 page 35 note. With respect to those of the Duke of Queensberry

see Pennant 'Tour in Scotland' page 109. For those of Chartley, see Low 'Domesticated Animals of Britain' 1845 page 238. For those of Gisburne see Bewick 'Quadrupeds' and 'Encyclop. of Rural Sports' page 101.)

The several above-specified differences in the park-cattle, slight though they be, are worth recording, as they show that animals living nearly in a state of nature, and exposed to nearly uniform conditions, if not allowed to roam freely and to cross with other herds, do not keep as uniform as truly wild animals. For the preservation of a uniform character, even within the same park, a certain degree of selection — that is, the destruction of the dark-coloured calves — is apparently necessary.

Boyd Dawkins believes that the park-cattle are descended from anciently domesticated, and not truly wild animals; and from the occasional appearance of dark-coloured calves, it is improbable that the aboriginal Bos primigenius was white. It is curious what a strong, though not invariable, tendency there is in wild or escaped cattle to become white with coloured ears, under widely different conditions of life. If the old writers Boethius and Leslie (3/52. Boethius was born in 1470; 'Annals and Mag. of Nat. Hist.' volume 2 1839 page 281; and volume 4 1849 page 424.) can be trusted, the wild cattle of Scotland were white and furnished with a great mane; but the colour of their ears is not mentioned. In Wales (3/53. 'Youatt on Cattle' 1834 page 48: See also page 242, on shorthorn cattle. Bell in his 'British Quadrupeds' page 423 states that, after long attending to the

subject, he has found that white cattle invariably have coloured ears.), during the tenth century, some of the cattle are described as being white with red ears. Four hundred cattle thus coloured were sent to King John; and an early record speaks of a hundred cattle with red ears having been demanded as a compensation for some offence, but, if the cattle were of a dark or black colour, 150 were to be presented. The black cattle of North Wales apparently belong, as we have seen, to the small longifrons type: and as the alternative was offered of either 150 dark cattle, or 100 white cattle with red ears, we may presume that the latter were the larger beasts, and probably belonged to the primigenius type. Youatt has remarked that at the present day, whenever cattle of the shorthorn breed are white, the extremities of their ears are more or less tinged with red.

The cattle which have run wild on the Pampas, in Texas, and in two parts of Africa, have become of a nearly uniform dark brownish-red. (3/54. Azara 'Quadrupedes du Paraguay' tome 2 page 361. Azara quotes Buffon for the feral cattle of Africa. For Texas see 'Times' February 18, 1846.) On the Ladrone Islands, in the Pacific Ocean, immense herds of cattle, which were wild in the year 1741, are described as "milk-white, except their ears, which are generally black." (3/55. Anson's Voyage. See Kerr and Porter 'Collection' volume 12 page 103.) The Falkland Islands, situated far south, with all the conditions of life as different as it is possible to conceive from those of the Ladrones, offer a more interesting case. Cattle have run wild there during eighty or

ninety years; and in the southern districts the animals are mostly white, with their feet, or whole heads, or only their ears black; but my informant, Admiral Sulivan (3/56. See also Mr. Mackinnon's pamphlet on the Falkland Islands, page 24.), who long resided on these islands, does not believe that they are ever purely white. So that in these two archipelagos we see that the cattle tend to become white with coloured ears. In other parts of the Falkland Islands other colours prevail: near Port Pleasant brown is the common tint; round Mount Usborn, about half the animals in some of the herds were lead- or mouse-coloured, which elsewhere is an unusual tint. These latter cattle, though generally inhabiting high land, breed about a month earlier than the other cattle; and this circumstance would aid in keeping them distinct and in perpetuating a peculiar colour. It is worth recalling to mind that blue or lead-coloured marks have occasionally appeared on the white cattle of Chillingham. So plainly different were the colours of the wild herds in different parts of the Falkland Islands, that in hunting them, as Admiral Sulivan informs me, white spots in one district, and dark spots in another district, were always looked out for on the distant hills. In the intermediate districts, intermediate colours prevailed. Whatever the cause may be, this tendency in the wild cattle of the Falkland Islands, which are all descended from a few brought from La Plata, to break up into herds of three different colours, is an interesting fact.

Returning to the several British breeds, the conspicuous difference in general appearance between Shorthorns,

Longhorns (now rarely seen), Herefords, Highland cattle, Alderneys, etc., must be familiar to every one. A part of this difference may be attributed to descent from primordially distinct species; but we may feel sure that there has been a considerable amount of variation. Even during the Neolithic period, the domestic cattle were to a certain extent variable. Within recent times most of the breeds have been modified by careful and methodical selection. How strongly the characters thus acquired are inherited, may be inferred from the prices realised by the improved breeds; even at the first sale of Colling's Shorthorns, eleven bulls reached an average of 214 pounds, and lately Shorthorn bulls have been sold for a thousand guineas, and have been exported to all quarters of the world.

Some constitutional differences may be here noticed. The Shorthorns arrive at maturity far earlier than the wilder breeds, such as those of Wales or the Highlands. This fact has been shown in an interesting manner by Mr. Simonds (3/57. 'The Age of the Ox, Sheep, Pig' etc. by Prof. James Simonds, published by order of the Royal Agricult. Soc.) who has given a table of the average period of their dentition, which proves that there is a difference of no less than six months in the appearance of the permanent incisors. The period of gestation, from observations made by Tessier on 1131 cows, varies to the extent of eighty-one days; and what is more interesting, M. Lefour affirms "that the period of gestation is longer in the large German cattle than in the smaller breeds." (3/58. 'Ann. Agricult. France' April 1837 as

quoted in 'The Veterinary' volume 12 page 725. I quote Tessier's observations from 'Youatt on Cattle' page 527.) With respect to the period of conception, it seems certain that Alderney and Zetland cows often become pregnant earlier than other breeds. (3/59. 'The Veterinary' volume 8 page 681 and volume 10 page 268. Low 'Domest. Animals, etc.' page 297.) Lastly, as four fully developed mammae is a generic character in the genus Bos (3/60. Mr. Ogleby in 'Proc. Zoolog. Soc.' 1836 page 138, and 1840 page 4. Quatrefages quotes Philippi 'Revue des Cours Scientifiques' February 12, 1688 page 657, that the cattle of Piacentino have thirteen dorsal vertebrae and ribs in the place of the ordinary number of twelve.), it is worth notice that with our domestic cows the two rudimentary mammae often become fairly well developed and yield milk.

As numerous breeds are generally found only in long-civilised countries, it may be well to show that in some countries inhabited by barbarous races, who are frequently at war with each other, and therefore have little free communication, several distinct breeds of cattle now exist or formerly existed. At the Cape of Good Hope Leguat observed, in the year 1720, three kinds. (3/61. Leguat's Voyage quoted by Vasey in his 'Delineations of the Ox-tribe' page 132.) At the present day various travellers have noticed the differences in the breeds in Southern Africa. Sir Andrew Smith several years ago remarked to me that the cattle possessed by the different tribes of Caffres, though living near each other under the same latitude and in the same kind of

country, yet differed, and he expressed much surprise at the fact. Mr. Andersson has described (3/62. 'Travels in South Africa' pages 317, 336.) the Damara, Bechuana, and Namaqua cattle; and he informs me in a letter that the cattle north of Lake Ngami are likewise different, as Mr. Galton has heard is also the case with the cattle of Benguela. The Namaqua cattle in size and shape nearly resemble European cattle, and have short stout horns and large hoofs. The Damara cattle are very peculiar, being big-boned, with slender legs, and small hard feet; their tails are adorned with a tuft of long bushy hair nearly touching the ground, and their horns are extraordinarily large. The Bechuana cattle have even larger horns, and there is now a skull in London with the two horns 8 ft. 8 1/4 in. long, as measured in a straight line from tip to tip, and no less than 13 ft. 5 in. as measured along their curvature! Mr. Andersson in his letter to me says that, though he will not venture to describe the differences between the breeds belonging to the many different sub-tribes, yet such certainly exist, as shown by the wonderful facility with which the natives discriminate them.

That many breeds of cattle have originated through variation, independently of descent from distinct species, we may infer from what we see in South America, where the genus Bos was not endemic, and where the cattle which now exist in such vast numbers are the descendants of a few imported from Spain and Portugal. In Columbia, Roulin (3/63. 'Mem. de 1'Institut present. par divers Savans' tome 6 1835 page 333. For Brazil

see 'Comptes Rendus' June 15, 1846. See Azara 'Quadrupedes du Paraguay' tome 2 pages 359, 361.) describes two peculiar breeds, namely, pelones, with extremely thin and fine hair, and calongos, absolutely naked. According to Castelnau there are two races in Brazil, one like European cattle, the other different, with remarkable horns. In Paraguay, Azara describes a breed which certainly originated in S. America, called chivos, "because they have straight vertical horns, conical, and very large at the base." He likewise describes a dwarf race in Corrientes, with short legs and a body larger than usual. Cattle without horns, and others with reversed hair, have also originated in Paraguay.

Another monstrous breed, called niatas or natas, of which I saw two small herds on the northern bank of the Plata, is so remarkable as to deserve a fuller description. This breed bears the same relation to other breeds, as bull or pug dogs do to other dogs, or as improved pigs, according to H. von Nathusius, do to common pigs. (3/64. 'Schweineschadel' 1864 s. 104. Nathusius states that the form of skull characteristic in the niata cattle occasionally appears in European cattle; but he is mistaken, as we shall hereafter see, in supposing that these cattle do not form a distinct race. Prof. Wyman, of Cambridge, United States, informs me that the common cod- fish presents a similar monstrosity, called by the fishermen "bull-dog cod." Prof. Wyman also concluded, after making numerous inquiries in La Plata, that the niata cattle transmit their peculiarities or form a race.) Rutimeyer believes that these cattle belong to the

primigenius type. (3/65 'Ueber Art des zahmen Europ. Rindes' 1866 s. 28.) The forehead is very short and broad, with the nasal end of the skull, together with the whole plane of the upper molar-teeth, curved upwards. The lower jaw projects beyond the upper, and has a corresponding upward curvature. It is an interesting fact that an almost similar confirmation characterizes, as I am informed by Dr. Falconer, the extinct and gigantic Sivatherium of India, and is not known in any other ruminant. The upper lip is much drawn back, the nostrils are seated high up and are widely open, the eyes project outwards, and the horns are large. In walking the head is carried low, and the neck is short. The hind legs appear to be longer, compared with the front legs, than is usual. The exposed incisor teeth, the short head and upturned nostrils, give these cattle the most ludicrous, self-confident air of defiance. The skull which I presented to the College of Surgeons has been thus described by Professor Owen (3/66. 'Descriptive Cat. of Ost. Collect. of College of Surgeons' 1853 page 624. Vasey in his 'Delineations of the Ox-tribe' has given a figure of this skull; and I sent a photograph of it to Prof. Rutimeyer.) "It is remarkable from the stunted development of the nasals, premaxillaries, and fore-part of the lower jaw, which is unusually curved upwards to come into contact with the premaxillaries. The nasal bones are about one-third the ordinary length, but retain almost their normal breadth. The triangular vacuity is left between them, the frontal and lachrymal, which latter bone articulates with the premaxillary, and thus excludes

the maxillary from any junction with the nasal." So that even the connexion of some of the bones is changed. Other differences might be added: thus the plane of the condyles is somewhat modified, and the terminal edge of the premaxillaries forms an arch. In fact, on comparison with the skull of a common ox, scarcely a single bone presents the same exact shape, and the whole skull has a wonderfully different appearance.

The first brief published notice of this race was by Azara, between the years 1783-96; but Don F. Muniz, of Luxan, who has kindly collected information for me, states that about 1760 these cattle were kept as curiosities near Buenos Ayres. Their origin is not positively known, but they must have originated subsequently to the year 1552, when cattle were first introduced. Senor Muniz informs me that the breed is believed to have originated with the Indians southward of the Plata. Even to this day those reared near the Plata show their less civilised nature in being fiercer than common cattle, and in the cow, if visited too often, easily deserting her first calf. The breed is very true, and a niata bull and cow invariably produce niata calves. The breed has already lasted at least a century. A niata bull crossed with a common cow, and the reverse cross, yield offspring having an intermediate character, but with the niata character strongly displayed. According to Senor Muniz, there is the clearest evidence, contrary to the common belief of agriculturists in analogous cases, that the niata cow when crossed with a common bull transmits her peculiarities more strongly

than does the niata bull when crossed with a common cow. When the pasture is tolerably long, these cattle feed as well as common cattle with their tongue and palate; but during the great droughts, when so many animals perish on the Pampas, the niata breed lies under a great disadvantage, and would, if not attended to, become extinct; for the common cattle, like horses, are able to keep alive by browsing with their lips on the twigs of trees and on reeds: this the niatas cannot so well do, as their lips do not join, and hence they are found to perish before the common cattle. This strikes me as a good illustration of how little we are able to judge from the ordinary habits of an animal, on what circumstances, occurring only at long intervals of time, its rarity or extinction may depend. It shows us, also, how natural selection would have determined the rejection of the niata modification had it arisen in a state of nature.

Having described the semi-monstrous niata breed, I may allude to a white bull, said to have been brought from Africa, which was exhibited in London in 1829, and which has been well figured by Mr. Harvey. (3/67. Loudon's 'Magazine of Nat. Hist.' volume 1 1829 page 113. Separate figures are given of the animal, its hoofs, eye, and dewlap.) It had a hump, and was furnished with a mane. The dewlap was peculiar, being divided between its fore-legs into parallel divisions. Its lateral hoofs were annually shed, and grew to the length of five or six inches. The eye was very peculiar, being remarkably prominent, and "resembled a cup and ball, thus enabling the animal to see on all

sides with equal ease; the pupil was small and oval, or rather a parallelogram with the ends cut off, and lying transversely across the ball." A new and strange breed might probably have been formed by careful breeding and selection from this animal.

I have often speculated on the probable causes through which each separate district in Great Britain came to possess in former times its own peculiar breed of cattle; and the question is, perhaps, even more perplexing in the case of Southern Africa. We now know that the differences may be in part attributed to descent from distinct species; but this cause is far from sufficient. Have the slight differences in climate and in the nature of the pasture, in the different districts of Britain, directly induced corresponding differences in the cattle? We have seen that the semi-wild cattle in the several British parks are not identical in colouring or size, and that some degree of selection has been requisite to keep them true. It is almost certain that abundant food given during many generations directly affects the size of a breed. (3/68. Low 'Domesticated Animals of the British Isles' page 264.) That climate directly affects the thickness of the skin and the hair is likewise certain: thus Roulin asserts (69 'Mem. de l'Institut present. Par divers Savans' tome 6 1835 page 332.) that the hides of the feral cattle on the hot Llanos "are always much less heavy than those of the cattle raised on the high platform of Bogota; and that these hides yield in weight and in thickness of hair to those of the cattle which have run wild on the lofty Paramos." The same difference has been observed in the hides

of the cattle reared on the bleak Falkland Islands and on the temperate Pampas. Low has remarked (3/70. Idem pages 304, 368 etc.) that the cattle which inhabit the more humid parts of Britain have longer hair and thicker skins than other British cattle. When we compare highly improved stall-fed cattle with the wilder breeds, or compare mountain and lowland breeds, we cannot doubt that an active life, leading to the free use of the limbs and lungs, affects the shape and proportions of the whole body. It is probable that some breeds, such as the semi-monstrous niata cattle, and some peculiarities, such as being hornless, etc., have appeared suddenly owing to what we may call in our ignorance spontaneous variation; but even in this case a rude kind of selection is necessary, and the animals thus characterised must be at least partially separated from others. This degree of care, however, has sometimes been taken even in little-civilised districts, where we should least have expected it, as in the case of the niata, chivo, and hornless cattle in S. America.

That methodical selection has done wonders within a recent period in modifying our cattle, no one doubts. During the process of methodical selection it has occasionally happened that deviations of structure, more strongly pronounced than mere individual differences, yet by no means deserving to be called monstrosities, have been taken advantage of: thus the famous Longhorn Bull, Shakespeare, though of the pure Canley stock, "scarcely inherited a single point of the long-horned breed, his horns excepted (3/71. 'Youatt on Cattle' page 193. A full account

of this bull is taken from Marshall.); yet in the hands of Mr. Fowler, this bull greatly improved his race. We have also reason to believe that selection, carried on so far unconsciously that there was at no one time any distinct intention to improve or change the breed, has in the course of time modified most of our cattle; for by this process, aided by more abundant food, all the lowland British breeds have increased greatly in size and in early maturity since the reign of Henry VII. (3/72. 'Youatt on Cattle' page 116. Lord Spencer has written on this same subject.) It should never be forgotten that many animals have to be annually slaughtered; so that each owner must determine which shall be killed and which preserved for breeding. In every district, as Youatt has remarked, there is a prejudice in favour of the native breed; so that animals possessing qualities, whatever they may be, which are most valued in each district, will be oftenest preserved; and this unmethodical selection assuredly will in the long run affect the character of the whole breed. But it may be asked, can this rude kind of selection have been practised by barbarians such as those of southern Africa? In a future chapter on Selection we shall see that this has certainly occurred to some extent. Therefore, looking to the origin of the many breeds of cattle which formerly inhabited the several districts of Britain, I conclude that, although slight differences in the nature of the climate, food, etc., as well as changed habits of life, aided by correlation of growth, and the occasional appearance from unknown causes of considerable deviations of structure, have all

probably played their parts; yet that the occasional preservation in each district of those individual animals which were most valued by each owner has perhaps been even more effective in the production of the several British breeds. As soon as two or more breeds were formed in any district, or when new breeds descended from distinct species were introduced, their crossing, especially if aided by some selection, will have multiplied the number and modified the characters of the older breeds.

SHEEP.

I shall treat this subject briefly. Most authors look at our domestic sheep as descended from several distinct species. Mr. Blyth, who has carefully attended to the subject, believes that fourteen wild species now exist, but "that not one of them can be identified as the progenitor of any one of the interminable domestic races." M. Gervais thinks that there are six species of Ovis (3/73. Blyth on the genus Ovis in 'Annals and Mag. of Nat. History' volume 7 1841 page 261. With respect to the parentage of the breeds see Mr. Blyth's excellent articles in 'Land and Water' 1867 pages 134, 156. Gervais 'Hist. Nat. des Mammiferes' 1855 tome 2 page 191.) but that our domestic sheep form a distinct genus, now completely extinct. A German naturalist (3/74. Dr. L. Fitzinger 'Ueber die Racen des Zahmen Schafes' 1860 s. 86.) believes that our sheep descend from ten aboriginally distinct species, of which only one is still living in a wild state! Another ingenious observer (3/75. J. Anderson 'Recreations in Agriculture and Natural History' volume 2 page

264.), though not a naturalist, with a bold defiance of everything known on geographical distribution, infers that the sheep of Great Britain alone are the descendants of eleven endemic British forms! Under such a hopeless state of doubt it would be useless for my purpose to give a detailed account of the several breeds; but a few remarks may be added.

Sheep have been domesticated from a very ancient period. Rutimeyer (3/76. 'Pfahlbauten' s. 127, 193.) found in the Swiss lake-dwellings the remains of a small breed, with thin tall legs, and horns like those of a goat, thus differing somewhat from any kind now known. Almost every country has its own peculiar breed; and many countries have several breeds differing greatly from each other. One of the most strongly marked races is an Eastern one with a long tail, including, according to Pallas, twenty vertebrae, and so loaded with fat that it is sometimes placed on a truck, which is dragged about by the living animal. These sheep, though ranked by Fitzinger as a distinct aboriginal form, bear in their drooping ears the stamp of long domestication. This is likewise the case with those sheep which have two great masses of fat on the rump, with the tail in a rudimentary condition. The Angola variety of the long-tailed race has curious masses of fat on the back of the head and beneath the jaws. (3/77. 'Youatt on Sheep' page 120.) Mr. Hodgson in an admirable paper (3/78. 'Journal of the Asiatic Soc. of Bengal' volume 16 pages 1007, 1016.) on the sheep of the Himalaya infers from the distribution of the several

races, "that this caudal augmentation in most of its phases is an instance of degeneracy in these pre-eminently Alpine animals." The horns present an endless diversity in character; being not rarely absent, especially in the female sex, or, on the other hand, amounting to four or even eight in number. The horns, when numerous, arise from a crest on the frontal bone, which is elevated in a peculiar manner. It is remarkable that multiplicity of horns "is generally accompanied by great length and coarseness of the fleece." (3/79. 'Youatt on Sheep' pages 142-169.) This correlation, however, is far from being general; for instance, I am informed by Mr. D. Forbes, that the Spanish sheep in Chile resemble, in fleece and in all other characters, their parent merino-race, except that instead of a pair they generally bear four horns. The existence of a pair of mammae is a generic character in the genus Ovis as well as in several allied forms; nevertheless, as Mr. Hodgson has remarked, "this character is not absolutely constant even among the true and proper sheep: for I have more than once met with Cagias (a sub-Himalayan domestic race) possessed of four teats." (3/80. 'Journal Asiat. Soc. of Bengal' volume 16 1847 page 1015.) This case is the more remarkable as, when any part or organ is present in reduced number in comparison with the same part in allied groups, it usually is subject to little variation. The presence of interdigital pits has likewise been considered as a generic distinction in sheep; but Isidore Geoffroy (3/81. 'Hist. Nat. Gen.' tome 3 page 435.) has shown that these pits or pouches are absent in some breeds.

In sheep there is a strong tendency for characters, which have apparently been acquired under domestication, to become attached either exclusively to the male sex, or to be more highly developed in this than in the other sex. Thus in many breeds the horns are deficient in the ewe, though this likewise occurs occasionally with the female of the wild musmon. In the rams of the Wallachian breed, "the horns spring almost perpendicularly from the frontal bone, and then take a beautiful spiral form; in the ewes they protrude nearly at right angles from the head, and then become twisted in a singular manner." (3/82. 'Youatt on Sheep' page 138.) Mr. Hodgson states that the extraordinarily arched nose or chaffron, which is so highly developed in several foreign breeds, is characteristic of the ram alone, and apparently is the result of domestication. (3/83. 'Journal Asiat. Soc. of Bengal' volume 16 1847 pages 1015, 1016.) I hear from Mr. Blyth that the accumulation of fat in the fat-tailed sheep of the plains of India is greater in the male than in the female; and Fitzinger (3/84. 'Racen des Zahmen Schafes' s. 77.) remarks that the mane in the African maned race is far more developed in the ram than in the ewe.

Different races of sheep, like cattle, present constitutional differences. Thus the improved breeds arrive at maturity at an early age, as has been well shown by Mr. Simonds through their early average period of dentition. The several races have become adapted to different kinds of pasture and climate: for instance, no one can rear Leicester sheep on mountainous

regions, where Cheviots flourish. As Youatt has remarked, "In all the different districts of Great Britain we find various breeds of sheep beautifully adapted to the locality which they occupy. No one knows their origin; they are indigenous to the soil, climate, pasturage, and the locality on which they graze; they seem to have been formed for it and by it." (3/85. 'Rural Economy of Norfolk' volume 2 page 136.) Marshall relates (3/86. 'Youatt on Sheep' page 312. On same subject, see excellent remarks in 'Gardener's Chronicle' 1858 page 868. For experiments in crossing Cheviot sheep with Leicesters see Youatt page 325.) that a flock of heavy Lincolnshire and light Norfolk sheep which had been bred together in a large sheep-walk, part of which was low, rich, and moist, and another part high and dry, with benty grass, when turned out, regularly separated from each other; the heavy sheep drawing off to the rich soil, and the lighter sheep to their own soil; so that "whilst there was plenty of grass the two breeds kept themselves as distinct as rooks and pigeons." Numerous sheep from various parts of the world have been brought during a long course of years to the Zoological Gardens of London; but as Youatt, who attended the animals as a veterinary surgeon, remarks, "few or none die of the rot, but they are phthisical; not one of them from a torrid climate lasts out the second year, and when they die their lungs are tuberculated." (3/87. 'Youatt on Sheep' note page 491.) There is very good evidence that English breeds of sheep will not succeed in France. (3/88. M. Malingie-Nouel 'Journal R. Agricult. Soc.' volume 14 1853

page 214 translated and therefore approved by a great authority, Mr. Pusey.) Even in certain parts of England it has been found impossible to keep certain breeds of sheep; thus on a farm on the banks of the Ouse, the Leicester sheep were so rapidly destroyed by pleuritis (3/89. 'The Veterinary' volume 10 page 217.) that the owner could not keep them; the coarser-skinned sheep never being affected.

The period of gestation was formerly thought to be of so unalterable a character, that a supposed difference of this kind between the wolf and the dog was esteemed a sure sign of specific distinction; but we have seen that the period is shorter in the improved breeds of the pig, and in the larger breeds of the ox, than in other breeds of these two animals. And now we know, on the excellent authority of Hermann von Nathusius (3/90. A translation of his paper is given in 'Bull. Soc. Imp. d'Acclimat.' tome 9 1862 page 723.), that Merino and Southdown sheep, when both have long been kept under exactly the same conditions, differ in their average period of gestation, as is seen in the following Table Merinos 150.3 days. Southdowns 144.2 " Half-bred Merinos and Southdowns 146.3 " 3/4 blood of Southdown 145.5 " 7/8 blood of Southdown 144.2 "

In this graduated difference in cross-bred animals having different proportions of Southdown blood, we see how strictly the two periods of gestation have been transmitted. Nathusius remarks that, as Southdowns grow with remarkable rapidity after birth, it is not surprising that their foetal development should

have been shortened. It is of course possible that the difference in these two breeds may be due to their descent from distinct parent-species; but as the early maturity of the Southdowns has long been carefully attended to by breeders, the difference is more probably the result of such attention. Lastly, the fecundity of the several breeds differs much; some generally producing twins or even triplets at a birth, of which fact the curious Shangai sheep (with their truncated and rudimentary ears, and great Roman noses), lately exhibited in the Zoological Gardens, offer a remarkable instance.

Sheep are perhaps more readily affected by the direct action of the conditions of life to which they have been exposed than almost any other domestic animal. According to Pallas, and more recently according to Erman, the fat-tailed Kirghisian sheep, when bred for a few generations in Russia, degenerate, and the mass of fat dwindles away, "the scanty and bitter herbage of the steppes seems so essential to their development." Pallas makes an analogous statement with respect to one of the Crimean breeds. Burnes states that the Karakool breed, which produces a fine, curled, black, and valuable fleece, when removed from its own canton near Bokhara to Persia or to other quarters, loses its peculiar fleece. (3/91. Erman 'Travels in Siberia' English translation volume 1 page 228. For Pallas on the fat-tailed sheep I quote from Anderson's account of the 'Sheep of Russia' 1794 page 34. With respect to the Crimean sheep see Pallas 'Travels' English translation volume 2 page 454. For the Karakool sheep

see Burnes 'Travels in Bokhara' volume 3 page 151.) In all such cases, however, it may be that a change of any kind in the conditions of life causes variability and consequent loss of character, and not that certain conditions are necessary for the development of certain characters.

Great heat, however, seems to act directly on the fleece: several accounts have been published of the change which sheep imported from Europe undergo in the West Indies. Dr. Nicholson of Antigua informs me that, after the third generation, the wool disappears from the whole body, except over the loins; and the animal then appears like a goat with a dirty door-mat on its back. A similar change is said to take place on the west coast of Africa. (3/92. See Report of the Directors of the Sierra Leone Company as quoted in White 'Gradation of Man' page 95. With respect to the change which sheep undergo in the West Indies see also Dr. Davy in 'Edin. New. Phil. Journal' January 1852. For the statement made by Roulin see 'Mem. de l'Institut present. par divers Savans.' tome 6 1835 page 347.) On the other hand, many wool-bearing sheep live on the hot plains of India. Roulin asserts that in the lower and heated valleys of the Cordillera, if the lambs are sheared as soon as the wool has grown to a certain thickness, all goes on afterwards as usual; but if not sheared, the wool detaches itself in flakes, and short shining hair like that on a goat is produced ever afterwards. This curious result seems merely to be an exaggerated tendency natural to the Merino breed, for as a great authority, namely, Lord Somerville, remarks, "the

wool of our Merino sheep after shear-time is hard and coarse to such a degree as to render it almost impossible to suppose that the same animal could bear wool so opposite in quality, compared to that which has been clipped from it: as the cold weather advances, the fleeces recover their soft quality." As in sheep of all breeds the fleece naturally consists of longer and coarser hair covering shorter and softer wool, the change which it often undergoes in hot climates is probably merely a case of unequal development; for even with those sheep which like goats are covered with hair, a small quantity of underlying wool may always be found. (3/93. 'Youatt on Sheep' page 69 where Lord Somerville is quoted. See page 117 on the presence of wool under the hair. With respect to the fleeces of Australian sheep page 185. On selection counteracting any tendency to change see pages 70, 117, 120, 168.) In the wild mountain-sheep (0vis montana) of North America there is an analogous annual change of coat; "the wool begins to drop out in early spring, leaving in its place a coat of hair resembling that of the elk, a change of pelage quite different in character from the ordinary thickening of the coat or hair, common to all furred animals in winter, — for instance, in the horse, the cow, etc., which shed their winter coat in the spring." (3/94. Audubon and Bachman 'The Quadrupeds of North America' 1846 volume 5 page 365.)

A slight difference in climate or pasture sometimes slightly affects the fleece, as has been observed even in different districts in England, and is well shown by the great softness

of the wool brought from Southern Australia. But it should be observed, as Youatt repeatedly insists, that the tendency to change may generally be counteracted by careful selection. M. Lasterye, after discussing this subject, sums up as follows: "The preservation of the Merino race in its utmost purity at the Cape of Good Hope, in the marshes of Holland, and under the rigorous climate of Sweden, furnishes an additional support of this my unalterable principle, that fine-woolled sheep may be kept wherever industrious men and intelligent breeders exist."

That methodical selection has effected great changes in several breeds of sheep no one who knows anything on the subject, entertains a doubt. The case of the Southdowns, as improved by Ellman, offers perhaps the most striking instance. Unconscious or occasional selection has likewise slowly produced a great effect, as we shall see in the chapters on Selection. That crossing has largely modified some breeds, no one who will study what has been written on this subject — for instance, Mr. Spooner's paper — will dispute; but to produce uniformity in a crossed breed, careful selection and "rigorous weeding," as this author expresses it, are indispensable. (3/95. 'Journal of R. Agricult. Soc. of England' volume 20 part 2, W.C. Spooner on cross-Breeding.)

In some few instances new breeds have suddenly originated; thus, in 1791, a ram-lamb was born in Massachusetts, having short crooked legs and a long back, like a turnspit-dog. From this one lamb the otter or ancon semi- monstrous breed was raised;

as these sheep could not leap over the fences, it was thought that they would be valuable; but they have been supplanted by merinos, and thus exterminated. The sheep are remarkable from transmitting their character so truly that Colonel Humphreys (3/96. 'Philosoph. Transactions' London 1813 page 88.) never heard of "but one questionable case" of an ancon ram and ewe not producing ancon offspring. When they are crossed with other breeds the offspring, with rare exceptions, instead of being intermediate in character, perfectly resemble either parent; even one of twins has resembled one parent and the second the other. Lastly, "the ancons have been observed to keep together, separating themselves from the rest of the flock when put into enclosures with other sheep."

A more interesting case has been recorded in the Report of the Juries for the Great Exhibition (1851), namely, the production of a merino ram-lamb on the Mauchamp farm, in 1828, which was remarkable for its long, smooth, straight, and silky wool. By the year 1833 M. Graux had raised rams enough to serve his whole flock, and after a few more years he was able to sell stock of his new breed. So peculiar and valuable is the wool, that it sells at 25 per cent above the best merino wool: even the fleeces of half-bred animals are valuable, and are known in France as the "Mauchamp-merino." It is interesting, as showing how generally any marked deviation of structure is accompanied by other deviations, that the first ram and his immediate offspring were of small size, with large heads, long

necks, narrow chests, and long flanks; but these blemishes were removed by judicious crosses and selection. The long smooth wool was also correlated with smooth horns; and as horns and hair are homologous structures, we can understand the meaning of this correlation. If the Mauchamp and ancon breeds had originated a century or two ago, we should have had no record of their birth; and many a naturalist would no doubt have insisted, especially in the case of the Mauchamp race, that they had each descended from, or been crossed with, some unknown aboriginal form.

GOATS.

From the recent researches of M. Brandt, most naturalists now believe that all our goats are descended from the Capra aegagrus of the mountains of Asia, possibly mingled with the allied Indian species C. falconeri of India. (3/97. Isidore Geoffroy St. Hilaire 'Hist. Nat. Generale' tome 3 page 87. Mr. Blyth 'Land and Water' 1867 page 37 has arrived at a similar conclusion, but he thinks that certain Eastern races may perhaps be in part descended from the Asiatic markhor.) In Switzerland, during the neolithic period, the domestic goat was commoner than the sheep; and this very ancient race differed in no respect from that now common in Switzerland. (3/98. Rutimeyer 'Pfahlbauten' s. 127.) At the present time, the many races found in several parts of the world differ greatly from each other; nevertheless, as far as they have been tried (3/99. Godron 'De l'Espece' tome 1 page 402.) they are all quite fertile when crossed. So numerous are the breeds,

that Mr. G. Clark (3/100. 'Annals and Mag. of Nat History' 2nd series volume 2 1848 page 363.) has described eight distinct kinds imported into the one island of Mauritius. The ears of one kind were enormously developed, being, as measured by Mr. Clark, no less than 19 inches in length and 4 3/4 inches in breadth. As with cattle, the mammae of those breeds which are regularly milked become greatly developed; and, as Mr. Clark remarks, "it is not rare to see their teats touching the ground." The following cases are worth notice as presenting unusual points of variation. According to Godron (3/101. 'De l'Espece' tome 1 page 406. Mr. Clark also refers to differences in the shape of the mammae. Godron states that in the Nubian race the scrotum is divided into two lobes; and Mr. Clark gives a ludicrous proof of this fact, for he saw in the Mauritius a male goat of the Muscat breed purchased at a high price for a female in full milk. These differences in the scrotum are probably not due to descent from distinct species: for Mr. Clark states that this part varies much in form.), the mammae differ greatly in shape in different breeds, being elongated in the common goat, hemispherical in the Angora race, and bilobed and divergent in the goats of Syria and Nubia. According to this same author, the males of certain breeds have lost their usual offensive odour. In one of the Indian breeds the males and females have horns of widely-different shapes (3/102. Mr. Clark 'Annals and Mag. of Nat. Hist.' 2nd series volume 2 1848 page 361.); and in some breeds the females are destitute of horns. (3/103. Desmarest 'Encyclop. Method.

Mammalogie' page 480.) M. Ramu of Nancy informs me that many of the goats there bear on the upper part of the throat a pair of hairy appendages, 70 mm. in length and about 10 mm. in diameter, which in external appearance resemble those above described on the jaws of pigs. The presence of inter-digital pits or glands on all four feet has been thought to characterise the genus Ovis, and their absence to be characteristic of the genus Capra; but Mr. Hodgson has found that they exist in the front feet of the majority of Himalayan goats. (3/104. 'Journal of Asiatic Soc. of Bengal' volume 16 1847 pages 1020, 1025.) Mr. Hodgson measured the intestines in two goats of the Dugu race, and he found that the proportional length of the great and small intestines differed considerably. In one of these goats the caecum was thirteen inches, and in the other no less than thirty-six inches in length!

CHAPTER 1.IV

DOMESTIC RABBITS.

DOMESTIC RABBITS DESCENDED FROM THE COMMON WILD RABBIT. ANCIENT DOMESTICATION. ANCIENT SELECTION. LARGE LOP-EARED RABBITS. VARIOUS BREEDS. FLUCTUATING CHARACTERS. ORIGIN OF THE HIMALAYAN BREED. CURIOUS CASE OF INHERITANCE. FERAL RABBITS IN JAMAICA AND THE FALKLAND ISLANDS. PORTO SANTO FERAL RABBITS. OSTEOLOGICAL CHARACTERS. SKULL. SKULL OF HALF-LOP RABBITS. VARIATIONS IN THE SKULL ANALOGOUS TO DIFFERENCES IN DIFFERENT SPECIES OF HARES. VERTEBRAE. STERNUM. SCAPULA. EFFECTS OF USE AND DISUSE ON THE PROPORTIONS OF THE LIMBS AND BODY. CAPACITY OF THE SKULL AND REDUCED SIZE OF THE BRAIN. SUMMARY ON THE MODIFICATIONS OF DOMESTICATED RABBITS.

All naturalists, with, as far as I know, a single exception, believe that the several domestic breeds of the rabbit are descended from the common wild species; I shall therefore describe them more carefully than in the previous cases. Professor Gervais (4/1. M.P. Gervais 'Hist. Nat. des

Mammiferes' 1854. tome 1 page 288.) states "that the true wild rabbit is smaller than the domestic; its proportions are not absolutely the same; its tail is smaller; its ears are shorter and more thickly clothed with hair; and these characters, without speaking of colour, are so many indications opposed to the opinion which unites these animals under the same specific denomination." Few naturalists will agree with this author that such slight differences are sufficient to separate as distinct species the wild and domestic rabbit. How extraordinary it would be, if close confinement, perfect tameness, unnatural food, and careful breeding, all prolonged during many generations, had not produced at least some effect! The tame rabbit has been domesticated from an ancient period. Confucius ranges rabbits among animals worthy to be sacrificed to the gods, and, as he prescribes their multiplication, they were probably at this early period domesticated in China. They are mentioned by several of the classical writers. In 1631 Gervaise Markham writes, "You shall not, as in other cattell, looke to their shape, but to their richnesse, onely elect your buckes, the largest and goodliest conies you can get; and for the richnesse of the skin, that is accounted the richest which hath the equallest mixture of blacke and white haire together, yet the blacke rather shadowing the white; the furre should be thicke, deepe, smooth, and shining;...they are of body much fatter and larger, and, when another skin is worth two or three pence, they are worth two shillings." From this full description we see that silver-grey

rabbits existed in England at this period; and what is far more important, we see that the breeding or selection of rabbits was then carefully attended to. Aldrovandi, in 1637, describes, on the authority of several old writers (as Scaliger, in 1557), rabbits of various colours, some "like a hare," and he adds that P. Valerianus (who died a very old man in 1558) saw at Verona rabbits four times bigger than ours. (4/2. U. Aldrovandi 'De Quadrupedibus digitatis' 1637 page 383. For Confucius and G. Markham see a writer who has studied the subject in 'Cottage Gardener' January 22, 1861 page 250.)

From the fact of the rabbit having been domesticated at an ancient period, we must look to the northern hemisphere of the Old World, and to the warmer temperate regions alone, for the aboriginal parent-form; for the rabbit cannot live without protection in countries as cold as Sweden, and, though it has run wild in the tropical island of Jamaica, it has never greatly multiplied there. It now exists, and has long existed, in the warmer temperate parts of Europe, for fossil remains have been found in several countries. (4/3. Owen 'British Fossil Mammals' page 212.) The domestic rabbit readily becomes feral in these same countries, and when variously coloured kinds are turned out they generally revert to the ordinary grey colour. (4/4. Bechstein 'Naturgesch. Deutschlands' 1801 b. 1 page 1133. I have received similar accounts with respect to England and Scotland.) Wild rabbits, if taken young, can be domesticated, though the process is generally very troublesome. (4/5. 'Pigeons and Rabbits' by E.S.

Delamer 1854 page 133. Sir J. Sebright 'Observations on Instinct' 1836 page 10) speaks most strongly on the difficulty. But this difficulty is not invariable, as I have received two accounts of perfect success in taming and breeding from the wild rabbit. See also Dr. P. Broca in 'Journal de la Physiologie' tome 2 page 368.) The various domestic races are often crossed, and are believed to be quite fertile together, and a perfect gradation can be shown to exist from the largest domestic kinds, having enormously developed ears, to the common wild kind. The parent-form must have been a burrowing animal, a habit not common, as far as I can discover, to any other species in the large genus Lepus. Only one wild species is known with certainty to exist in Europe; but the rabbit (if it be a true rabbit) from Mount Sinai, and likewise that from Algeria, present slight differences; and these forms have been considered by some authors as specifically distinct. (4/6. Gervais 'Hist. Nat. des Mammiferes' tome 1 page 292.) But such slight differences would aid us little in explaining the more considerable differences characteristic of the several domestic races. If the latter are the descendants of two or more closely allied species, these, with the exception of the common rabbit, have been exterminated in a wild state; and this is very improbable, seeing with what pertinacity this animal holds its ground. From these several reasons we may infer with safety that all the domestic breeds are the descendants of the common wild species. But from what we hear of the marvellous success in France in rearing hybrids between the hare and rabbit (4/7.

See Dr. P. Broca's interesting memoir on this subject in Brown-Sequard 'Journ. de. Phys.' volume 2 page 367.), it is possible, though not probable, from the great difficulty in making the first cross, that some of the larger races, which are coloured like the hare, may have been modified by crosses with this animal. Nevertheless, the chief differences in the skeletons of the several domestic breeds cannot, as we shall presently see, have been derived from a cross with the hare.

There are many breeds which transmit their characters more or less truly. Every one has seen the enormous lop-eared rabbits exhibited at our shows; various allied sub-breeds are reared on the Continent, such as the so- called Andalusian, which is said to have a large head with a round forehead, and to attain a greater size than any other kind; another large Paris breed is named the Rouennais, and has a square head; the so-called Patagonian rabbit has remarkably short ears and a large round head. Although I have not seen all these breeds, I feel some doubt about there being any marked difference in the shape of their skulls. (4/8. The skulls of these breeds are briefly described in the 'Journal of Horticulture' May 7, 1861 page 108.) English lop-eared rabbits often weigh 8 pounds or 10 pounds, and one has been exhibited weighing 18 pounds; whereas a full-sized wild rabbit weighs only about 3 1/4 pounds. The head or skull in all the large lop-eared rabbits examined by me is much longer relatively to its breadth than in the wild rabbit. Many of them have loose transverse folds of skin or dewlaps beneath the throat, which

can be pulled out so as to reach nearly to the ends of the jaws. Their ears are prodigiously developed, and hang down on each side of their faces. A rabbit was exhibited in 1867 with its two ears, measured from the tip of one to the tip of the other, 22 inches in length, and each ear 5 3/8 inches in breadth. In 1869 one was exhibited with ears, measured in the same manner, 23 1/8 in length and 5 1/2 in breadth; "thus exceeding any rabbit ever exhibited at a prize show." In a common wild rabbit I found that the length of two ears, from tip to tip, was 7 5/8 inches, and the breadth only 1 7/8 inch. The weight of body in the larger rabbits, and the development of their ears, are the qualities which win prizes, and have been carefully selected.

The hare-coloured, or, as it is sometimes called, the Belgian rabbit, differs in nothing except colour from the other large breeds; but Mr. J. Young, of Southampton, a great breeder of this kind, informs me that the females, in all the specimens examined by him, had only six mammae; and this certainly was the case with two females which came into my possession. Mr. B.P. Brent, however, assures me that the number is variable with other domestic rabbits. The common wild rabbit always has ten mammae. The Angora rabbit is remarkable from the length and fineness of its fur, which even on the soles of the feet is of considerable length. This breed is the only one which differs in its mental qualities, for it is said to be much more sociable than other rabbits, and the male shows no wish to destroy its young. (4/9. 'Journal of Horticulture' 1861 page 380.) Two live

rabbits were brought to me from Moscow, of about the size of the wild species, but with long soft fur, different from that of the Angora. These Moscow rabbits had pink eyes and were snow-white, excepting the ears, two spots near the nose, the upper and under surface of the tail, and the hinder tarsi, which were blackish-brown. In short, they were coloured nearly like the so-called Himalayan rabbits, presently to be described, and differed from them only in the character of their fur. There are two other breeds which come true to colour, but differ in no other respect, namely silver-greys and chinchillas. Lastly, the Nicard or Dutch rabbit may be mentioned, which varies in colour, and is remarkable from its small size, some specimens weighing only 1 1/4 pounds; rabbits of this breed make excellent nurses for other and more delicate kinds. (4/10. 'Journal of Horticulture' May 28, 1861 page 169.)

(FIGURE 5. HALF-LOP RABBIT. (Copied from E.S. Delamer's work.)

Certain characters are remarkably fluctuating, or are very feebly transmitted by domestic rabbits: thus, one breeder tells me that with the smaller kinds he has hardly ever raised a whole litter of the same colour: with the large lop-eared breeds "it is impossible," says a great judge (4/11. 'Journal of Horticulture' 1861 page 327. With respect to the ears see Delamer on 'Pigeons and Rabbits' 1854 page 141; also 'Poultry Chronicle' volume 2 page 499 and ditto for 1854 page 586.), "to breed true to colour, but by judicious crossing a great deal may be done

towards it. The fancier should know how his does are bred, that is, the colour of their parents." Nevertheless, certain colours, as we shall presently see, are transmitted truly. The dewlap is not strictly inherited. Lop-eared rabbits, with their ears hanging down flat on each side of the face, do not transmit this character at all truly. Mr. Delamer remarks that, "with fancy rabbits, when both the parents are perfectly formed, have model ears, and are handsomely marked, their progeny do not invariably turn out the same." When one parent, or even both, are oar-laps, that is, have their ears sticking out at right angles, or when one parent or both are half-lops, that is, have only one ear dependent, there is nearly as good a chance of the progeny having both ears full-lop, as if both parents had been thus characterised. But I am informed, if both parents have upright ears, there is hardly a chance of a full-lop. In some half-lops the ear that hangs down is broader and longer than the upright ear (4/12. Delamer 'Pigeons and Rabbits' page 136. See also 'Journal of Horticulture' 1861 page 375.); so that we have the unusual case of a want of symmetry on the two sides. This difference in the position and size of the two ears probably indicates that the lopping results from the great length and weight of the ear, favoured no doubt by the weakness of the muscles consequent on disuse. Anderson (4/13. 'An Account of the different Kinds of Sheep in the Russian Dominions' 1794 page 39.) mentions a breed having only a single ear; and Professor Gervais another breed destitute of ears.

We come now to the Himalayan breed, which is sometimes

called Chinese, Polish, or Russian. These pretty rabbits are white, or occasionally yellow, excepting their ears, nose, feet, and the upper side of the tail, which are all brownish-black; but as they have red eyes, they may be considered as albinoes. I have received several accounts of their breeding perfectly true. From their symmetrical marks, they were at first ranked as specifically distinct, and were provisionally named L. nigripes. (4/14. 'Proc. Zoolog. Soc.' June 23, 1857 page 159.) Some good observers thought that they could detect a difference in their habits, and stoutly maintained that they formed a new species. The origin of this breed is so curious, both in itself and as throwing some light on the complex laws of inheritance that it is worth giving in detail. But it is first necessary briefly to describe two other breeds: silver-greys or silver-sprigs generally have black heads and legs, and their fine grey fur is interspersed with numerous black and white long hairs. They breed perfectly true, and have long been kept in warrens. When they escape and cross with common rabbits, the product, as I hear from Mr. Wyrley Birch, of Wretham Hall, is not a mixture of the two colours, but about half take after the one parent, and the other half after the other parent. Secondly, chinchillas or tame silver-greys (I will use the former name) have short, paler, mouse or slate-coloured fur, interspersed with long, blackish, slate-coloured, and white hairs. (4/15. 'Journal of Horticulture' April 9, 1861 page 35.) These rabbits breed perfectly true. A writer stated in 1857 (4/16. 'Cottage Gardener' 1857 page

141.) that he had produced Himalayan rabbits in the following manner. He had a breed of chinchillas which had been crossed with the common black rabbit, and their offspring were either blacks or chinchillas. These latter were again crossed with other chinchillas (which had also been crossed with silver-greys), and from this complicated cross Himalayan rabbits were raised. From these and other similar statements, Mr. Bartlett (4/17. Mr. Bartlett in 'Proc. Zoolog Soc.' 1861 page 40.) was led to make a careful trial in the Zoological Gardens, and he found that by simply crossing silver-greys with chinchillas he could always produce some few Himalayans; and the latter, notwithstanding their sudden origin, if kept separate, bred perfectly true. But I have recently been assured the pure silver-greys of any sub-breed occasionally produce Himalayans.

The Himalayans, when first born, are quite white, and are then true albinoes; but in the course of a few months they gradually assume their dark ears, nose, feet, and tail. Occasionally, however, as I am informed by Mr. W.A. Wooler and the Rev. W.D. Fox, the young are born of a very pale grey colour, and specimens of such fur were sent me by the former gentleman. The grey tint, however, disappears as the animal comes to maturity. So that with these Himalayans there is a tendency, strictly confined to early youth, to revert to the colour of the adult silver-grey parent-stock. Silver-greys and chinchillas, on the other hand, present a remarkable contrast with the Himalayans in their colour whilst quite young, for they are born perfectly

black, but soon assume their characteristic grey or silver tints. The same thing occurs with grey horses, which, as long as they are foals, are generally of a nearly black colour, but soon become grey, and get whiter and whiter as they grow older. Hence the usual rule is that Himalayans are born white and afterwards become in certain parts of their bodies dark-coloured; whilst silver-greys are born black and afterwards become sprinkled with white. Exceptions, however, and of a directly opposite nature, occasionally occur in both cases. For young silver-greys are sometimes born in warrens, as I hear from Mr. W. Birch, of a cream-colour, but these young animals ultimately become black. The Himalayans, on the other hand, sometimes produce, as is stated by an experienced amateur (4/18. 'Phenomenon in Himalayan Rabbits' in 'Journal of Horticulture' January 27, 1865 page 102.), a single black young one in a litter; and this, before two months elapse, becomes perfectly white.

To sum up the whole curious case: wild silver-greys may be considered as black rabbits which become grey at an early period of life. When they are crossed with common rabbits, the offspring are said not to have blended colours, but to take after either parent; and in this respect they resemble black and albino varieties of most quadrupeds, which often transmit their colours in this same manner. When they are crossed with chinchillas, that is, with a paler sub-variety, the young are at first pure albinoes, but soon become dark-coloured in certain parts of their bodies, and are then called Himalayans. The young Himalayans,

however, are sometimes at first either pale grey or completely black, in either case changing after a time to white. In a future chapter I shall advance a large body of facts showing that, when two varieties are crossed both of which differ in colour from their parent-stock, there is a strong tendency in the young to revert to the aboriginal colour; and what is very remarkable, this reversion occasionally supervenes, not before birth, but during the growth of the animal. Hence, if it could be shown that silver-greys and chinchillas were the offspring of a cross between a black and albino variety with the colours intimately blended — a supposition in itself not improbable, and supported by the circumstance of silver-greys in warrens sometimes producing creamy-white young, which ultimately become black — then all the above given paradoxical facts on the changes of colour in silver-greys and in their descendants the Himalayans would come under the law of reversion, supervening at different periods of growth and in different degrees, either to the original black or to the original albino parent-variety.

It is, also, remarkable that Himalayans, though produced so suddenly; breed true. But as, whilst young, they are albinoes, the case falls under a very general rule; albinism being well known to be strongly inherited, for instance with white mice and many other quadrupeds, and even white flowers. But why, it may be asked, do the ears, tail, nose, and feet, and no other part of the body, revert to a black colour? This apparently depends on a law, which generally holds good, namely, that characters common

to many species of a genus — and this, in fact, implies long inheritance from the ancient progenitor of the genus — are found to resist variation, or to reappear if lost, more persistently than the characters which are confined to the separate species. Now, in the genus Lepus, a large majority of the species have their ears and the upper surface of the tail tinted black; but the persistence of these marks is best seen in those species which in winter become white: thus, in Scotland the L. variabilis (4/19. G.R. Waterhouse 'Natural History of Mammalia: Rodents' 1846 pages 52, 60, 105.) in its winter dress has a shade of colour on its nose, and the tips of its ears are black: in the L. tibetanus the ears are black, the upper surface of the tail greyish-black, and the soles of the feet brown: in L. glacialis the winter fur is pure white, except the soles of the feet and the points of the ears. Even in the variously-coloured fancy rabbits we may often observe a tendency in these same parts to be more darkly tinted than the rest of the body. Thus the several coloured marks on the Himalayan rabbits, as they grow old, are rendered intelligible. I may add a nearly analogous case: fancy rabbits very often have a white star on their foreheads; and the common English hare, whilst young, generally has, as I have myself observed, a similar white star on its forehead.

When variously coloured rabbits are set free in Europe, and are thus placed under their natural conditions, they generally revert to the aboriginal grey colour; this may be in part due to the tendency in all crossed animals, as lately observed, to

revert to their primordial state. But this tendency does not always prevail; thus silver-grey rabbits are kept in warrens, and remain true though living almost in a state of nature; but a warren must not be stocked with both silver-greys and common rabbits; otherwise "in a few years there will be none but common greys surviving." (4/20. Delamer on 'Pigeons and Rabbits' page 114.) When rabbits run wild in foreign countries under new conditions of life, they by no means always revert to their aboriginal colour. In Jamaica the feral rabbits are described as having been "slate-coloured, deeply tinted with sprinklings of white on the neck, on the shoulders, and on the back; softening off to blue-white under the breast and belly." (4/21. Gosse 'Sojourn in Jamaica' 1851 page 441 as described by an excellent observer, Mr. R. Hill. This is the only known case in which rabbits have become feral in a hot country. They can be kept, however, at Loanda (see Livingstone 'Travels' page 407). In parts of India, as I am informed by Mr. Blyth, they breed well.) But in this tropical island the conditions were not favourable to their increase, and they never spread widely, and are now extinct, as I hear from Mr. R. Hill, owing to a great fire which occurred in the woods. Rabbits during many years have run wild in the Falkland Islands; they are abundant in certain parts, but do not spread extensively. Most of them are of the common grey colour; a few, as I am informed by Admiral Sulivan, are hare- coloured, and many are black, often with nearly symmetrical white marks on their faces. Hence, M. Lesson described the black variety as a distinct species, under

the name of Lepus magellanicus, but this, as I have elsewhere shown, is an error. (4/22. Darwin 'Journal of Researches' page 193; and 'Zoology of the Voyage of the Beagle: Mammalia' page 92.) Within recent times the sealers have stocked some of the small outlying islets in the Falkland group with rabbits; and on Pebble Islet, as I hear from Admiral Sulivan, a large proportion are hare-coloured, whereas on Rabbit Islet a large proportion are of a bluish colour, which is not elsewhere seen. How the rabbits were coloured which were turned out of these islets is not known.

The rabbits which have become feral on the island of Porto Santo, near Madeira, deserve a fuller account. In 1418 or 1419, J. Gonzales Zarco (4/23. Kerr 'Collection of Voyages' volume 2 page 177: page 205 for Cada Mosto. According to a work published in Lisbon in 1717 entitled 'Historia Insulana' written by a Jesuit, the rabbits were turned out in 1420. Some authors believe that the island was discovered in 1413.) happened to have a female rabbit on board which had produced young during the voyage, and he turned them all out on the island. These animals soon increased so rapidly, that they became a nuisance, and actually caused the abandonment of the settlement. Thirty-seven years subsequently, Cada Mosto describes them as innumerable; nor is this surprising, as the island was not inhabited by any beast of prey or by any terrestrial mammal. We do not know the character of the mother-rabbit; but it was probably the common domesticated kind. The Spanish peninsula, whence Zarco sailed, is known to have abounded with the common wild species at the

most remote historical period; and as these rabbits were taken on board for food, it is improbable that they should have been of any peculiar breed. That the breed was well domesticated is shown by the doe having littered during the voyage. Mr. Wollaston, at my request, brought home two of these feral rabbits in spirits of wine; and, subsequently, Mr. W. Haywood sent to me three more specimens in brine, and two alive. These seven specimens, though caught at different periods, closely resembled each other. They were full grown, as shown by the state of their bones. Although the conditions of life in Porto Santo are evidently highly favourable to rabbits, as proved by their extraordinarily rapid increase, yet they differ conspicuously in their small size from the wild English rabbit. Four English rabbits, measured from the incisors to the anus, varied between 17 and 17 3/4 inches in length; whilst two of the Porto Santo rabbits were only 14 1/2 and 15 inches in length. But the decrease in size is best shown by weight; four wild English rabbits averaged 3 pounds 5 ounces, whilst one of the Porto Santo rabbits, which had lived for four years in the Zoological Gardens, but had become thin, weighed only 1 pound 9 ounces. A fairer test is afforded by the comparison of the well-cleaned limb-bones of a Porto Santo rabbit killed on the island with the same bones of a wild English rabbit of average size, and they differed in the proportion of rather less than five to nine. So that the Porto Santo rabbits have decreased nearly three inches in length, and almost half in weight of body. (4/24. Something of the same kind has occurred on

the island of Lipari, where, according to Spallanzani ('Voyage dans les deux Siciles' quoted by Godron 'De l'Espece' page 364), a countryman turned out some rabbits which multiplied prodigiously, but, says Spallanzani, "les lapins de l'ile de Lipari sont plus petits que ceux qu'on eleve en domesticite.") The head has not decreased in length proportionally with the body; and the capacity of the brain case is, as we shall hereafter see, singularly variable. I prepared four skulls, and these resembled each other more closely than do generally the skulls of wild English rabbits; but the only difference in structure which they presented was that the supra-orbital processes of the frontal bones were narrower.

In colour the Porto Santo rabbit differs considerably from the common rabbit; the upper surface is redder, and is rarely interspersed with any black or black-tipped hairs. The throat and certain parts of the under surface, instead of being pure white, are generally pale grey or leaden colour. But the most remarkable difference is in the ears and tail; I have examined many fresh English rabbits, and the large collection of skins in the British Museum from various countries, and all have the upper surface of the tail and the tips of the ears clothed with blackish-grey fur; and this is given in most works as one of the specific characters of the rabbit. Now in the seven Porto Santo rabbits the upper surface of the tail was reddish-brown, and the tips of the ears had no trace of the black edging. But here we meet with a singular circumstance: in June, 1861 I examined two of these rabbits recently sent to the Zoological Gardens, and their tails and ears were coloured as

just described; but when one of their dead bodies was sent to me in February, 1865, the ears were plainly edged, and the upper surface of the tail was covered with blackish-grey fur, and the whole body was much less red; so that under the English climate this individual rabbit had recovered the proper colour of its fur in rather less than four years!

The two little Porto Santo rabbits, whilst alive in the Zoological Gardens, had a remarkably different appearance from the common kind. They were extraordinarily wild and active, so that many persons exclaimed on seeing them that they were more like large rats than rabbits. They were nocturnal to an unusual degree in their habits, and their wildness was never in the least subdued; so that the superintendent, Mr. Bartlett, assured me that he had never had a wilder animal under his charge. This is a singular fact, considering that they are descended from a domesticated breed. I was so much surprised at it, that I requested Mr. Haywood to make inquiries on the spot, whether they were much hunted by the inhabitants, or persecuted by hawks, or cats, or other animals; but this is not the case, and no cause can be assigned for their wildness. They live both on the central, higher rocky land and near the sea-cliffs, and, from being exceedingly shy and timid, seldom appear in the lower and cultivated districts. They are said to produce from four to six young at a birth, and their breeding season is in July and August. Lastly, and this is a highly remarkable fact, Mr. Bartlett could never succeed in getting these two rabbits, which were both

males, to associate or breed with the females of several breeds which were repeatedly placed with them.

If the history of these Porto Santo rabbits had not been known, most naturalists, on observing their much reduced size, their colour, reddish above and grey beneath, their tails and ears not tipped with black, would have ranked them as a distinct species. They would have been strongly confirmed in this view by seeing them alive in the Zoological Gardens, and hearing that they refused to couple with other rabbits. Yet this rabbit, which there can be little doubt would thus have been ranked as a distinct species, as certainly originated since the year 1420. Finally, from the three cases of the rabbits which have run wild in Porto Santo, Jamaica, and the Falkland Islands, we see that these animals do not, under new conditions of life, revert to or retain their aboriginal character, as is so generally asserted to be the case by most authors.

OSTEOLOGICAL CHARACTERS.

When we remember, on the one hand, how frequently it is stated that important parts of the structure never vary; and, on the other hand, on what small differences in the skeleton fossil species have often been founded, the variability of the skull and of some other bones in the domesticated rabbit well deserves attention. It must not be supposed that the more important differences immediately to be described strictly characterise any one breed; all that can be said is, that they are generally present in certain breeds. We should bear in mind that selection has not

been applied to fix any character in the skeleton, and that the animals have not had to support themselves under uniform habits of life. We cannot account for most of the differences in the skeleton; but we shall see that the increased size of the body, due to careful nurture and continued selection, has affected the head in a particular manner. Even the elongation and lopping of the ears have influenced in a small degree the form of the whole skull. The want of exercise has apparently modified the proportional length of the limbs in comparison with that of the body.

[As a standard of comparison, I prepared skeletons of two wild rabbits from Kent, one from the Shetland Islands, and one from Antrim in Ireland. As all the bones in these four specimens from such distant localities closely resembled each other, presenting scarcely any appreciable difference, it may be concluded that the bones of the wild rabbit are generally uniform in character.

SKULL.

I have carefully examined skulls of ten large lop-eared rabbits, and of five common domestic rabbits, which latter differ from the lop-eared only in not having such large bodies or ears, yet both larger than in the wild rabbit. First for the ten lop-eared rabbits: in all these the skull is remarkably elongated in comparison with its breadth. In a wild rabbit the length was 3.15 inches, in a large fancy rabbit 4.3; whilst the breadth of the cranium enclosing the brain was in both almost exactly the same.

Even by taking as the standard of comparison the widest part of the zygomatic arch, the skulls of the lop-eared are proportionally to their breadth three-quarters of an inch too long. The depth of the head has increased almost in the same proportion with the length; it is the breadth alone which has not increased. The parietal and occipital bones enclosing the brain are less arched, both in a longitudinal and transverse line, than in the wild rabbit, so that the shape of the cranium is somewhat different. The surface is rougher, less cleanly sculptured, and the lines of sutures are more prominent.

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