

SKETCH OF
SPECIES
THEORY
1844

J13

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B

(46(x4) = [illegible] with (43 & 44)

1844 Sketch of Species
Theory

Fair copy annotated
by C.D.

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When reading Scraps, make note what to Assume
in Reading the Books, as Barnacle; or matter of
Principle Fauna embryonic a law!
Make list of laws which I cannot explain
as Imitation Fortis Polaris, Barnacles Colonies
&c &c. Then start to investigate the literature.
Say if I can understand & give an explanation by the authority

Inches 1 2
cm 1 2 3 4 5

1. Variation
Changes in individuals and sports
3. do — plants — (sports in diviual)
4. Congenital Variation
5. Hereditary tendency
7. Causes of Variation
10. Selection, principle of
13. — effects of
14 — antiquity of
15. Crossing breeds, source of variation
18 — blends variation together.
19 — Crossing, probability of in all stems
— — advantage of
20. Races, Domestic whether from one or more parent stocks?
24. Variation limit of
27. Domestication, what consists of. Begin here.
29. Races, Domestic, some do not vary, cause of.

Chapt 2.
32. Variation in state of nature.
40 natural selection
Malthusian doctrine
42. Propagation rapid of animals — Rates of increase
44. Effect of Selection
47. Sexual selection. Darwin's theory §§ 89, 90
51. Sterility of species not expected
55 — of individuals from changes in conditions from nearly similar parents sometimes.
63. Analogical Characters between species & races.
64. Hybrids & mongrels, compared. misspelled Darwin's
66 62 Races & species compared
67. Variation Limits of.

Chapt. 3.
70. Instincts, or Habits in Domestic animals
72 — inheritance of habits &c
75 — characteristics of. Habits & instincts compared.
78 — & Habits compared & confusing.
78. — variation of in wild animals
79 — selection of variations in
81 — difficulties in believing the more complicated acquired

I think will discussion at § 193. ought to be in here somewhere, regarding period when variation supposed to become hereditary —

It is certain that we cannot judge of utility of many differences than by the want of them. Darwin's Origin of Species p. 61

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Book 113

This was sketched in 1839 & copied at full, as then written & read & so in 1844

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Darwin 113

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Part I

Chapter I

On the variation of organic beings under domestication, and on the principles of Selection. (p. 1 to 32.)

[The most favourable conditions for variation seem to be when organic beings are bred for many generations under domestication: one may infer this, from the simple fact of the vast number of races, and breeds of almost every plant & animal, which has long been domesticated. Under certain conditions organic beings even during their individual lives, become slightly altered from their usual form, size, or other characters: and many of the peculiarities thus acquired are transmitted to their offspring. Thus in animals, the size & vigour of body, fatness, period of maturity, habits of body or consensual movements, habits of mind and temper, are modified or acquired during the life of the individual, & become inherited. There is reason to believe that when long exercise has given to certain muscles great development, or disuse has lessened them, that such development is also inherited. Food & climate will

case of Orchis – more remarkable as not long cultivated & tendency seminal propagation.
(& maize) general
case of varieties which soon accumulate, like Aegilops & cannot & contain & character
& then go on varying.

Scrapbook?

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occasionally produce changes in the colour & texture of the external coverings of animals; and certain unknown conditions affect the horns of cattle in parts of Abyssinia: but whether these peculiarities, thus acquired during individual lives, have been inherited, I do not know. It appears certain that mal-conformation & lameness in horses, produced by too much work on hard roads - that affections of the eyes in this animal probably caused by bad ventilation - that tendencies towards many diseases in man, such as gout, caused by the course of life & ultimately producing changes of structure, and that many other diseases produced by unknown agencies such as germs, & idiotcy, resulting from it, all become hereditary.

Scorpion?

It is very doubtful whether the flowers & leaf-buds, annually produced from the same bulb, root, or tree, can properly be considered as parts of the same individual, though in some respects they certainly seem to be so. If they are parts of an individual, plants also are subject to considerable changes during their individual lives. Most florist-flowers, if neglected degenerate, that is, lose some of their characters; so common is this, that fineness is often

Natra, as greatly enhancing the value of a variety: tulips
break their colours only after some years culture; some
plants become double & others single, by neglect or care:
these characters can be transmitted by cuttings or grafts, &
in some cases by true or seminal propagation. Occasionally
a single bud on a plant, assumes at once a new & widely
different character: thus it is certain that nectarines
have been produced on peach trees & mosse roses on provence
roses; white currants on red-currant bushes; flowers of a
different colour from that of the stock, in Chrysanthemum,
Dahlias, sweet-william, Azalias &c &c; variegated leaf-buds
on many trees, & other similar cases. These new characters
appearing in ~~individual~~ single buds, can, like those before change
affecting the whole plant, be multiplied not only by cut-
tings & such means, but often likewise by true seminal
generation.

The changes thus appearing during the lives of individual
animals & plants, are extremely rare compared with those
which are congenital or which appear soon after birth. Slight
differences thus arising are infinitely numerous: the

proportions & form of every part of the frame, inside & outside, appear to vary in very slight degrees: anatomists dispute what is the "beau ideal" of the bones, the liver, & kidneys, like fashion do of the proportions of the face: the proverbial expression that no two animals or plants are born absolutely alike, is much truer when applied to those under domestication, than to those in a state of nature. Besides these slight differences, single individuals are occasionally born, considerably unlike in certain parts or in their whole structure, to their parents: these are called by horticulturists & breeders "sports"; and are not uncommon, except when very strongly marked. Such sports are known in some cases, to have been parents of some of our domestic races; & such probably have been the parents of many other races, especially of those, which in some senses may be called hereditary monsters; for instance where there is an additional limb, or where all the limbs are stunted (as in the ancon sheep), or where a part is wanting as in rumpless fowls & tailless dogs or cats. The effects of external conditions on the size, colour & form, which can rarely and

obscurely or detected during one individual life, become apparent after several generations: the slight differences, often hardly describable, which characterize the stock of different countries, & even of districts in the same country, seem to be due to such continued action.

on the hereditary tendency. to p. 7

A volume might be filled with facts showing what a strong tendency there is to inheritance, in almost every case of the most trifling, as well as of the most remarkable congenital peculiarities. The term congenital peculiarity, I may remark, is a loose expression & can only mean a peculiarity apparent when the part affected, is nearly or fully developed: in the Second Part, I shall have to discuss, at what period of the embryonic life, connatal peculiarities probably first appear; & I shall then be able to show from some evidence, that at whatever period of life a new peculiarity first appears, it tends hereditarily to appear at a corresponding period: Numerous though slight changes, slowly supervening in animals during ma-=ture life, (often, though by no means always, taking the form of disease) are, as stated in the first paragraphs

very often hereditary. In plants, again, the buds which assume a different character from their stock likewise tend to transmit their new peculiarities. There is not sufficient reason to believe that either mutilations or changes of form produced by mechanical pressure, even if continued for hundreds of generations, or that any changes of structure quickly produced by disease, are inherited; it would appear as if the tissues of the part affected must slowly & freely grow into the new form, in order to be inheritable. There is a very great difference in the hereditary tendency of different peculiarities and of the same peculiarity, in different individuals & species; thus 20 thousand seeds of the weeping ash have been sown & not one came up true; — out of seventeen seeds of the weeping yew nearly all came up true. The ill-formed & almost monstrous 'Niata' cattle of S. America & ancon sheep, when (together) both bred and when crossed with other breeds, seem to transmit their peculiarities to their offspring as truly, as the ordinary breeds. I can throw no light on these differences in the power of hereditary transmission. Breeders believe, & apparently with good cause, that a peculiarity generally becomes more firmly implanted after

having passed through several generations; that is if one offspring out of twenty inherits a peculiarity from its parents, then its descendants will tend to transmit this peculiarity to a larger proportion than one in twenty; & so on in succeeding generations.

I have said nothing about mental peculiarities being inheritable for I reserve this subject for a separate chapter.

causes of variation. to p. 10

[Attention must here be drawn to an important distinction in the first origin or appearance of varieties: when we see an animal highly kept producing offspring with an hereditary tendency to early maturity & fatness; when we see the wild-duck & Australian dog always becoming, when bred for one or a few generations in confinement, mottled in their colours; when we see people living in certain districts or circumstances becoming subject to an hereditary taint to certain organic diseases, as consumption or plica polonica, — we naturally attribute such changes to the direct effect of known or unknown agencies, acting for one or more generations on the parents.

It is probable that a multitude of peculiarities may be thus directly caused by unknown external agencies. But in breeds, characterized by an extra limb or claw, as in certain

fowls & dogs; by an extra joint in the vertebra; by the loss of a part, as the tail; by the substitution of a tuft of feathers for a comb in certain poultry; & in a multitude of other cases, we can hardly attribute these peculiarities directly to external influences, but indirectly to the laws of embryonic growth & of reproduction. When we see a multitude of varieties (as has often been the case, where a cross has been carefully guarded against) produced from seeds matured in the very same capsule, with the male & female principle nourished from the same roots & necessarily exposed to the same external influences; we cannot believe that the endless slight differences between resulting varieties thus produced, can be the effect of any corresponding difference in their exposure. We are led (as Müller has remarked) to the same conclusion, when we see in the same litter, produced by the same act of conception, animals considerably different. As variation to this degree here alluded to, has been observed only in organic beings under domestication, and in plants amongst those most highly & long cultivated, we must attribute in such cases, the varieties (although the difference between each variety cannot

possibly be attributed to any correspondingdifference of exposure in the parents) to the indirect effects of domestication on the action of the reproductive system. It would appear, as if the reproductive powers failed in their ordinary function of producing new organic beings, closely like their parents; and, as if the entire organization of the embryo, under domestication, became in a slight degree plastic. We shall hereafter have occasion to show, that in organic beings, a considerable change from the natural conditions of life, affects, independently of their general State of health, in another & remarkable manner, the reproductive system. I may add, judging from the vast number of new varieties of plants which have been produced in the same districts & under nearly the same routine of culture, that probably the indirect effects of domestication in making the organization plastic, is a much more efficient source of variation, than any direct effect, which external causes may have on the colour, texture, or form of each part. In the few instances in which, as in the Dahlia, the course of variation has been recorded, it appears that domestication produces little effect for several generations in

rendering the organization plastic; but afterwards, as if by an accumulated effect, the original character of the species suddenly gives way or breaks.]

on Selection to p. 11.

[We have hitherto only referred to the first appearance in individuals of new peculiarities; but to make a race or breed, something more is generally requisite than such peculiarities (except in the case of the peculiarities being the direct effect of constantly surrounding conditions) should be inheritable, — namely the principle of selection, implying separation. Even in the rare instances of sports, with the hereditary tendency very strongly implanted, crossing must be prevented with other breeds, or if not prevented the best characterized of the half-bred offspring must be carefully selected. Where the external conditions are constantly tending to give some character, a race possessing this character will be formed with far greater ease by selecting & breeding together the individuals most affected. In the case of the endless slight variations, produced by the indirect effects of domestication on the action of the reproductive system, selection is indispensable to form races; & when carefully applied, wonderfully numerous and

diverse races can be formed. Selection though so simple in theory, is & has been, to a degree, which can hardly be overrated. important It requires extreme skill, the result of long practice, in detect-ing the slightest difference in the forms of animals, & it im-plies some distinct object in view; with these requisites & patience, the Breeder has simply to watch for every the smallest approach to the desired end, to select such individuals & pair them with the most suitable forms, & so continue with succeeding generations. In most cases careful selection & the prevention of accidental crosses will be necessary for several generations; for in new breeds there is a strong tendency to vary & especially to revert to ancestral forms: but in every succeeding gener-ation less care will be requisite for the breed will become truer; until ultimately only an occasional individual will require to be separated or destroyed: Horticulturists in raising seeds, regularly practice this, & call it 'roguing', or destroying the 'rogues' or false varieties. There is another & less efficient means of selection amongst animals; namely repeat-edly procuring males with some desirable qualities, and allowing them & their offspring to breed freely together; & this

in the course of time will affect the whole lot. These principles of selection have been methodically followed for scarcely a century; but their high importance is shown by the practical results, & is admitted in the writings of the most celebrated agriculturists & horticulturists;— I need only name, Anderson, Marshall, Bakewell, Coke, Western, Sebright & Knight.

[Even in well established breeds, the individuals of which to an unpractised eye would appear absolutely similar, which would give, it might have been thought, no scope to selection, the whole appearance of the animal has been changed, in a few years (as in the case of Lt. Western's sheep). So that practised agriculturists could scarcely credit, that the change had not been effected by a cross with other breeds. Breeders both of plants & animals frequently give their means of selection greater scope, by crossing different breeds & selecting the offspring; but we shall have to recur to this subject again.

The external conditions will doubtless influence and modify the results of the most careful selection; it has been found impossible to prevent certain breeds of cattle from

degenerating on mountain pastures; it would probably be impossible to keep the plumage of the wild-duck in the domesticated race; in certain soils, no care has been sufficient to raise cauliflower seed true to its character; & so in many other cases. But with patience, it is wonderful what man has effected: (he has selected & therefore in one sense made one breed of horses to race & another to pull;— he has made sheep with fleeces good for carpets & other sheep good for broadcloth;— he has, in the same sense, made one dog to find game & give him notice when found, & another dog to fetch him the game when killed;— he has made the fat to lie mixed with the meat in one breed & in another to accumulate in the bowels for the tallow-chandler;— he has made the legs of one breed of pigeons long, & the beak of another so short that it can hardly feed itself;— he has previously determined how the feathers on a bird's body shall be coloured, & how the petals of many flowers shall be streaked or fringed, and has given prizes for complete success;— he has made the leaves of one variety & the flower-bud of another variety of the cabbage good to eat, ~~both~~ at different seasons of the year; and

Hooker
Jos. goodish

thus has he acted on endless varieties. I do not wish to affirm that the long- & short wooled sheep, or that the pointer & retriever, or that the cabbage & cauliflower have certainly descended from one & the same aboriginal wild stock; if they have not so descended, though it leaves what man has effected, a large result must be left unquestioned.

[In saying as I have done, that man makes a breed, let it not be confounded with saying that man makes the individuals, which are given by nature with certain desirable qualities; man only adds together & makes a permanent gift of nature's bounties. In several cases, indeed, for instance in the 'ancon' sheep, ~~good for~~ valuable form not getting over fences, & in the turn spit dog- man has probably only prevented crossing; but in many cases, we positively know that he has gone on selecting, & taking advantage of successive small variations.

Selection has been methodically followed, as I have said, for barely a century; but it cannot be doubted that occasionally it has been practised from the remotest ages, in those animals completely under the dominion of man. In the earliest chapters of the Bible there are rules given for—

influencing the colours of breeds, & black & white sheep are spoken of as separated. In the time of Pliny, the Barbarians of Europe & Asia endeavoured by cross-breeding with a wild stock to improve the races of their dogs & horses. The savages of Guyana now do so with their dogs: such care shows at least that the characters of individual animals were attended to. In the rudest times of English history, there were laws to prevent the exportation of fine animals of established breeds, & in the case of horses, in Henry VIII. time, laws for the destruction of all horses under a certain size. In one of the oldest numbers of the Phil. Transactions, there are Rules for selecting & improving the breeds of sheep.— Sir T. Burbury, in 1660, has given rules for selecting the finest seedling= =plants, with as much precision, as the best recent Horticulturist (called. Even in the most savage & rude nations, in the wars & famines, which so frequently occur, the most useful of their animals would be preserved: the value set upon animals by savages is shown by the inhabitants of Tierra del Fuego devouring their old women before their dogs, which as they asserted are useful in otter-hunting: who can doubt but that in every case of famine & war, the best otter-hunters would be preserved, & therefore in fact selected for breeding. As the

offspring so obviously take after their parents, & as we have seen that savages take pains in crossing their dogs & horses with wild stocks, we may even conclude as probable, that they would sometimes pair the most useful of their animals & keep their offspring separate. As different races of men require & admire different qualities in their domesticated animals, each would thus slowly, though unconsciously, by selecting a different breed: as Pallas has remarked, who can doubt, but that the ancient Russian would esteem & endeavour to preserve those sheep in his flocks, which had the thickest coats. This kind of insensible selection by which new breeds, are not selected & kept separate, but a peculiar character is slowly given to the whole mass of the breed, by often saving the life of animals with certain characteristics, we may feel nearly sure, from what we see has been done by the more direct method of separate selection within the last 50 years in England, would in the course of some thousand years, produce a marked effect.

Crossing Breeds to p 20.

[When one or two or more races are formed, or if more than one race, or species fertile inter se, originally existed in a wild state, their

copious
crossing becomes a most ~~fertile~~ source of new races. When two

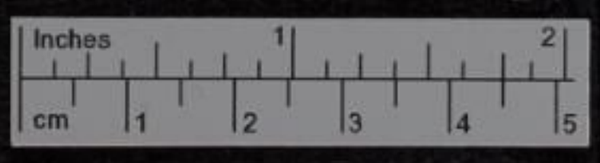
well-marked races, are crossed the offspring in the first generation take more or less after either parent or are quite intermediate between them, or rarely assume characters in some degree new. In the second & several succeeding generations, the offspring are generally found to vary exceedingly, one compared with another, & many revert nearly to their ancestral forms. This greater variability in succeeding generations seems analogous to the breaking or variability of organic beings after having been bred for some generations under domestication, so marked in this ability in cross-bred descendants, that Pallas & some other naturalists have supposed that all variation is due to an original cross; but I conceive that the history of the Potato, Dahlia, Scotch Rose, the guinea-pig, & many trees in this country, where only one species of the genus exists, clearly shows, that a species may vary, where there can have been no crossing. Owing to this variability & tendency to reversion in cross-bred beings, much careful selection is requisite to make intermediate or new permanent races: nevertheless crossing has been a most powerful engine, especially with plants, where means of propagation exist by which the cross-bred varieties can be secured without incurring the risk of fresh variation from seminal propagation: with animals the most skilful agriculturists now greatly prefer careful selection, ~~though with less scope of variation~~, from

a ~~permanent~~ well established breed, rather than from uncertain cross-bred stocks.

Although intermediate & new races may be formed by the mingling of others; yet if the two races are allowed to mingle quite freely, so that none of either parent race remain pure, then, especially if the parent races are not widely different, they will slowly blend together, & the two races will be destroyed, & a mongrel ~~one~~ face left in its place. This will of course happen in a shorter time, if one of the parent races exists in greater number than the other. We see the effect of this mingling, in the manner in which the aboriginal breeds of dogs & pigs in the Oceanic Is.ds and the many breeds of our domestic animals introduced into S. America, have all been lost & absorbed in a mongrel race. It is probably owing to the freedom of crossing, that, in uncivilized countries, where inclosures do not exist, we seldom meet with more than one race of a species: it is only in inclosed countries, where the inhabitants do not migrate, & ~~with~~ have conveniences for separating the several kinds of domestic animals, that we meet with a multitude of races ~~of the same species~~. Even in civilized countries, want of care for a few years has been found to destroy the good results of far longer periods of selection & separation.

Land: Does not terrestrial mean belonging to the world?

[This power of crossing will affect the races of all land terrestrial animals; for all terrestrial animals require for their reproduction the union of two individuals. Amongst plants, races will not cross & blend together with so much freedom, as in terrestrial animals; but this crossing takes place through various curious contrivances to a surprising extent. In fact ~~in so very many hermaphrodite flowers, I believe with few exceptions,~~ (in so very many hermaphrodite flowers) such contrivances exist, by which an occasional cross may take place, that I cannot avoid (with Mr Knight) suspecting that the reproductive action requires, ~~in every case~~ at intervals, the concurrence of distinct individuals. Most breeders of plants & animals are firmly convinced that benefit is derived from an occasional cross, not with another race, but with another family of the same race; & that, on the other hand injurious consequences follow from long-continued close interbreeding in the same family. Of marine animals, many more, than was till lately believed, have their sexes on separate individuals; & where they are hermaphrodite, there seems very generally to be means through the water, of one individual occasionally impregnating another: if individual animals can singly propagate themselves for perpetuity, it is unaccountable that no terrestrial



Diseases caused by Diseases — Race of Poultry.

animal, where the means of observation are more obvious, should
& mightly perpetuating its kind.)
be in this predicament. I conclude, then, that races of most

animals & plants, when unconfined in the same country, would

tend to blend together.

Whether our domestic races have descended from one or more wild stocks. to p. 24

Several Naturalists, of whom Pallas ~~was one of the first~~ regarding
were the first
animals, & Humboldt regarding certain plants, believe that the breeds

of many of our domestic animals such as of the horse, pig, dogs,
and of our Plants,
sheep, pigeons & poultry have descended from more than one

aboriginal form. They may have it doubtful, whether such forms
true
are to be considered wild races, or tame species, whose offspring
are fertile when crossed inter se. The main arguments for this view
consist; first, of the great difference between such breeds,

as the Race & Cart Horse, or the greyhound & Bull-dog, & of our

ignorance of the Steps or Stages, through which these could

have passed from a common parent; and secondly that in the
still
most ancient historical periods, breeds resembling some of

those at present most different, existed in different countries.

The wolves of N. America & of Siberia are thought to be different

species; & it has been remarked, that the dogs belonging to the

Savages in these two countries, resemble the wolves of the same

country; & therefore that they have probably descended from two
different wild stocks. In the same manner, these naturalists believe
that the Horse of Arabia & of Europe have probably descended
from two wild stocks both apparently now extinct. I do not
Qu (inter se)? think the assumed fertility of these wild stocks any very great
difficulty on this view; for although in animals, the offspring of
most cross-bred species are infertile, it is not always remember-
ed, that the experiment is very seldom fairly tried, except when
two near species both breed freely (which does not readily hap-
pen, as we shall hereafter see) when under the dominion of
man. Moreover in the case of the China & common goose, the
canary & siskin, the hybrids breed freely; in other cases the
offspring from a hybrid crossed with either pure parent, are fertile, as is
practically taken advantage with the yak & cow; as far as the
analogy of plants serves, it is impossible to deny that some species
Not clear to me are quite fertile inter se; but to this subject we shall recur.

On the other hand, the upholders of this view that the several breeds
of dogs, horses &c &c, have descended each from one stock, may aver
that their view removes all difficulty about fertility, & that the main
argument from the high antiquity of different breeds, somewhat

similar to the present breeds, is worth little without knowing the date of the domestication of such animals, which is far from being the case. They may also with more weight aver, that, knowing that organic beings under domestication do vary in some degree, the argument for the great difference between certain breeds is worth nothing, without we know the limits of variation during a long course of time, which is far from the case. They may argue that almost every county in England, & in many districts of other countries, for instance in India, there are slightly different breeds of the domestic animals; & that it is opposed to all that we know of the distribution of wild animals to suppose that these have descended from so many different wild races or species: if so, they may argue, is it not probable that countries quite separate & exposed to different climates, would have breeds not slightly, but considerably different. Taking the most favourite case on both sides, namely that of the dog; they might urge that, surely such breeds as the Bull-dog & turnspit have been from the ascertained fact that reared by man, ~~knowing that the origin of~~ strictly analogous breeds (namely the Kiala ox & anoon sheep) ~~is ascertained amongst other~~ in other quadrupeds have thus originated. quadrupeds. Again they may say, seeing what training & careful selection has effected for the greyhound; & seeing how absolutely unfit

the Italian greyhound is to maintain itself in a state of nature, is it not probable that at least all greyhounds, from the Rough Deer, the smooth Persian, the common English, to the Italian, have descended from one stock? If so, is it so improbable that the Deer-Greyhound & long-legged Shepherd dog have so descended? If we admit this, & give up the Bull-Dog, we can hardly dispute, the probable common descent of the other breeds.

The evidence is so conjectural & balanced on both sides, that at present, I conceive no one can decide: for my own part, I lean to the probability of most of our domestic animals having descended from more than one wild stock; though from the arguments last advanced, & from reflecting on the slow though inevitable effect of different races of man kind, under different circumstances, saving the lives of & therefore selecting the individuals most useful to them, I cannot doubt but that one class of naturalists have much overrated the probable number of the wild aboriginal stocks. as far as we admit the difference of our races is due to the differences of their original stocks, so much must we give up of the amount of variation produced under domestication. But this appears to me unimportant, for we certainly know in some few cases, for instance in the Dahlia & Potato and Rabbit, that a great number of varieties

have processed from one stock; & in many of our domestic races we know that man, by slowly selecting & by taking advantage of sudden sports, has considerably modified old races & produced new ones.

Whether we consider our races as the descendants of one or several wild stocks, we are in far the greater number of cases, equally ignorant, what these stocks were.

Limits to Variation in legue's mind & p. 27.

Man's power in making races depends, in the first instance, on the stock, on which he works being variable; but his labours are modified & limited as we have seen, by the direct effects of the external conditions, - by the deficient or imperfect hereditariness of new peculiarities, - & by the tendency to continual variation & especially to reversion to ancestral forms. If the stock is not variable under domestication, of course he can do nothing; & it appears that species differ considerably in this tendency to variation, in the same way, as even sub-varieties from the same variety differ greatly in this respect, & transmit to their offspring this difference in tendency. Whether the absence of a tendency to vary is an unalterable quality in certain species, or depends on some deficient condition of the particular state of domestication to which they are exposed, there is no evidence. When the organization is rendered variable, or plastic as I have expressed it, under domestication,

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different parts of the frame vary more or less in different species: thus in the breeds of cattle, it has been remarked, that the horns are the most constant or least variable character, for these often remain constant, whilst the colour, size, proportions of the body, tendency to fatten &c vary; in sheep, I believe, the horns are much more variable. As a general rule the less important parts of the organization seem to vary most, but I think there is sufficient evidence that every part occasionally varies in a slight degree. Even when man has the primary requisite variability, he is necessarily checked by the health & life of the stock, he is working on: thus he has already made pigeons with such small beaks that they can hardly eat & will not rear their own young; he has made families of sheep with so strong a tendency to early maturity & to fatten, that in certain pastures they cannot live from their extreme liability to inflammation; he has made (i e selected) sub-varieties of plants, with a tendency to such early growth, that they are frequently killed by the spring frosts; he has made a breed of cows having calves with such large hinder quarters, that they are born with great difficulty, often to the death of their mothers; the breeders were compelled to remedy this, by the selection of a breeding stock with smaller hinder

quarters; in such a case, however, it is possible that by long patience
& great loss, a remedy might have been found, in selecting cows capa-
+ [too different] for [a human head, then + no bull, terestay bodi]
-ble of giving birth to calves with large kidney-quarters. Besides the
limits already specified, there can be little doubt that the vari-
-ation of different parts of the frame are connected together by
many laws: thus the two sides of the body, in health & disease,
seem almost always to vary together: it has been asserted by
breeders, that if the head is much elongated, the bones of the ex-
-tremities will likewise be so; in seedling-apples, large leaves &
fruit generally go together, & often the horticulturist as some guide in his
selection; we can here see the reason, as a fruit is only a meta-
-morphosed leaf. In animals the teeth & hair seem connected for
the hairless Chinese dog is almost toothless. Breeders believe that
one part of the frame or function being increased, causes other
parts to decrease: they dislike great horns & great bones as do
much flesh lost; in hornless breeds of cattle, certain bones of the
head become more developed: it is said that fat accumulating in
one
part, checks its accumulation in another, & likewise checks the ac-
-tion of the udder. The whole organization is so connected, that it is
probable, where are many conditions, determining the variation of each

Lives of St Hilaries, with the Study in ecclesiastical identification

Schleiden on alkalies. – What is it [illegible] what cause variation?

one present Bio[illegible] –

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part, & causing other parts to vary with it; & man in making new-
races, must be limited & ruled by all such laws.

elimat. variation } In what consist Domestication to p. 31.

In this chapter we have treated of variation under Domestication,
& it now remains to consider, in what does this power of domesti-
=cation consist— a subject of considerable difficulty. Observing
that organic beings of almost every class, in all climates, countries,
& times, have varied when long bred under domestication; we must
conclude that this influence is of some very general nature. Mr.
Knight alone, as far as I know, has tried to define it; he believes it
consists of an excess of food, together with transport to a more ge-
-nial climate or protection from its severities. I think we cannot admit
2 Not Julia Sketch of varieties
this latter proposition, for we know how many vegetable products, abori-
-gines of this country, here vary, when cultivated & when exotic cultivated with-
-out any protection from the weather; & some of our variable trees,
3 Hooker - look, to it - five parts of Terria are raging cold in Winter
as apricots, peaches, have undoubtedly been derived from a more
genial climate. There appears to be much more truth in the doctrine
of excess of food being the cause, though I much doubt whether this
is the sole cause, although it may well be a requisite for the kind
of variation, desired by man, namely increase of size & vigour. No
doubt horticulturists when they wish to raise new seedlings, often

It appears that slight changes of condition good for health: that more
change affect reproduction system, so that variation results
close
more with checks or destroys fertility not of offspring

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pluck off all the flower-buds, except a few, or remove the whole during one season, so that a great stock of nutriment may be thrown into the flowers, which are to seed. When plants are transported from high-lands, forests, marshes, heaths, into our gardens & green-houses, there must be a considerable change of food, but it wd be hard to prove that there was in every case an excess of the kind proper to the plant. If it be an excess of food, compared with that which the being obtained in its natural state, the effects continue for an improbably long time; during how many ages has wheat been cultivated, & cattle & sheep reclaimed, & we cannot suppose their but their condition with at best been constant amount of food has gone on increasing, nevertheless these are amongst the most variable of our domestic productions. It has been remarked (Marshall) that some of the most highly kept breeds of sheep all crosses avoided & cattle are truer or less variable than the straggling animals of the poor; which subsist on commons, & pick up a bare subsistence. In the case of forest-trees, raised in nurseries, which vary more, 23200 inferrable, than the same trees would do in their aboriginal forests; the cause would seem simply to lie, in their not having to struggle against other trees & weeds, which in their natural state doubtless would limit the conditions of their existence. It appears to me

that the power of domestication resolves itself into the accumulated effects of a change of all or some of the natural conditions of the life of the species, often associated with excess of food. These conditions, moreover, I may add can seldom remain, owing to the mutability of the affairs, habits, migrations, & knowledge of man, for very long periods the same. I am the more inclined to come to this foregoing conclusion, from finding, as we shall hereafter show, that changes of the natural conditions of existence seem peculiarly to affect the action of the reproductive system. As we see that hybrids & mongrels, after the first generation, are apt to vary much, we may at least conclude, that variability does not altogether depend on excess of food.

After these views, it may be asked, how it comes that certain animals & plants, which have been domesticated for a considerable length of time, & transported from very different conditions of existence, have not varied much, or scarcely at all; for instance, the ass, Peacock, Guinea-fowl, asparagus, Jerusalem artichoke,

I have already said, that probably different species, like different sub-varieties, possess different degrees of tendency to vary; but I am inclined to attribute, in these cases the want of numerous races, less to want of

on them.

variability, than to selection not having been practised. No one will take the pains to select without some corresponding object, either of use or amusement; the individuals raised must be tolerably numerous, & not so voracious, but that he may freely destroy, those not answering to his wishes. If Guinea-fowls or Peacocks became "fancy" birds, I cannot doubt that after some generations several breeds would be raised. Ashes have not been worked on from mere neglect; but they differ in some degree in different countries. The insensible selection, due to different races of mankind, preserving those individuals, most useful to them in their different circumstances, will apply only to the oldest & most widely domesticated animals. In the case of plants, we must put entirely out of the case those, exclusively (or almost so) propogated by cuttings, layers or tubers, such as the Jerusalem Artichoke & Laurel; & if we put on one side plants of little ornament or use, & those which are used at so early a period of their growth, that no especial characters signify, as asparagus & Kabala, I can think of none long cultivated, which have not varied. In no case ought we to expect to find as much variation in a race, when it alone has been formed, as when several have been formed for their

Here are Nite Peacocks

There are varieties of asparagus

crossing and recrossing will greatly increase their variability.

Summary of the First Chapter

To sum up this chapter: Races are made under domestication: 1st by the direct effects of the external conditions to which the species is exposed: 2. by the indirect effects of the exposure to new conditions, often aided by excess of food, rendering the organization plastic, & by man's selecting & separately breeding certain individuals, or introducing to his stock selected males, or often preserving with care the life of the individuals best adapted to his purposes: 3. by crossing & recrossing races already made, & selecting their offspring. After some generations man may relax his care in selection; for the tendency to vary & to revert to ancestral forms, will increase, so that he will have only occasionally to remove or destroy one of the yearly offspring which departs from its type. Ultimately with a large stock, the effect of free crossing would keep, even without this care, his breed ~~perfectly~~ true. By these means man can produce infinitely numerous races, curiously adapted to ends, both most important & most frivolous; at the same time that the effects of the surrounding conditions, the laws of inheritance, of growth, &

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of variation, will modify & limit his labours.

Chap.r II

On the variation of organic brings in a wild state;- on the natural means of Selection;- and on the comparison of domestic races & true species. (p. 32 to 69)

Having treated of variation under domestication, we now come to it, in a state of nature, -

Most Organic brings in a state of nature vary exceedingly little: I put out of the case variations, (as Stunted plants &c, & sea-shells in brackish water) which are directly the effect of external agencies, & which we do not know are in the breed, or are hereditary - the amount of hereditary variation is very difficult to ascertain, because naturalists (partly from the want of knowledge, & partly from the inherent difficulty of the subject) do not all agree whether certain forms are species or races. Some ~~wild~~ strongly-marked races of plants, comparable with the accidental sports of horticulturists, in a state of nature, undoubtedly exist, as is actually known by experiment, for instance in the primrose & cowslip - in two so-called species of Dandelion, in two of foxglove, & I believe in some pines. Lamarck has observed, that as long as we confine our attention to one limited

Compare letters here & Oxford MSS
with those in Selden & Helsby
That use of Imperial chancery
Constit + Empire - Angelli Kohlrausch
Epistola : show just
Solarium d Arbini case —
XX Varidici 81 sexual character, etc - Jewel & wife).

country, there is seldom much difficulty in deciding what forms to call species & what varieties; & that it is when collections flow in from all parts of the world, that naturalists often feel at a loss to decide the limit of variation. Yet amongst British plants, (& I may add Land-Shells) which are probably better known than any in the world, the best naturalists differ very greatly in the relative proportions of what they call species & what varieties. In many genera of insects & shells & plants it seems almost hopeless to establish which are which. In the higher classes there are less doubts; though we find considerable difficulty in ascertaining what ought to be called species amongst foxes & wolves; & in some birds, for instance in the case of the white Barn-~~Owl~~ Fowl. When specimens are brought from different parts of the world, how often do naturalists dispute, this same question, as I found with respect to the birds ~~under similar circumstances, as I have observed, in specimens~~ brought from the Galapagos islands. Gould has remarked that the individuals of the same undoubted ~~European~~ species of birds, from Europe and N. America, usually present slight, indefinable though perceptible, differences. The recognition indeed of one animal by another, of its kind, seems to imply some difference. The disposition of

wild animals undoubtedly differs. The variation, such as it is, chiefly affects the same parts in wild organisms as in domestic breeds; for instance the size, colour, & the external & less important parts. In many species the variability of certain organs or qualities is even stated as one of the specific characters: thus in plants, the colour, size, hairiness, ~~in plants~~ the number of the stamens & pistils, & even their presence, the form of the leaves; the size & form of the mandibles of the males of some insects; the length & curvature of the beak in some birds (as in Opetiorhynchus,) are ~~all fixed characters~~ variable characters in some species & quite fixed ~~variable~~ in others. I do not perceive that any just distinction (?) can be drawn between this recognized variability of certain (?) parts in many species, & the more general variability of the whole frame in domestic races.

Although the amount of variation be exceedingly small in most organic beings in a state of nature, & probably quite wanting (as far as our senses serve) in the majority of cases; yet considering how many animals & plants, taken by mankind from different quarters of the world, for the most diverse purposes, have varied under domestication in every country & in every age; I think we may safely conclude that all organic beings, with few exceptions, if capable of

being domesticated & bred for long periods, would vary. Domestication seems to resolve itself into a change from the natural conditions of the species, generally perhaps including an increase of food; if this be so, organisms in a state of nature must occasionally in the course of ages be exposed to analogous influences; for geology clearly shows that many places, must, in the course of time, become exposed to the widest range of climatic & other influences; & if such places be isolated, so that new & better adapted organic beings cannot freely immigrate, the old inhabitants will be exposed to new influences, probably far more varied, than man applies under the form of domestication. Although every species no doubt will soon breed up to the full number, which the country will support, yet it is easy to conceive, that on an average some species may receive an increase of food, for the times of ~~dearth~~ short, calamitous Kill &
may be recurrent only at long intervals. All such changes of conditions, from geological causes, would be exceedingly slow; what effect the slowness might have we are ignorant; under domestication, it appears, that the effects (of change of condition) accumulate, & then break out. Whatever might be the result of these slow geological changes, we may feel sure, from the (means of) dissemination common in a greater or

greater degree to every organism, taken conjointly with the changes of geology, which are steadily (& sometimes suddenly, as when an isthmus at last separates) in progress, that occasionally organisms must suddenly be introduced into new regions, where if the conditions of existence are not so foreign as to cause its extermination, it will often be propagated under circumstances, still more closely analogous to those of domestication; & therefore we expect will evince a tendency to vary. It appears to me quite inexplicable, if this has never happened; but it can happen very rarely. Let us then suppose that an organism by some chance (which might be hardly repeated in a 1000 years) arrives at a modern volcanic island in process of formation & not fully stocked with the most appropriate organisms; the new organism might readily gain a footing, although the external conditions were considerably different from its native ones. The effect of this, we might expect, would influence in some small degree the size, colour, nature of covering &c and from inexplicable influences even special parts & organs of the body.

But we might further (& what is far more important) expect that the reproductive system would be affected, as under domesticity, and the function of the offspring rendered in some small degree plastic. ~~It be rendered plastic~~. Hence almost every part of the body would

tend to vary from the typical form in slight degrees & in no deter-

minate way; & therefore without selection, the free crossing of these

small variations, together with the tendency to reversion to the

original form, would constantly be counteracting this unsettling

effect of the extraneous conditions on the reproductive system.

Such, I conceive, would be the unimportant result without

selection. And here I must observe that the foregoing remarks

are equally applicable to that small & admitted amount of variation,

which has been correct in some organisms in a state of nature; as well as to the above hypothe-

tical variation consequent on changes of condition. [Let us

now, suppose a Being with penetration sufficient to perceive

differences in the outer & innermost organization, quite

imperceptible to man, & with forethought extending over

future centuries, to watch with unerring care & select for any

object, the offspring of an organism produced under the fore-

-going circumstances; I can see no conceivable reason, why

he could not form a new race (or several were he to separate the

stock of the original organism & work on several islands) adapted to

new ends. As we assume his discrimination, & his forethought, & of his

those qualities in

steadiness of object, to be incomparably greater than that of man,

so we may suppose the beauty & complications of the adaptations of the new races, & their differences from the original stock, to be greater than in the domestic races, produced by mans agency: The groundwork of his labours we may aid, by supposing, that the external condition of the volcanic isl[d] from its emergence continued & the occasional introduction of new immigrants, to vary; & thus to act on the reproductive system of the organism, on which he is at work, & so keep its organization somewhat plastic. With time enough, such a being might rationally, (without some unknown law opposed him) aim at almost any result.

For instance, let this imaginary Bringwish, from seeing a plant growing on the decaying matter in a forest & choked by other plants, to give it power of growing on the rotten stems of trees, he would commence selecting every seedling, whose berries were in the smallest degree more attractive to tree-frequenting birds, so as to cause, a proper dissemination of the seeds, & at the same time he would select selecting those plants which had the slightest degree more & more power of drawing nutriment from rotten wood; & destroying all others. He might thus in the course of century after century, hope to make the plant by degrees grow on rotten wood, even high up on trees, wherever birds

dropped the non-digested seeds. He might then, if the organization of the plant was plastic, attempt by continued selection of chance-seedlings, to make it grow on less & less rotten wood, till it would grow on sound wood. Supposing, again, during these changes the plant failed to seed quite freely from non-impregnation, he might begin selecting seedlings, with a little ~~more~~ sweeter or differently tasted honey or pollen, to tempt insects to visit the flowers regularly: having effected this, he might wish, if it profited the plant, to render abortive the stamens & pistils in different flowers, which he could do by continued selection. By such steps, he might aim at making a plant, as wonderfully related to other organic beings, as is the Mistletoe, whose existence absolutely depends on certain insects for impregnation, certain birds for transportal, & certain trees for growth. Furthermore if the insect which had been induced regularly to visit this hypothetical plant, profited much by it, our same Being might wish by selection to modify by gradual selection the insect's structure, so as to facilitate its obtaining the honey or pollen: in this manner he might adapt the insect (always presupposing its organization to be in some degree plastic) to the flower, & the impregnation of the flower to the insect; as is the case with

The selection in cases where adult life or fertile years, as Spencer, must fall on Cases. - cases in
Speculation of the effect of changes in it, to bring in parents.

Natural means Selection
Ch. 42.

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many Bees & many plants.

Seeing what blind capricious man has actually effected by selection

during the few last years, & what in a ruder state he has probably ef-

=fected without any systematic plan during the last few thousand years,

he will be a bold person, who will positively put limits to what the sup-

=posed Being could effect during whole geological periods. In accor-

=dance with the plan, by which this universe seems governed by the

Creator, let us consider whether there exist any secondary means in

the economy of nature, by which the process of selection could go on,

adapting nicely & wonderfully, organisms, if in ever so small a degree

plastic, to diverse ends. I believe such secondary means do exist.]

As there are conditions of life, so it is hard to select misfortune against typical circumstances, authors & survival of Darwin Wallace

Natural Means of Selection to p. 48.

[Decandolle in an eloquent passage, has declared that all nature

is at war, one organism with another, or with external nature. Seeing

the contented face of nature, this may at first be well doubted; but re-

=flection will inevitably prove it is too true. The war, however, is not

constant, but only recurrent in a slight degree at short periods, & more

severely at occasional more distant periods; & hence its effects are

easily overlooked. It is the doctrine of Malthus applied in most cases

with ten-fold force. As in every climate, there are seasons for each of

its inhabitants of greater & less abundance, so all annually breed; & the

moral restraint, which in some small degree checks the increase of man-

-kind, is entirely lost. Even slow-breeding man-kind has doubled in

25 years, & if he could increase his food with greater ease, he would double

artificial means,
in less time. But ~~for~~ animals without ~~reason~~, on an average, the amount

of food for each species must be constant; whereas the increase of all

organisms tends to be geometrical, & in a vast majority of cases at an

enormous ratio. Suppose in a certain spot there are eight pairs of

Bds
~~Robins~~, & that only four pairs of them annually (including double hatches)

rear ~~their~~ say only four young; & that these go on rearing their young

at the same rate; then at the end of seven years (a short life ex-

-cluding violent deaths for a ~~Robin~~ Bd) there will be 2048 robins, instead

of the original sixteen; as this increase is quite impossible, so we must

conclude either that Robins do not rear nearly half their young,

or that the average life of a Robin when reared is from accident

not nearly seven years. Both checks probably concur. The same

kind of calculation applied to all vegetables & animals produces re-

-sults either more or less striking, but in scarcely a single instance,

striking
less than in man.

Many practical illustrations of this rapid tendency to increase

are on record, namely during peculiar seasons, in the extraordinary

increase of certain animals, for instance during the year 1826 to 28,
in La Plata when from drought some millions of cattle perished, the
whole country swarmed with innumerable mice: now I think it
cannot be doubted that during the breeding season all the mice
(with the exception of a few males or females in excess) ordinarily
pair; & therefore this astounding increase during three years
must be attributed to a greater than usual number surviving
the first year, & then breeding & so on till the third year, when
their numbers were brought down to their usual limits, on the
return of wet weather. Where man has introduced plants & animals
into a new country, favourable to them, there are many accounts
of in how surprisingly few years, the whole country has become
stocked with them. This increase would necessarily stop as soon as
the country was fully stocked; & yet we have every reason to believe from
what is known of wild animals, that all would pair in the spring. In
the majority of cases, it is most difficult to imagine where the
check falls, generally no doubt on the seeds, eggs, & young; but
when we remember how impossible even in mankind (so much better
known than any other animal) it is to infer from repeated casual
observations, what the average of life is, or to discover how different the
the difference

percentage of death to the ~~population~~ births in different countries we ought

to feel no legitimate surprise at not seeing where the check falls

in animals & plants. It should always be remembered, that in most cases

the checks are yearly recurrent in a small regular degree; & in an

extreme degree during occasionally unusually cold, hot, dry, or wet

years, according to the constitution of the being in question. Lighten,

any check in the smallest degree, & the geometrical power of increase

in every organism, will instantly increase the average numbers

of the favoured species. Nature may be compared to a surface, on

which rest ten thousand sharp wedges touching each other &

driven inwards by incessant blows. Fully to realize these views,

much reflection is requisite; Malthus on man should be studied;

and all such cases, as those of the mice in La Plata, of the cattle &

horses when first turned out in S. America, of the Robins by our

calculation &c, should be well considered: reflect on the enormous

multiplying power inherent & annually in action in all animals;

reflect on the countless seeds, scattered by a hundred ingenious

contrivances, year after year, over the whole face of the land;- &

yet we have every reason to suppose, that the average percentage

of every one of the inhabitants of a country will ordinarily remain

(a') In case like Mr Jeffreys, it may be ~~said~~ asked why not more terms, so other terms interfere; - answer almost sufficient / same causes which checks the multiplication / of residuals.

constant. Finally let it be borne in mind that the average number (of individuals) (the external condition remaining the same) in each country is kept up by recurrent struggles against other species or against external nature (as on the borders of the arctic regions, (a) where the cold checks life); & that ordinarily each individual of each species holds its place, either by its own struggle & capacity of acquiring nourishment in some period (from the egg upwards) of its life, or by the struggle of its parents (in short-lived organisms, when the main check occurs at long intervals), against & compared with other individuals of the same or different species.

But let the external conditions of a country change; if in a small degree, the relative proportions of the inhabitants will in most cases simply be slightly changed; but let the number of inhabitants be small, as on an island, & free access to it from other countries be circumscribed; & let the change of conditions continue progressing (forming new stations) (in such case the original inhabitants must cease to be so perfectly adapted to the changed conditions, as they originally were. It has been shown that probably such changes of external conditions, would from acting on the reproductive system, cause the organization of the beings most affected to become, as under domestication, plastic. Now

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can it be doubted from the struggle each individual ~~has~~ (or its parents)

has to obtain subsistance, that any minute variation in structure, ha-

bits, or instincts, adapting that individual better to the new conditions,

would tell upon its vigour & health. In the struggle, it would have

a better chance of surviving, & those of its offspring which inherited

the variation, tho' it be ever so slight, would have a better chance

to survive. Yearly more are bred than can survive; the smallest

grain in the balance, in the long run, must tell on which death

shall fall, & which shall survive. Let this work of selection, on

the one hand, & death on the other, go on for a thousand generations;

who will pretend to affirm that it would produce no effect, when we

remember what in a few years, Bakewell effected in cattle and

Western in sheep, by this identical principle of selection. To

[7. o] give an imaginary example, from changes in progress on an island,

let the organization of a canine animal become slightly plastic,

which animal preyed chiefly on rabbits, but sometimes on hares;

let these same changes cause the number of rabbits very slowly

to decrease & the number of hares to increase; the effect of this

wd. be that the fox or dog wd. be driven to try to catch more hares, &

his numbers wd. tend to decrease; his organization however brings

slightly plastic, those individuals with the lightest forms, longest limbs & best eyesight, (though perhaps with less cunning or scent), would be slightly favoured, let the difference be ever so small, ~~would be slightly favoured~~, would tend to live longer, & to survive during that time of the year, when food was shortest; they would also rear more young, which young would tend to inherit these slight peculiarities. The less fleet ones would be rigidly destroyed. I can see no more reason to doubt, but that these causes in a thousand generations would produce a marked effect, and adapt the form of the fox to catching hares instead of rabbits, than that greyhounds can be improved by selection & careful breeding. So would it be with plants under similar circumstances; if the number of individuals of a species with plumed seeds could be increased within its own area by greater powers of dissemination, that is if the check to increase fell chiefly on the seeds, those seeds, which were provided with ever so little more down, or with plume placed so as to be slightly more acted on by the winds, would on the long run tend to be most disseminated; thence a greater number of seeds thus formed would germinate, & would tend to produce plants inheriting this slightly better adapted down.

Besides this natural means of selection, by which those individuals are preserved,

whether in their egg or seed, or in their mature state, which are

best adapted to the places they fill in nature; ~~are preserved~~, there is

a second agency at work in most bisexual animals, tending to produce

the same effect, namely the struggle of the males for the females.

These struggles are generally decided by the law of battle; but in the

case of birds, apparently, by the charms of their song, their beauty or

their power of courtship, as in the dancing rock-thrush of Guyana.

Even in the animals which pair, there seems to be an excess of males

which w^d aid in causing a struggle: in the polygamous animals

however, as in Deer, oxen, Poultry, we might expect there w^d be

severest struggle: is it not in the poly-gamous animals that the males

are best formed for mutual war? The most vigourous ~~healthy~~ males,

implying perfect adaptation, must generally gain the victory in

their sexual contests. This kind of selection, however, is less rig-

orous than the other; it does not require the death of the less

successful, but gives to them fewer descendants. This struggle falls,

moreover, at a time of year when food is generally abundant, &

perhaps the effect chiefly produced would be the alteration of sexual

characters, & the selection of individuals forms, no way related to their

power of obtaining food, or of defending themselves from their natural

enemies, but of fighting one with another. This natural struggle amongst the males may be compared in effect, but in a less degree, to that produced by those agriculturists who pay less attention to the careful selection of all the young animals which they breed, & more to the occasional use of a choice male.

Differences between "Races" & "Species":— first, in their powers of variability to p. 51.

Races produced by these natural means of selection, we may expect would differ in some respects from those produced by man. Man selects chiefly by the eye, & is not able to perceive the course of every vessel & nerve, or the form of the bones, or whether the internal structure corresponds to the outside shape. He is unable to select shades of constitutional differences, & by the protection he affords & his endeavours to keep his property alive, in whatever country he lives, he checks, as much as lies in his power, the selecting action of nature, which will, however, go on to a lesser degree with all living things, even if their length of life is not determined by their own powers of endurance. He has bad judgment, is capricious, he does not, or his successors do not, wish to select for the same exact end for hundreds of generations. He cannot always suit the selected form to the properest condition; nor does he keep those conditions uniform: he selects that which is useful to him,

not that best adapted to the ~~its~~ condition, in which each variety ~~the organism~~ is placed by him: ~~he~~ : he selects a small dog, but feeds it highly, he selects a long-backed dog & does not exercise it in any peculiar manner, at least not during every generation. He seldom allows the most vigorous males to struggle for themselves and propagate; but picks out such, as he possesses, or such as he prefers, & not necessarily those best adapted to the existing conditions. Every agriculturist & breeder knows how difficult it is to prevent an occasional cross with another breed. He often grudges to destroy an individual which departs considerably from the required type. He often begins his selection by a form or sport, considerably departing from the parent form. Very differently does the natural law of selection act: the varieties selected differ only slightly from the parent-forms; the conditions are constant for long periods & change slowly; rarely can there be a cross; the selection is rigid & unfailing, & continued through many generations; a selection can never be made without the form becoming better adapted to the conditions, than the parent form; the selecting power, which is ever on the watch, & steadily for thousands of years, continues to adapt the form to these conditions. The

is testing power, is not deceived by external appearances; it tries

the being during its whole life, & if less well adapted than is com-

-pers, without fail it is destroyed; every part of its structure is

in nature which
thus scrutinized & proved good towards the place it occupies.]

[We have every reason to believe, that in proportion to the number

of generations that a domestic race is kept free from crosses, &

to the care employed in continued steady selection with one end in

to the care
view, & in not placing the variety in conditions unsuited to it;

in such proportion, does the new race become "true" or subject to

little variation. How incomparably 'truer', then, would a race pro-

duced by the above rigid, steady, natural means of selection, ex-

cellently trained & excellently adapted to its conditions, free from

stains of blood or crosses, & continued during thousands of years,

be compared with one produced by the feeble, capricious, mis-

-directed & ill adapted selection of man. These races of domestic

animals, produced by savages, partly by the inevitable conditions

of their life, & partly unintentionally by their greater care of the in-

-dividuals most valuable to them, would probably approach closest

to the character of a species; and I believe the is the case. Now the charac-

-teristic mark of a species, next if not equal, in importance to its

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sterility when crossed with another species; & indeed almost the only

other character (without we beg the question & affirm the essence

of a species is, its not having descended from a parent common

to any other form) is the similarity of the individuals composing species, that

or in the language of agriculturists their breeds."

Difference between "Races" & "species" in fertility, when crossed.- L p. 62.

The Sterility of species, or of their offspring when crossed, has, how-

-ever, received more attention, than the uniformity in character of

the individuals composing the species. It is exceedingly natural

that such sterility should have been long thought the certain char-

-acteristic of species. For it is obvious, that if the allied dif-

-ferent forms, which we meet with in the same country, could

cross together, instead of finding a number of distinct species, we

sh. have a confused & blending series. The fact, however of a perfect

gradation in the degree of sterility between species; & the circum-

-stance of some species, most closely allied (for instance many spe-

-cies of crocus & European can? Heaths) refusing to breed together, whereas

other species widely different, & even belonging to distinct

pheasant & grouse (Thuya & Juniperus,

genera, as the fowl & the Peacock, azalea & Rhododendrum, *

~~in the case of the pheasant & Grouse breeding so readily is frequent-~~

breeding together,

~~-ly the cross in the wild state~~, ought to have caused a doubt, whether

the sterility did not depend on other causes, distinct from a law, coincident with

their creation. I may, here, remark that the fact whether one species will or will

not breed with another, is far less important than the sterility of the offspring

when produced; for even some domestic races, differ so greatly in size (as the

great stag-greyhound & lap-dog; or cart-horse & Burmese ponies) that union is

nearly impossible; & what is less generally known, is, that in plants Gaertner has

shown by hundreds of experiments, that the pollen of one species will fecundate

the germen of another species, whereas the pollen of this latter, will never

act on the germen of the former; so that the simple fact of mutual impreg-

-nation, certainly has no relation whatever to the distinctness in creation of

the two forms. When two species are attempted to be crossed, which are so distantly

allied, that offspring are never produced, it has been observed in some cases, that the

pollen commences its proper action by exserting its tube, & the germen commences swell-

-ing, though soon afterwards it decays. In the next stage in the series, hybrid-offspring

are produced, though only rarely & few in number, & these are absolutely sterile: thus we

have hybrid-offspring more numerous & occasionally, though very rarely, breeding with either

-er parent, as is the case with the common mule. Again other hybrids though infertile inter se

will breed quite freely with either parent, or with a third species, & will yield offspring generally

infertile, but sometimes fertile; & these latter again will breed with either parent or with a

third or fourth species: thus Gaertner bred together many forms. Lastly it is now admitted

by those botanists, who have longest contended against the admission, that in certain families the hybrid-offspring of many of the species, are some-times perfectly fertile in the first generation, when bred together: indeed in some few cases, Mr Herbert found that the hybrids were decidedly more fertile, than either of their pure parents. There is no way to escape from the admission, that the hybrids from some species of plants are fertile; except by declaring that no form shall be considered as a species, if it produces with another form, fertile offspring: but this is begging the question. It has often been stated, that different species of animals have a sexual repugnance towards each other; I can find no evidence of this; it appears as if they merely did not excite each others passions. I do not believe that in this respect there is any essential distinction between animals & plants; and in the latter there cannot be a feeling of repugnance.

Causes of sterility in Hybrids.

[The difference in nature between species, which causes the greater or lesser degree of sterility in their offspring, appears, according to Herbert & Koelreuter, to be connected much (as with external form, size, or structure, than with constitutional peculiarities; by which is meant, their adaptation to different climates, food and situation &c: these peculiarities

of constitution, probably affect the entire frame, and no
Yet the laws contrary to the
one part in particular.) case of the results of crosses above
mentioned

From the foregoing facts, I think we must admit, that there exists a perfect gradation in fertility between species, which when crossed are quite fertile (as in Rhododendrum, on (?) Calceolaria &c,) and indeed in an extraordinary degree fertile (as in Crinum), and those species which never produce offspring, but which by certain effects, (as the extention of the pollen-tube) evince their alliance. Hence I conceive we must give up sterility, although undoubtedly in a lesser or greater degree of very frequent occurrence, as an unfailing mark by which species can be distinguished from races, i.e. from those forms which have descended from a common stock.

Let us see whether there are any analogical facts, which will throw any light on this subject, and will tend to explain why the offspring of certain species, when crossed, should be sterile, & not others; without

~~how coincide that birbes of animals with~~ ~~be~~ bee

animals seen more often made sterile & ~~be~~ very latter end of their

native condition than plants, & so on more sterile when crossed.

We have no bond but the identity in

hybrids in ~~no~~ each case which to ~~them~~ them

& Florence — & then on all hair

also set of selection. —

requiring a distinct law connected with their creation to that effect. Great numbers, probably a large majority of animals, when caught by man & removed from their natural condition, although taken very young, rendered quite tame, living to a good old age, & apparently quite healthy, seem incapable under their circumstances of breeding. I do not refer to animals kept in menageries, such as at the Zoological gardens (many, however, of which appear healthy & live long) & unite but do not produce; but to animals caught & left nearly at liberty in their native country. Rengger enumerates several caught young & rendered tame, which he kept in Paraguay, and which would not breed: the Hunting Leopard or Chetah & Elephant offer other instances; as Bears in Europe, & the 25 species of hawks, belonging to different genera, thousands of which have been kept for hawking & have lived for long periods in perfect vigour. When the expence & trouble of procuring a succession of young animals in a wild state, be borne in mind, one may feel sure that no trouble has been spared in endeavours to make them breed. So clearly marked is this difference in different kinds of animals, when ~~taken~~ Captured by man, that St. Hilaire makes two great classes of animals useful to man; — the tame, which will not breed, & the domestic which will

bred in domestication. From certain singular facts, we might have supposed, that the non-breeding of animals was owing to some perversion of instinct. But we meet with exactly the same class of facts in plants: I do not refer to the large number of cases, where the climate does not permit the seed or fruit to ripen, but where the flowers do not "set," owing to some imper-fection of the ovule or pollen. The latter, which alone can be distinctly examined, is often manifestly imperfect, as any one with a microscope can observe by comparing the pollen of the Persian & Chinese lilacs with the common lilac; the two former (I may add) are equally sterile in Italy as in this country. Many of the American bog-plants have produce little or no pollen, whilst the Indian species of the same genera freely produce it. Lindley observes that sterility is the bane of the Horticulturist: Linnaeus has remarked on the sterility of nearly all alpine flowers when cultivated in a lowland district. Perhaps the immense class of double flowers chiefly owe their structure to an excess of food acting on parts rendered slightly sterile & less capable of performing their true function, & therefore liable to be rendered monstrous, which monstrosity, like any other disease

is inherited. So far from domestication bringing in itself unfavour-
-able to fertility, that it is well known when an organism is once ca-
-pable of submission to such conditions, their fertility is increased be-
-yond the natural limit. According to Agriculturists, slight changes
of conditions, that is of food or habitation, & likewise crosses with
races slightly different, increase the vigour, & probably the fertility
of their offspring. It would appear, also, that even a great
change of condition, for instance transportal from temperate
countries to India, in many cases does not in the least affect
fertility, although it does health, & length of life, & period of ma-
-turity. When sterility is induced by domestication it is of the
same kind, & varies in degree, exactly as with hybrids: for
be it remembered that the most sterile hybrid is no way mons-
-trous; its organs are perfect, but they do not act, & minute
microscopical investigations show, that they are in the same
state, as those of pure species in the intervals of the breeding
season. The defective pollen in the cases above alluded to, pre-
-cisely resemble that of hybrids. The occasional breeding of
hybrids, as of the common mule, may be aptly compared to the most
rare, but occasional reproduction of elephants in captivity. The cause

of many exotic geraniums producing, (although in vigorous health)
imperfect pollen, seems to be connected with the period when
water is given them; but in the far greater majority of cases, we
can not form any conjecture on what exact cause the sterility of
organisms, taken from their natural conditions, depends. Why, for
instance the cheetah will not breed, whilst the common cat and
ferret (the latter generally kept shut up in a small box) do, — why
the elephant will not whilst the pig will abundantly — why the
partridge & grouse in their own country will not, whilst several ~~some~~
species of pheasants, the guenea-fowl from the deserts of Africa,
& the peacock from the jungles of India, will. We must, however,
feel convinced that it depends on some constitutional peculi-
arities in these beings, not suited to their new condition; though
not necessarily causing an ill state of health. Ought we then to
wonder much, that those hybrids which have been produced by the
crossing of species with different constitutional tendencies, (which
tendencies we know to be eminently inheritable) should be sterile.
It does not seem improbable that the cross from an alpine & lowland
plant, shd have its constitutional powers arranged, in nearly the
same manner, as when the parent alpine-plant is brought into

a lowland district. Analogy, however, is a deceitful guide, & it would be rash to affirm, although it may appear probable, that the steri-lity of hybrids is due to the constitutional peculiarities of one parent being disturbed by being blended with those of the other parent, in exactly the same manner, as it is caused in some organ-ic beings when placed by man out of their natural conditions. Although this would be rash, it would, I think, be still rasher, seeing that sterility is no more incidental to all ~~hybrids~~ cross-bred productions, than it is to all organic beings when captured by man, to assert that the sterility of certain hybrids proved a distinct creation of their parents.

But it may be objected, however little the sterility of certain hybrids is connected with the distinct creations of species, how comes it, that if species are only races produced by natural selection, that when crossed, they so frequently produce ster-ile offspring, whereas in the offspring of those races confessedly produced by the arts of man, there is no one instance of sterility. There is not much difficulty in this, for the races produced by the natural means above explained, will be slowly but steadily selected; will be adapted to various & diverse conditions, & to these conditions they will be rigidly confined for immense periods of time; hence



First step gained & was keeping apart –

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we may suppose that they would acquire different constitutional peculiarities adapted to the Stations they occupy; & on the con-=stitutional differences between species, their sterility, according to the best authorities, depends. On the other hand, man selects by external appearance; from his ignorance & from not having any test at least comparable in delicacy, to the natural struggle for food, continued at intervals through the life of each individual, he cannot eliminate fine shades of constitution, dependent on invisible differences in the fluids or solids of the body; again from the value which he attaches to each individual, he exerts his utmost power in contravening the natural tendency of the most vig-orous to survive. Man, moreover, especially in the earlier ages, cannot have kept his condition of life constant, & in later ages his stock pure. Until man selects two varieties from the same stock, adapted to two climates or to other different ex-=ternal conditions, & confines each rigidly for one or several thousand years to such conditions, always selecting the in-=dividuals best adapted to them, he cannot be said to have even commenced the experiment. Moreover, the organic beings which man has longest had under domestication, have

been those which were of the greatest use to him, & one chief element

of their usefulness, especially in the earlier ages, must have been

their capacity to undergo sudden transportals into various climates,

& at the same time to retain their fertility, which in itself implies

that in such respects their constitutional peculiarities were

not closely limited. If the opinion already mentioned, ~~of various~~

~~naturalists~~ be correct, that most of the domestic animals in

their present state have descended from the fertile commixture

of wild races or species, we have indeed little reason now to ex-

-pect infertility between any cross of stock, thus descended.

It is worthy of remark, that as many organic beings, when taken

by man out of their natural condition, have their reproductive system

~~so~~ affected as to be incapable of propagation, so, we saw in the

First chapter, that although organic brings when taken by man do propagate

freely, their offspring after some generations vary or sport to a degree,

which can only be explained by their reproductive system being some-

-way affected. Again, when species cross, their offspring are generally ster-

-ile; but it was found by Hoelgenter, that when hybrids are capable

of breeding with either parent or with other species, that their offspring

are subject after some generations to excessive variation. Agri-

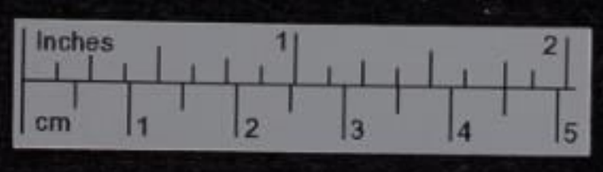
= culturists, also, affirm that the offspring from mongrels, after the first generation, vary much. Hence we see that both sterility and variation in the succeeding generations, are consequent both, on the removal of individual species from their natural states, & on species crossing. The connection between these facts may be accidental, but they certainly appear to elucidate and support each other, on the principle of the reproductive system of all organic beings being eminently sensitive to any disturbance, whether from removal or commixture, in their constitutional relations to the conditions, to which they are exposed.

Points of resemblance between "Races" and "Species" v. p. 66.

~~Races descended from a common parent~~ Races and reputed species agree differing, for causes, which we have in some respects, although ~~they differ in their fertility when~~ seen, we can in some degree understand, in their fertility & ~~crossed~~ & in their "trueness", from causes which we can only see "trueness" of their offspring. ~~degree understand~~. In the first place, there is no clear sign by which to distinguish races from species, as is evident from the difficulty experienced by naturalists, in attempting great ~~differences amongst naturalists~~ to discriminate them. As far as external characters are concerned, many of the races which are ~~notably~~ descended from the same stock, differ far more than true species of the same genus;- look at the willow-wrens, some of

which skilful ornithologists can hardly distinguish from
each other, except by their nests; look at the wild swans,
& compare the distinct species of the genera with the races of domestic
ducks. ~~the Dorking & Bantam fowls, the several~~ poultry and pigeons; & so
again with plants, compare the cabbages, peaches & nectarines, &c with
the species of many genera. — St Hilaire has even remarked that
there is a greater difference in size between races, as in dogs,
(for he believes all have descended from one stock) than between
the species of any one genus; nor is this surprising, considering
that amount of ~~form~~ food & consequently growth is the element of change,
over which man has most power. I may recall a former statement, that
Breeders believe the growth of one part or thing action of one function,
causes a decrease in other parts; for this seems in some degree analogous to the
law of "organic compensation", which many most naturalists believe holds
good, ~~with some exceptions; for instance~~ To give an instance of this law of compensation, — those species of Car-
=nivora, ~~in~~ have which the canine teeth ~~are~~ greatly developed, have certain
molar teeth ~~are~~ deficient; or again in that division of the Crustaceans
in which the abdomen tail is much developed, the body is little so, the converse.
The ~~variation~~ points of or difference between different races, is often strikingly analogous to
that between species of the same genus: trifling spots or marks of colour,

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(as the bars on pigeon's wings) are often preserved in races of plants and animals, precisely in the same manner, as similar trifling characters of species how[ever] characterise all the species of a genus, and often a family. Flowers in varying their colours, often become veined & spotted, & the leaves become divided, like true species: it is known that the varieties of the same plant never have red, blue & yellow flowers, though the hyacinth makes a very near approach to an exception; & different species of the same genus seldom, though sometimes, they have flowers of these three colours. Dun-coloured horses having a dark stripe down their backs, & certain domestic dogs having transverse bars on their legs, afford striking examples of a variation analogous in its character to the distinctive marks of the species of the same genus.

Ox talis & Gentiana

External characters of Hybrids & Mongrels

There is, however, as it appears to me, a more important method of comparison between species & races, namely the character of the offspring when species are crossed & when races are crossed: I believe, in no one respect, except in sterility, is there any difference. It would, I think, be a marvellous fact, if species have been formed by distinct acts of creation, that they should act upon each other in uniting, like races descended from a common stock. In the first place by repeated crossing, one species, can like one race, absorb & wholly obliterate the

characters of another ~~species or race of several species or races~~ or of several other species, in the same manner, as one race will absorb & offspring another race. ~~as has been demonstrated by Hooker.~~ Marvellous, that one act of creation should absorb another or even several acts of creation! The offspring of species, that is hybrids & the offspring of races that is mongrels, resemble each other in being ~~even those of the same birth~~ either intermediate in character (as is most frequent in hybrids) or in resembling, sometimes closely one ~~of~~ the other parent; ~~both sometimes re-~~ produced by the same act of conception, sometimes differ in this degree of resemblance; certain a certain part or organ very like that of either parent; both, as we have seen, become in succeeding generations variable; and this tendency to vary, can be transmitted by both; in both for many generations there is a strong tendency to reversion to their ancestral form. [In the case of a hybrid Laburnum & of a supposed mongrel vine, different parts of the same plants taste after their two parents.] In the hybrids from some species, & in the mongrel of some races, the offspring differ, according as which of the two species, or of the two races, is the father (as in the common mule & hinny) & which the mother. Some races will breed together, which differ so greatly in size, that the dam often perishes in labour; so it is, with some species, when crossed. When a dam of one species has borne offspring to (the male of) another, her succeeding offspring are sometimes

stained (as in D^r Marston's mare by the Quagga, wonderful as the fact is) by this first cross; & agriculturists positively affirm is the case, when a breed of pigs or sheep has produced offspring by the sire of another breed.

Summary of Second Chapt: to p. 69:

Let us sum up this second chapter. If slight variations do occur in organic beings in a state of nature; if changes of condition from geological causes, do produce in the course of ages, effects, analogous to those of domestication, on any, however few, organisms; & how can we doubt it, from what is actually known, & from what may be presumed, since thousands of organisms taken by man for sundry uses, & placed in new conditions, have varied. If such variations tend to be hereditary; & how can we doubt it, when we see shades of expression, peculiar manners, monstrosities of the strangest kinds, diseases, & a multitude of other peculiarities, which characterize & form by being inherited, the endless races (there are 1200 kinds of cabbages) of our domestic plants & animals. If we admit that every organism maintains its place by an almost periodically recurrent struggle; & how can we doubt it, when we know that all beings tend to increase in a geometrical ratio (as is instantly seen, when the conditions become for a time more favourable); whereas on an average, the amount

of food must remain constant; ~~this~~ if so, there will be a natural mean

of selection tending to preserve those individuals with any

slight deviations of structure more favourable to the then

existing conditions, & tending to destroy any with deviations of

an opposite ~~tendency~~ nature. If this ~~be so~~ above proposition, be correct, & there be no law of na-

=ture, limiting the possible amount of variation, new races of beings

will,- perhaps only rarely & only in some few districts,- be formed.]

Better limits of variation

[That a limit to variation does exist in nature, is assumed by

most authors; though I am unable to discover a single fact on

which this belief is grounded. One of the commonest statements

is, that plants do not become acclimatised; & I have even observed that

kinds, not raised from seed, but propagated by cuttings &c are

instanced. A good instance has, however, been advanced in the

case of Kidney Beans, which it is believed, are now as tender, as when

first introduced. Even if we overlook the frequent introduction of

seed from warmer countries, let me observe that as long as the seed was

promiscuously from the bed, without continual observation and

careful selection of those plants, which have stood the climate best

during their whole growth; the experiment of acclimitisation

has hardly not been begun. Are not all those plants & animals, of which



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we have the greatest number of races, the most domesticated?

Considering the quite recent progress of systematic agri-
-culture & horticulture, is it not opposed to every fact, that
we have exhausted the capacity of variation in our cat-
-le & in our corn, even if we have done so in some trivial
points, as their fatness or kind of wool? Will any one say, that
if horticulture continues to flourish, during the next
few centuries, that we shall not have numerous new
kinds of the Potato & Dahlia? But take two varieties of
each of these plants, & adapt them to certain fixed conditions
& prevent any cross for 5 000 years, & then again vary their
conditions; try many climates & situations; & who will predict the
number & degrees of difference, which might arise from these
stocks. I repeat that we know nothing of any limit to the
possible amount of variation, & therefore to the number
& differences of the races, which might be produced by the
natural means of selection, so infinitely more efficient,
than the agency of man. Races thus produced, would pro-
-bably be very "true"; & if from having been adapted
to different conditions of existence, they possessed

if sterility removed from sexual selection, by [illegible] be stopped &

different constitutions, their offspring would perhaps, or

~~even probably~~, be infertile. Such races would be undis-

-tinguishable from species. But is there any evidence

that the species, which surround us on all sides,

have been thus produced? This is a question,

which on examination of the economy of nature,

we might expect, would answer either in the

affirmative or negative.

Cartwright p. 89 (& perhaps ~~probably~~ 93) omits to take into consideration, viz

difficulty in forming such organs, as eye, & selection. —

Chapter III

On the variation of Instincts & other mental attributes; on the difficulties in this subject; and on analogous difficulties with respect to corporeal Structures. (p. 70 to 94)

I have as yet only alluded to the mental qualities, which differ greatly in different species. Let me here premise, that, as will be seen in the Second Part, there is no evidence & consequently no attempt to show that all existing organisms have descended from any one common parent-stock, but that only those have so descended, which in the language of naturalists, are clearly related to each other. Hence the facts and reasoning advanced in this chapter, do not apply to the first origin of the senses, or of the chief mental attributes, such as of memory, attention reasoning &c &c by which most or all of the great related groups are characterized, any more than they apply to the first origin of life, or growth, or the power of reproduction. The application of such facts, as I have collected, is merely to the differences of the primary mental qualities & of the instincts, in the species of the several great groups. [In domestic animals every observer has remarked in how great a degree, in the individuals of the same species, the dispositions,

Variation of mental attributes under domestication to p. 75.

namely courage, pertinacity, suspicion, restlessness, confidence, tem-
-per, pugnaciousness, affection, care of their young, sagacity &c &c vary.

It would require a most able metaphysician to explain, how many
primary qualities of the mind, must be changed, to cause these diver-
-sities of complex dispositions. From these dispositions being inherit-
-ed, of which the testimony is unanimous, families & breeds arise vary-
-ing in these respects. I may instance the good will temper of diffe-
-rent stocks of Hares & of Horses - the pugnacity & courage of game fowls - the
pertinacity of certain dogs as in bull-dogs, & the sagacity of others -
for restlessness & suspicion, compare a wild rabbit reared with the
greatest care from its earliest age, with the extreme tameness
of the domestic breed of the same animal. The offspring of the do-
-mestic dogs, which have run wild in Cuba, though caught quite
(Lappig) young, are most difficult to tame, probably nearly as much so,
as the original parent stock, from which the Domestic dog descended.
The habitual "periods" of different families or stocks of animals of the same species differ,
for instance the time of year of reproduction, & the period of life when the ca-
-pacity is acquired, & the hour of roosting (in Malay fowls) & though these
periodical habits are perhaps spontaneously corporeal,
are hardly corporeal habits, & may be compared to nearly similar habits
are known to vary splendidly.
in plants, which like Conservical movements

(as called by Müller) vary & are inherited, - such as the cantering and ambling pace on horses, - the tumbling of pigeons, & perhaps the hand-writing, which is sometimes so similar between father & sons may be ranked in this class. Manners, & even tricks which perhaps are only peculiar manners, according to W. Hunter & my Father are decidedly inherited, in cases where children have lost their parents in early infancy. The inheritance of expression, which often reveals the finest shades of character, is familiar to every one. Again the tastes & pleasures of different breeds vary. - Thus the sheepherd dog delights in chasing the sheep, but has no wish to kill them, - the terrier (see Knight) delights in killing vermin, & the Spaniel in finding game. But it is impossible to separate their mental peculiarities, in the way I have done: the tumbling of pigeons which I have instanced as a conventional movement, might be called a trick, & is associated with a taste for flying in a close flock at a great height. Certain breeds of fowls have a taste for roosting in trees. The different action of pointers & setters might have been adduced in the same class, as might the peculiar manner of hunting of the Spaniel. Even in the same breed of dogs, namely in fox-hounds, it is the fixed opinion of those best able to judge, that the different pups

are born with different tendencies; some are best to find their fox in the cover, some are apt to run straggling, some are best to make casts to recover the last scent &c; that these peculiarities undoubtedly are transmitted to their progeny. Or again the tendency to point might be adduced, as a distinct habit, which has become inherited, - as might the tendency of a true sheep-dog. (as I have seen a spaniel in arc under) to run round the flock, instead of directly at them, as is the case with other young dogs when attempted to be taught. The "transmutists" (several authors) sheep in Spain, which for some centuries have been yearly taken a journey of several hundred miles from one province to another, know when the time comes & show the greatest restlessness (like migratory birds in confinement), & are prevented with difficulty from starting by themselves, which they sometimes do, & find their own way. There is a case on good evidence of a sheep, which when she lambed (Hogg) was turned across a mountainous country, to her own birth-place, although at other times of year not of a rambling disposition: Her lambs inherited this same disposition, & would go to produce their young on the farm whence their parent came; & so troublesome was this habit, that the whole family was destroyed. These facts must lead to the conviction, justly wonderful as it is, that almost infinitely numerous shades of

Disposition, habits, peculiar-movements, & even of individual ac-

tions, can be modified or acquired by one individual, & transmitted to

its offspring. One is forced to admit that mental phenomena (no

doubt through their intimate connexion with the brain) can be

inherited, like infinitely numerous & fine differences of corporeal

structure.] [In the same manner, as peculiarities of corporeal

structure,
slowly acquired or lost during mature life, (especially cognisant in

disease) as well as congenital peculiarities, are transmitted; so

it appears to be with the mind. The inherited powers in the horse,

have no doubt been acquired by compulsion during the lives of

the parents: & temper & tameness may be modified in a breed by the

which the
treatment individuals receive. Knowing that a pig has been

taught to point, one would suppose that this quality in pointer-dogs

was the simple result of habit, but some facts with respect to the

occasional appearance of a similar quality in other dogs, do make

one suspect that it originally appeared in a less perfect degree,

"by chance", that is from a congenital tendency in the parent of the

breed of pointers. One cannot believe that the tumbling, & high

flight in a compact body, of one breed of pigeons, has been taught; for

the case of the slight differences in the manner of hunting in

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young fox hounds, they are doubtless congenital. The inheritance
of the foregoing & similar mental phenomena ought perhaps to excite
less surprise, from the reflection, that in no case, do individual
acts of reasoning, or movements or other phenomena connect-
-ed with consciousness, appear to be transmitted. An action, however
complicated done, when from long practice it is performed unconsciously
without any effort (& indeed in the case of many peculiarities of manner, oppos-
-ed to the will) is said, according to a common expression, to be performed
"instinctively". Those cases of languages & songs, learnt in early
childhood & quite forgotten, being perfectly repeated during the un-
-consciousness of illness, appear to me only a few degrees less wonder-
-ful, than if they had been transmitted to a second generation.

Sep. 1-78

Hereditary habits compared with Instincts. t.p. 78

Sep. 1-78

The chief characteristics of true instincts, appear to be, their
invariability & non improvement during the mature age of the indivi-
-dual animal; the absence of knowledge of the end, for which the ac-
-tion is performed, being associated, however, sometimes with a de-
-gree of reason; being subject to mistakes & being associated with certain states
of the body or times of the year or day. In most of these respects there
is a resemblance, in the above detailed cases of acquired or modified
mental qualities, during domestication.
mental qualities. No doubt the instincts of wild animals are more uniform

than those habits or qualities modified or recently acquired under

domestication, in the same manner & from the same causes, that

in the State

the corporeal structure is less uniform, than in beings in their

natural conditions. I have seen a young pointer point as correctly,

the first day it was taken out, as any old dog; Mag Endie says this

was the case with a retriever, which he himself reared: the tum-

bling of pigeons is not probably improved by age: we have seen that in

the case above given, that the young sheep inherited the migratory tendency

to their particular birth-places, the first time they lambed. This last fact is

an instance of a domestic instinct being associated with a state of body:

as also the "transandantes" sheep, with a time of year. Ordinarily, the acquired

instincts of domestic animals seem to require a certain degree of education

(as generally in pointers & retrievers &c) to be perfectly developed: perhaps this

holds good amongst wild animals in rather greater degree, than is gen-

erally supposed; for instance, in the singing of birds, & in the knowledge

of proper herbs in Ruminants. It seems pretty clear that Bees transmit knowl-

-edge from generation to generation. Lord Brougham insists

strongly on ignorance of the end proposed, being eminently characteristic

of true instincts; and this appears to me to apply to many acquired, here-

ditary habits; for instance, in the case of the young pointer alluded to

before, which pointed so steadfastly the first day, that we were obli-

-ged several times to carry him away. This puppy not only pointed at sheep, at

large white stones, & at every little bird, but likewise "backed" the oth-

-er pointers: this young dog must have been as unconscious for what

end he was pointing, namely to facilitate his master's killing game

to eat, as is a butterfly which lays her eggs on a cabbage, that cater-

-pillars will come from them & eat the leaves. So a horse that ambles

instinctively, manifestly is ignorant that he performs that peculiar

pace for the ease of man; & if man had never existed, he would never

have ambled. The young pointer, pointing at white stones appears

to be as much a mistake of its acquired instinct, as in the case of

flesh-flies laying their eggs on certain flowers, instead of putrifying

meat. However true the ignorance of the ox may generally be, one

sees that instincts are associated with some degree of reason; for

instance, in the case of the Taylor-bird, who spins threads with which

to make his nest, will use artificial threads when he can procure

them; so it has been known, that a pointer has broken his point & gone

round a hedge to drive out a bird towards his master.

Robert Kelby on Bird

There is one other, quite distinct method, by which the instincts or

habits acquired under domestication may be compared with those

(see p. 83) (This ought to have been introduced at p. 75)

The term instinct is often used in a sense which implies no more than that the animal does the action in question. Faculties & instincts may, I think, & ought to be completely separated. The mode in which the faculty of seeking a mate has come & the instinct to apply it — the kind of response which the instinct to feel it as action & the faculty of finding the way a certain period. It can hardly be said to have the faculty of hearing the tune, for it can respond to mere vibrations of sound without indeed it be even consciousness & perceptions. — We have actions, & even whether faculties & instincts can be separated. — faculty of walking in the night, & an instinct prompting us to do so may be a certain hour of night or day. Savages finding their way. — Wrangel account, probably a faculty as inexplicable & the perception of hearing with reasons & means. — besides faculties, "means" a condition of time with reasons & means. —

I think all the generally ~~apply~~ implied, another useful & I shall

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given by nature, by a test of a fundamental kind;- I mean the com-

=parison of the mental powers of mongrels & hybrids. Now the instincts,

or habits, habits, & dispositions of one breed of animals, when crossed with another

breed, for instance a shepherd dog with a harrier, are blended and

appear in the same curiously mixed degree, both in the first &

succeeding generations, exactly as happens when one species is

crossed with another. This would hardly be the case, if there was

any fundamental difference between the domestic & natural in-

-stinct; if the former were, to use a metaphorical expression,

merely superficial.

Give some definition of Instinct, & at least give short attributes

Variation in the mental attributes of wild animals. t p. 80.

With respect to the variation of the mental powers of animals in

a wild state, we know that there is a considerable difference in the dis=

position of different individuals of the same species, as is recog=

=nized by all those, who have had the charge of animals in a menagerie.

- With respect to the wildness of animals, that is fear directed particu-

larly against man, which appears to be as true an instinct, as the

dread of a young mouse of a cat, we have excellent evidence, that it

is slowly acquired & becomes hereditary. It is also certain, that in a na-

-tural state, individuals of the same species, lose or do not practice

their migratory instincts;- as woodcocks in Madeira. With respect-

to any variation in the more complicated instincts, it is obviously most difficult to detect, even more so than in the case of corporeal structure, of which it has been admitted the variation is exceeding small & perhaps scarcely any in the majority of species at any one period. Yet, to take one excellent case of instinct, namely the nests of birds, those who have paid most attention to the subject, maintain that not only certain individuals seem to be able to build very imperfectly, but that a difference in skill, may now & then be frequently be detected between individuals. Certain birds moreover, adapt their nests to circumstances; the water-ouzel makes no vault, when she builds under cover of a rock - the sparrow builds very differently when its nest is in a tree or in a hole, & the golden crested wren sometimes suspends its nest below & sometimes places it on the branches of trees. [As the instincts of a species are fully as important to its preservation & multiplication, as its corporeal structure, it is evident that if there be the slightest congenital differences in the instincts & habits, or if certain individuals during their lives are induced or compelled to vary their habits, & if such differences are in the smallest degree more favourable, under slightly modified external conditions, to their

Principles of Selection, applicable to Instincts ℔ p. 80

preservation, such individuals must in the long run, have a better chance of being preserved & of multiplying. If this be admitted, a series of small changes, may, as in the case of corporeal structure, work great changes in the mental powers, habits & instincts of any species.

Difficulties in the acquisition of complex Instincts by selection. t p. 89

Every one will at first be inclined to exclaim (as I did for a long time) that many of the more complicated & wonderful instincts could not be acquired in the manner here supposed. The Second Part of this work is devoted to the general consideration of how far the general economy of nature justifies or opposes the belief, that related species & genera are descended from common stocks; but we may here consider, whether the instincts of animals offer such a prima facie case of impossibility of gradual acquirement, as to justify the rejection of any such theory, however strongly it may be supported by other facts. I beg to repeat, that I wish here to consider not the probability, but the possibility of complicated instincts having been acquired by the slow & long-continued selection of very slight (either congenital or produced by habit) modifications of foregoing simpler instincts; each modification being as useful & necessary to the species practising it, as the most complicated kind

[First, to take the case of bird-nests; of existing species (almost infinitely few in comparison with the multitude which must have existed

since the period of the new Red Sandstone of N. America, of whose habits we must always remain ignorant) a tolerably perfect series could be made from eggs laid on the bare-ground, to others with a few sticks just-laid round them, to a simple nest like the wood-pigeon's, to others more & more complicated: now if, as is asserted, there occasionally exists slight differences in the building powers of an individual, if, which is at least probable, that such differences would tend to be inherited; then we can see, that it is at least possible that the ~~n~~difficatory instincts may have been acquired by the gradual selection, during thousands & thousands of generations, of the eggs & young of those individuals, whose nests were in some slight degree better adapted for the preservation of their young, under the then existing conditions. One of the most surprising instincts on record, is that of the Australian bush-turkey, whose eggs are hatched by the heat generated from a huge pile of fermenting materials, which it heaps together; but here the habits of an allied species show how this instinct might possibly have been acquired. This species inhabits a tropical district, where the heat of the sun is sufficient to hatch its eggs,

this bird burying its eggs, apparently for concealment, under a loose heap of rubbish, but of a dry nature, so as not to ferment. Now suppose this bird to range slowly into a climate which was cooler & where trees were more abundant, in that case, those individuals which chanced to have their collecting instinct strongest developed, would make a somewhat larger pile, & the eggs laid under the slightly cooler climate by the heat of incipient fermentation, would in the long run, be more freely hatched & would probably produce young ones, with the same more highly developed collecting tendencies;- & of these again, those with the best developed powers, would again tend to rear most young. Thus this strange instinct might possibly be acquired, every individual bird being ignorant of the laws of fermentation, & the consequent development of heat, as we know they must be.

Secondly, to take the case of animals feigning death (as it is commonly expressed) to escape danger. In the case of insects, a perfect series can be shown, from some insects, who momentarily stand still, to others who for a second slightly contract their legs, to others which will remain immovably drawn together for a quarter of an hour, & may be torn asunder or roasted at a slow fire,

without evincing the smallest sign of sensation. No one will doubt that the length of time, during which each remains immovable, is well adapted to escape the dangers, to which it is most exposed; & I dare not deny the possibility of the change from one degree to another, by the same & at the rate already explained. Thinking it, however, wonderful, (though not impossible) that the attitude of death sh^d have been acquired by methods, which imply no imitation, I compared several species, when feigning, as is said, death, with others of the same species really dead, & their attitudes were in no one case the same.

Thirdly; In considering many instincts it is useful to endeavour to separate the faculty by which they perform it, & the mental power which urges to the performance, which is more properly called an instinct. We have an instinct to eat, we have jaws &c to give us the faculty to do so. These faculties are often unknown to us: bats, with their eyes destroyed, can avoid strings suspended across a room, we know not at present by what faculty they do this. — Thus, also, with migratory birds, it is a wonderful instinct, which urges them at certain times of the year to direct their course in certain directions, but it is a faculty by which they know the time & find their way. With respect to time; Man without seeing the sun, can judge to a certain extent

At the time when corn was pitched on the market cluster of 10 by sample the grass in the townfields of Newcastle wch to know market days & come in to pick at the corn spilt &c. &c.?

of the hour, as must those cattle, which come down from the inland mountains to feed on sea-weed left bare at the changing hour of low-water. A hawk (D'orbigny) seems certainly to have acquired a knowledge of a period of every 21 days.— In the cases already given of the sheep, which travelled to their birth-place, to cast their lambs, & the sheep in Spain, which know their time of march, we may conjecture that the tendency to move is associated, we may then call it instinctively with some corporal sensations.— With respect to direction we can easily conceive, how a tendency to travel in a certain course may have possibly have been acquired, although we must remain ignorant how birds, are able to preserve any direction whatever in a dark night over the wide ocean. I may observe that the power of some savage races of mankind to find their way, although perhaps wholly different from the faculty of birds, is nearly as unintelligible to us: Bellinghausen, a skilful navigator, describes with the utmost wonder, the manner in which some Esquimaux guided him to a certain point, by a course never straight through newly formed hummocks of ice, on a thick foggy day, when he with a compass, found it impossible from having no land-marks & from their course being so extremely

crooked, could preserve to any sort of uniform direction (so it is with Australian savages in thick forests). In north & south America, many birds slowly travel northward & southward, urged on by the food they find, as the seasons change; let them continue to do this, till, as in the case of the sheep in Spain, it has become an urgent instinctive desire, & they will gradually accelerate their journey. ~~according to their speed~~. They would cross narrow rivers, if these were converted by subsidence into narrow estuaries, & gradually during centuries in the arms of the sea. Still we may suppose their restless desire of travelling onwards would impel them to cross such an arm, even if it had become of great width beyond their span of vision. How they are able to preserve a course in any one direction, I have said, is a faculty unknown to us. To give another illustration of the means, by which I conceive it possible, that the direction of migrations have been determined; Elk and rein deer in N. America, annually cross, as if they could marvellously smell or see at the distance of a hundred miles, a wide tract of absolute desert, to arrive at certain islands where there is a scanty supply of food – the changes of temperature which geology proclaims, renders it probable, that this desert tract formerly

supported some vegetation, & thus these quadrupeds might have

been annually led on, till they reached the more fertile spots, & so ac-

-quired, like the sheep of Spain, their migratory powers.

Fourthly; with respect to the combs of the Hive-Bee; here again we

must look to some faculty or means by which they make their

hexagonal cells, without indeed we view these insects as mere

machines. At present such a faculty is quite unknown: Mr.

Walker-house supposes that several bees are led by their instinct

to excavate a mass of wax to a certain thinness, & that the result

of this, is that hexagons necessarily remain. Whether this or some

other theory be true, some such means they must possess. They

abound, however, with true instincts, which are the most won-

derful that are known. If we examine the little that is

known, concerning the habits of other species of Bees, we find

much simpler instincts: the humble bee, merely fills neat balls

of wax with honey, & aggregates them together with little order

in a rough nest of grass. If we knew the instinct of all the Bees,

which ever had existed; it is not improbable, that we should have insti-

-cts of every degree of complexity, from actions as simple as a

bird making a nest & rearing her young, to the wonderful

architecture & government of the Hive-Bee;— at least such is possible, which is all that I am here considering.

Finally;— I will briefly consider under the same point of view, one other class of instincts, which have often been advanced as truly wonderful, namely parents bringing food to their young, which they themselves neither like nor partake of;— for instance the common Sparrow, a granivorous bird, feeding its young with caterpillars. We might of course, look into the case still earlier, & seek how an instinct in the parent of feeding its young at all, was first acquired; but it is useless to waste time in conjectures on a series of gradations from the young feeding themselves & being slightly & occasionally assisted in their search, to their entire food being brought to them. With respect to the parent bringing a different kind of food from its own kind, we may suppose either that the remote stock, whence the Sparrow & other congenerous birds have descended, was insectivorous, & that its own habits & structure have been changed, whilst its ancient instincts with respect to its young have remained unchanged;— or we may suppose, that the parents have been induced to vary

slightly the food of their young, by a slight scarcity of the pro-
-per kind (or by the instinct of some individuals not being
so fully developed) & in this case those young which were
most capable of surviving, were necessarily most often pre-
-served, & would themselves in time become parents, & would
be similarly compelled to alter the food for their young. In
the case of those animals, the young of which feed themselves,
changes in their instincts for food, & in their structure, might
be selected from slight variations, just as in mature animals.
Again where the food of the young, or where the mother places her
eggs, as in the case of the caterpillars of the cabbage butterfly, we
may suppose that the parent stock of the species, deposited her
eggs sometimes on one kind and sometimes on another of congenerous
plants, (as some species now do) & if the cabbage suited the cat-
-pillars better than any other plant, the caterpillars of those butterflies,
which had chosen the cabbage, would be most plentifully reared,
& would produce butterflies, more apt to lay their eggs on the cabbage,
than on the other congenerous ~~kinds~~ plants.

However vague & unphilosophical these conjectures, may
appear, they serve, I think, to show that one's first impulse

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utterly to reject any theory whatever, implying a gradual

acquirement of those instincts, which for ages have excited

mans admiration, may at least be delayed. Once grant, that

dispositions, tastes, actions or habits can be slightly modified, either

by slight congenital differences, (we must suppose in the brain) or

by the forces of external circumstances, & that such slight modi-

=fications can be rendered inheritable — a proposition which

no one can reject, — & it will be difficult to put any limit to the com-

=plexity & wonder of the tastes & habits, which may possibly be thus

acquired.

difficulties in the acquirement by selection of complex corporeal structures. t. p. 94.

After the past discussion, it will perhaps be convenient here to

consider, whether any particular corporeal organs, or the entire

structure of any animal, are so wonderful, as to justify the rejection

primâ facie of our theory. In the case of the eye, as with the

more complicated instincts, no doubt one's first impulse is

utterly reject every such theory. But if the eye from its most

complicated form can be shown to graduate into an exceedingly

simple state, it is clear (for in this work we have nothing to do

if selection can produce the smallest change, & if such a series exists, then

with the first origin of organs in their simplest forms) that it may

possibly have been acquired by gradual selection of slight, but in

each case useful deviations. Every naturalist, when he meets with any new & singular organ, always expects to find & looks for other & simpler modifications of it in other beings.— In the case of the eye, we have a multitude of different forms, more or less simple, not graduating into each other, but separate by sudden gaps or intervals; but we must recollect how incomparably greater would the multitude of visual structures be, if we had the eyes of every fossil, which ever existed. We shall discuss the probable vast proportion of the extinct to the recent in the succeeding part. Notwithstanding the large series of existing forms, it is most difficult even to conjecture by what intermediate stages, very many simple organs could possibly have graduated into complex ones: but it should be borne in mind, that a part having originally a wholly different function, may on the theory of gradual selection, be slowly worked into quite another use: the gradations of forms, from which naturalists believe in the hypothetical metamorphosis of part of the ear into the swimming bladder in fishes, & of insects of legs into jaws, show the manner in which this is possible. As under domestication, modifications of structure take place, without any continued selection, which man

finds very useful, or valuable for curiosity (as the hooked calyx

of the teazle, or the ruff round some pigeons necks) so in a

state of nature, some small modifications, apparently beauti-

-fully adapted to certain ends, may perhaps be produced from the

accidents of the reproductive system, & be at once propagated

(small deviation, towards that structure.

without long-continued selection for such ends. In conjectur-

-ing, by what stages any complicated organ in an individual spe-

-cies may have arrived at its present state, although we may

look to the analogous organs in other existing species, we should

do this merely to aid & guide our imaginations; for to know the

real stages, we must look only through one line of species, to one

in question

ancient stock, from which the individual species has drop-

-ped. a Quadruped.

-ped. In considering the eye of man for instance, though we

may look at the eye of a molluscous animal or of an insect,

as a proof how simple an organ will serve some of the ends of

vision; & at the eye of a fish as a nearer guide of the manner

(afterwards in a Mammal & Bird & Reptile)

of simplification; we must remember that it is a mere chance

if any existing organic being has preserved any one organ, in

exactly the same condition, as it existed in the ancient

species at remote geological periods.

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The nature or condition of certain structures, has been thought by some naturalists, to be of no use to the possessor, but to have been formed wholly for the good of other species; thus certain fruit seeds have been thought to have been made nutritious for certain animals, - numbers of insects, especially in their larval state, to exist for the same end; - certain fish to be bright coloured to aid certain birds of prey in catching them &c. Now could this be proved, (which I am far from admitting) the theory of natural selection would be quite overthrown; for it is evident that selection, depending on the advantage of one individual with some slight deviation over others, would never produce a structure of quality profitable only to another species. No doubt, one being takes advantage of qualities in another, & may even cause its extermination; but this is far from proving that this quality was produced for such an end. It may be advantageous to a plant to have its seeds attractive to animals, if one out of a hundred or thousand escape being digested & thus aids its dissemination: the bright colours of a fish may be of some advantage to it, or more probably may result from exposure to certain conditions in favourable haunts for food,

notwithstanding it becomes subject to be caught more easily by certain birds.

If instead of looking, as above, at certain individual organs, in order to speculate on the stages by which their parts have been matured & selected; we consider an individual animal, we meet with the same or greater difficulty, but which, I believe, as in the case of single organs, rests entirely on our ignorance. It may be asked by what intermediate forms could, for instance, a Bat possibly have passed; — but the same question might have been asked with respect to the Seal, if we had not been familiar with the otter & other semi-aquatic carnivorous quadrupeds. But in the case of the Bat, who can say what might have been the habits of some parent-form with less developed wings, when we now have insectivorous opossums & herbivorous squirrels fitted for merely gliding through the air. One species of bat is at present partly aquatic in its habits! Woodpeckers & tree-frogs are especially adapted, as their names express, for climbing trees; yet we have species of both, inhabiting the open plains of La Plata, where a tree does not exist: I might argue from this circumstance,

Richardson in Fauna Boreali Americana
i.p. 69. A.

that a structure eminently fitted for climbing, tree, might
^ ascend

from forms inhabiting a country where a tree did not exist. Not=
withstanding these & a multitude of other well-known facts, it has
been maintained by several authors, that one species, for instance of the
carnivorous order, could not pass into another, for instance into an otter,
because in its transitional state its habits would not be adapted to
See Richardson, a far better case
any proper conditions of life; — but the jaguar is a thoroughly terrestrial
& a plant-animal, the half-jaguar is aquatic
quadruped in its structure, yet it takes freely to the water & catches
many fish; — will it be said that it is impossible, that the conditions
of its country might become such, that the jaguar should be driven
to feed more on fish than they now do; & in that case is it impossible,
is it not probable, — that any the slightest deviation in its instincts,
its form of body, — in the width of its feet & in the extension of the skin
(which already unites the base of its toes) would give such individuals
a better chance of surviving & propagating young with similar, barely
perceptible (though thoroughly exercised) deviations? Who will say what could
thus be effected in the course of ten thousand generations? — Who can answer
the same question with respect to instincts? If no one can, the possibility
in this chapter
(for we are not here considering the probability) of simple organs or
organic beings, being modified by natural selection & the effects of
external agencies, into complicated ones, ought not to be absolutely
rejected.]

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I think the description of p. 151. ought to come in here, or at head of Geography. Chapter.

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Part II.

Chapter I.

On the number of intermediate forms, required on the theory of common descent; & on their absence in a fossil state.

I must here premise, that according to the view ordinarily received, the myriads of organisms, which have during past & present times peopled this world, have been created by so many distinct acts of Creation. It is impossible to reason concerning the will of the Creator, & therefore according to this view, we can see no cause, why or why not the individual organism should have been created on any fixed scheme: That all the organisms of this world, have been produced on a scheme, is certain from their general affinities; & if this scheme can be shown to be the same with that, which would result from all the organic beings descending from common stocks, it becomes highly improbable that they have been separately created by individual acts of the will of ~~our~~ a Creator: for as well might it be said, that although the planets move in courses conformably to the law of gravity, yet we ought to attribute the course of each planet to the individual

act of the will of the Creator. It is in every case more conformable with what we know of the government of this earth, that the Creator shd have imposed only general laws. As long as no method was known, by which races could become exquisitely adapted to various ends,— whilst the existence of species was thought to be proved by the sterility of their offspring, it was allowable to attribute each organism to an individual act of Creation. But in the two former Chapters it has ? (I think) been shown that the production, under the existing conditions, of things of exquisitely adapted species, is at least possible. Is there then any direct evidence, in favour or against this view: I believe that the geographical distribution of organic beings in past & present times; the kind of affinity linking them together; their so called "metamorphic" & "abortive" organs, appear in favour of this view. On the other hand, the imperfect evidence of the continuousness of the organic series, which, we shall immediately see, is required on our theory, is against it; & is the most weighty objection. The evidence, however, even on this point, as far as it goes, is favourable; & considering the imperfection of our knowledge, especially with respect to past ages, it wd be surprising, if evidence drawn from such sources were not also imperfect.] [As I suppose that species have been

formed in an analogous manner, with the varieties of the domesticated animals & plants, so must there have existed intermediate forms between all the species of the same group, not differing more than recognized varieties differ. It must not be supposed necessary, that there should have existed forms, exactly intermediate in character, between any two species of a genus, or even between any two varieties of a species; but it is necessary that there should have existed every intermediate form between the one species or variety & the common parent, & likewise between the second species or variety, & this same common parent. Thus it does not necessarily follow that there ever has existed series of intermediate sub-varieties (differing no more than the occasional seedlings ~~sports~~ differ from the same seed-capsule) between Brocooli & common Red Cabbage; but it is certain, that there have existed between Brocooli & the wild parent cabbage, a series of such intermediate seedlings, & again between Red cabbage & the wild parent cabbage: so that the Brocooli & Red Cabbage are linked together, but not necessarily by directly intermediate forms. It is of course possible that may have been directly intermediate forms, for the Brocooli may have long since descended from a common Red Cabbage, & this from the wild Cabbage. So on my theory, it must

have been with species of the same genus. Still more must the

Imperfection of the Geol. Rec. p. 101 → (Must we not have descended from them)

supposition be avoided, that there has necessarily ever existed

directly intermediate forms between any two genera or families—

for instance between the genus Sus & Tapir, although it is necess-

-ary that intermediate forms (not differing more than the varieties

of our domestic animals) should have existed between Sus &

some unknown parent form, & Tapir with this same parent

form. The latter may have differed more from Sus & Tapir, than

these two genera now differ from each other. In this sense, accor-

ding to our theory, there has been a gradual passage (the steps

not being wider apart, than, our domestic varieties) between the

species of the same genus, between genera of the same family,

& between families of the same order, & so on, as far as facts,

hereafter to be given, lead us; & the number of forms which must

have

at former periods existed, thus to make good this passage between

different species, genera & families, must have been almost infin-

-itely great.

What evidence is there, of a number of intermediate forms having

existed, making a passage in the above sense, between the spe-

-cies of the same groups? Some naturalists have supposed that

if every fossil, which now lies entombed, together with all existing species, were collected together, a perfect linked series on every great class would be formed. Considering the enormous number of species requisite to effect this, especially in the above sense of the forms not being directly intermediate between the existing species & genera, but only intermediate by being linked through a common, but often widely different, ancestor, I think this supposition highly improbable. — I am however, far from underrating the probable number of fossilized species: no one who has attended to the wonderful progress of palæontology during the last few years, will doubt that we as yet have found, only an exceedingly small fraction, of the species buried in the crust of the earth.

Although the almost infinitely numerous intermediate forms in no one class may have been preserved, it does not follow that they have not existed. The fossils which have been discovered, it is important to remark, do tend, the little way they go, to make good the series; for as observed by Buckland, they all fall in-to or between existing groups. Moreover, those that fall be-tween our existing groups, fall in, according to the manner required by our theory, for they do not directly connect two existing



Then can he no doubt of our having the Spot, existing going Stars now separate.

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species of different groups, but they connect the groups themselves:
thus the Pachydermata & Ruminantia are now separated by several characters, amongst which the Pachydermata have both a tibia & fibula, whilst Ruminantia have only a tibia; now the fossil Macrauchenia has a leg bone exactly intermediate in the respect & likewise has some other intermediate characters. But the Macrauchenia does not connect any one species of Pachydermata with some one other of Ruminantia, but it shows that these two groups have at one time been less widely divided.

So have Fish & Reptiles been at one time less widely divided than most closely connected in some points, than they now are. Generally the more ancient the fossil, the more often it falls between existing groups, or into small existing groups which now lie between other large existing groups. — Cases like the foregoing, of which there are many, form steps, though few & far between, in a series of the kind required by my theory.

The earliest forms. I be such as others could not at first.

As I have admitted the high improbability, that if every fossil were discovered, they would compose a perfect series in each of the great Divisions of nature of the kind required; consequently, I freely admit, that if those geologists are in the right, who consider the lowest known formation, as contemporaneous with

propositiones
in originales

the first appearances of life; or the several formations as at all closely consecutive; or any one formation as containing a nearly perfect record of the organisms ~~of any one group~~ which existed during the whole period of its deposition in that quarter of the globe; if such proportions are to be accepted, my theory must be abandoned. [If the Palæozoic system is really contemporaneous with the first appearance of life, my theory must be abandoned, both in as much as it limits for shortness of time, the total number of forms which can have existed on this world, & because the organisms, as Fish

The parent-form of Molluscs. I probably better guess for the present.—It is not likely that any one division of molluscs is descended from just these molluscs which other have become metamorphosed into

Molluscoa & Star-fish, found in its lower beds, cannot be considered as the parent-forms of all the successive species in these classes. But no one has yet overturned the arguments of Hutton & Lyell, that the lowest formations known to us, are only those which have escaped being metamorphosed by heat: if we argued from some considerable districts, we might have supposed that even the cretaceous system was that in which life first appeared. From the number of distant points, however, in which the Silurian system has been found to be the lowest, & not always metamorphosed, there are some objections to Hutton's & Lyell's view; but we must not forget, that the now existing land forms only $\frac{1}{5}$ part of the

superficies of the globe, & that this fraction is only imperfectly known.— With respect to the fewness of the organisms preserved in the Silurian & other Palæozoic formations, there is less difficulty, in as much as (besides their gradual obliteration) we can expect formations of this vast antiquity to escape entire denudation, only when they have been accumulated over a wide area & have been subsequently protected by vast superimposed deposits: now this could generally only hold good with deposits, accumulating in a wide & deep ocean, & therefore unfavourable to the presence of many living things. A more narrow, but very thick strip of matter, deposited along a coast where organisms most abound, would have no chance of being preserved to the present time from such immensely distant ages.

escaping denudation and

If the several known formations are at all nearly consecutive in time, & present a fair record of the organisms, which have existed, my theory must be abandoned. But when we consider the great change in mineralogical nature & texture between successive formations, what vast & entire changes in the geography generally of the surrounding countries must have been effected, thus wholly to have changed the nature of the deposits on the same area. What time

such changes must have required! Moreover how often has it not been found, that between two conformable & apparently immediately successive deposits, a vast pile of water-worn matter is interpolated in an adjoining district. We have no means of conjecturing in many cases how long a period has elapsed between successive formations, for the species are often wholly different: as remarked by Lyell, in some cases probably as long a period has elapsed between two formations, as the whole Tertiary system, itself broken by wide gaps.

Reflect on a comparison of Chalk, Wealden & Tertiary Crimea

Consult the writings of anyone who has particularly attended to any one stage in the Tertiary system (& indeed of every system) & see how deeply impressed he is with the time required for its accumulation. Reflect on the years elapsed in many cases, since the latest beds containing only living species have been formed;- see what Jordan Smith says of the 2,000 years since the last bed, which is above the boulder formation in Scotland, has been upraised; or of the far longer period since the recent beds of Sweden have been upraised 400 feet, what an enormous period the Boulder formation must have required, & yet how insignificant are the records (although there has been plenty of elevation

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to bring up submarine deposits) of the shells, which we know existed at that time. Think, then, over the entire length of the Tertiary epoch, & think over the probable length of the intervals, separating the Secondary deposits. Of these deposits, moreover, those consisting of sand & pebbles have seldom been favourable, either to the embedment or to the preservation of fossils.

Nor can it be admitted as probable, that any one Secondary formation contains a fair record even of those organisms which are most easily preserved, namely hard marine bodies. In how many cases have we not certain evidence that between apparently consecutive beds, the lower one existed for an unknown time as land, covered with trees. Some of the Secondary formations which contain most marine remains, appear to have been formed in a wide & not deep sea, & therefore only those marine animals which live in such situations would be preserved. In all cases, on indented rocky coasts, or any other coast, where sediment is not accumulating, although often highly favourable to marine animals, none can be embedded: where pure sand & pebbles are accumulating fast none will be preserved. I may here instance the great western line of the S. American coast, tenanted by many peculiar animals,

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of which none probably will be preserved to a distant epoch. From

these causes, & especially from such deposits as are formed along a line of coast

, steep above & below water, being of little breadth, & therefore more

likely to be subsequently ground down & worn away, we can see why it is

improbable that our secondary deposits contain a fair record of

the marine Fauna of any one period. The East Indian

archipelago offers an area, as large as most of our secondary de-

=posits, in which there are wide & shallow seas, teeming with ma-

=rine animals, & in which sediment is accumulating; now supposing

that all the hard marine animals, were preserved to a future age,

excepting those which lived on rocky shores where no sediment

or only sand & gravel were accumulating, & excepting those embed-

=ded along the steeper coasts, where only a narrow fringe of sed-

=iment was accumulating, supposing all this, how poor a notion

would a person at this future age, have of the marine Fauna

of the present day. Lyell has compared the geological series to a

work, of which only the few last but not consecutive chapters have

been preserved; & out of which, it may be added, very many leaves

have been torn, the remaining ones only illustrating a scanty

portion of the Fauna of each period. On this view the records

of anteceding ages confirm my theory; or any other they destroy it.

Finally if we narrow the question into, why we do not find in some instances every intermediate form between any two species; the answer may well be, that the average duration of each specific form (as we have good reason to believe) is immense in years, & that the transition could, according to my theory, be effected only by numberless small gradations; & therefore that we should require for this end a most perfect record, which the foregoing reasoning teaches us not to expect. It might be thought, that in a vertical section of great thickness in the same formation, some of the species ought to be found to vary in the upper flower parts, but it may be doubted whether any formation has gone on accumulating without any break for a period as long as the duration of a species; & if it had done so, we should require a series of specimens, from every part. How rare must be the chance of sediment accumulating for some 20 or 30 thousand years on the same spot, with the bottom subsiding, so that a proper depth might be preserved for any one species to continue living: What an amount of subsidence will be thus required, & this subsidence must not destroy the source, whence the sediment continued to be derived. In the case of terrestrial

animals, what chance is there when the present time is become

a pleistocene formation (at an earlier period than this, sufficient

elevation to expose submarine beds could not be expected), that

chance is there, that future geologists will make out the innumer-

-able transitional sub-varieties, through which the short-horned

& long-horned cattle (so different in shape of body) have been derived

from the same parent stock? yet this transition has been effec-

-ted in the same country, viz a far shorter time, than would

be probable in a wild state, both contingencies highly favourable

for the future hypothetical geologists, being enabled to trace

the variation.

Chapter II. Chpt. B. V

Gradual appearance & disappearance of Species. (to p. 114)

In the Tertiary system, in the last uplifted beds, we find

all the species recent & living in the immediate vicinity; in

rather older beds, we find only recent species but some not living

in the immediate vicinity; we then find beds with two or three or a

few more extinct species; then considerably more extinct spe-

-cies, but with gaps in the regular increase; & finally we have beds

with only two or three or not one living species. Most geologists believe

that the gaps in the percentage, that is the sudden increase in the number of the extinct species in the Stages of the Tertiary system, are due to the imperfection of the geological record. Hence we are led to believe that the species in the Tertiary System have been gradually introduced; & from analogy to carry on the same view to the Secondary formations. In these latter, however, entire groups of species generally come in abruptly; but this would naturally result, if, as argued in the fore-going chapter, these secondary deposits are separated by wide epochs.

Moreover it is important to observe, that with our increase of know-ledge, the gaps between the older formations become fewer and smaller; how beautifully has the Devonian system come in between the Carboniferous & Silurian formations. I need hardly observe that the slow & gradual appearance of new forms follows from our theory for to form a new species, we do not only be plastic in its organization, becoming so probably from changes in the conditions of its existence; but a place in the natural economy of the district must be made for the selection of some new modification of its struc-ture, better fitted to the surrounding conditions, than are the other individuals of the same or other species.

In the Tertiary System, the same facts, which makes us admit

that new species have slowly appeared, lead to the admission that sim
ilar events have slowly disappeared; & by analogy one is induced to ex-
tend this belief to the Secondary & Palæozoic epochs. In some
cases, as the subsidence of a flat country, or the breaking down of an
isthmus, & the sudden inroad of many new & destructive species,
extinction might be locally sudden. The view entertained by many
geologists, that each fauna of each Secondary epoch has been sud-
denly destroyed over the whole world, so that no succession could be
left for the production of new forms, is subversive of my theory,
(The great breaks here coincident on Europe.—)
but I see no grounds whatever to admit such a view. On the contrary,
the law, which has been made out by independent observers, with
reference to distinct epochs, namely that the wider the geograph-
(d'Archiac Forbes Pictet)
-ical range of a species, the longer is its duration in time, seems
entirely opposed to any universal extermination. The fact of
(Pictet) species of mammiferous animals & fish being renewed at a
(Angl. Pleistocene)
quicker rate than mollusca; & of these the terrestrial genera
(Forbes)
being renewed quicker, than the marine; & the marine mollusca
(Phillips)
being again renewed quicker than the Infusorial animalcules,
all seem to show that the extinction & renewal of species does not
depend on general catastrophes, but on the particular relations of

the several classes, to the conditions to which they are exposed. Some authors seem to consider the fact of a few species having survived amidst a number of extinct forms (as is the case with a tortoise & a (Falconer) crocodile out of the vast number of extinct sub-himalayan fossils) as strongly opposed to the view of species being mutable. No doubt this would be the case, if it were presupposed with Lamarck, that there was some inherent tendency to change & development in all species; for which supposition I see no evidence. As we see some species at present adapted to a wide range of conditions, so we may suppose, that such species would survive unchanged & unexterminated for a long time; time generally being from geological causes, a correlative of changing conditions. How at present one species becomes adapted to a wide range, & another species to a restricted range of conditions, is of difficult explanation.

Extinction of Species. to p. 114.

[The extinction of the larger quadrupeds, of which we imagine we better know the conditions of existence, has been thought little less wonderful than the appearance of new species; & has, I think, chiefly led to the belief of universal catastrophes. When considering the wonderful disappearance within a late period, whilst recent shells were living, of the numerous great & small mammifers of—

S. America, one is strongly induced to join with the catastrophists.

I believe, however, that very erroneous views are held on this subject.

As far as is historically known, the disappearance of species from any one country, has been slow, - the species becoming rarer & rarer, locally extinct, & finally lost. It may be objected that this has been effected by man's direct agency, or by his indirect agency in altering the state of the country; in this latter case, however, it would be difficult to draw any just distinction between his agency & natural agencies. But we now know in the later Tertiary deposits that shells, the organic beings broome rarer & rarer in the successive beds, & finally disappear: it has happened, also, that shells in a fossil state, thought to have been extinct, have been found to be still living species, but very rare ones. If the rule is, that organisms become extinct by becoming rarer & rarer, we ought not to view their extinction, even in the case of the larger quadrupeds, as any thing wonderful & out of the common course of events. For no naturalist thinks it wonderful that one species of a genus should be rare & another abundant, although ~~each of equal fertility~~ notwithstanding he be quite incapable of explaining the causes of the comparative rareness. Why is one species of Willow-wren or Hawk or Woodpecker common in

England & another extremely rare: why at the Cape of Good Hope is one species of Rhinoceros or antelope far more abundant than other species? Why again is the same species much more abundant in one district of a country than in another district? No doubt there are in each case good causes; but they are unknown & unperceived by us. May we not then safely infer, that as certain causes are acting unperceived around us, & are making one species to be common & another exceedingly rare, that they might equally well cause the final extinction of some species, without being perceived by us? We should always bear in mind, that there is a recurrent struggle for life in every organism, & that in every country, a destroying agency is always counteracting the geometrical tendency to increase in every species; & yet without our being able to tell with certainty at what period of life or at what period of the year, the destruction ~~destruction~~ falls the heaviest. Ought we then to expect to trace the steps by which this destroying power, always at work & scarcely perceived by us, becomes increased; & yet if it continues to increase ever so slowly (without the fertility of the species in question be likewise increased) the average number of individuals of that species must decrease, & will become finally lost. (As much as this) From our more intimate

A in text

I may give a single instance of a shrub, causing local extermination, which might long have escaped discovery; the horse though swarming in a wild state in La Plata & under apparently the most unfavourable conditions in the scorched & alternately flooded plains of Caracas, will not in a wild state extend beyond a certain degree of latitude into the intermediate country of Paraguay; this is owing to a certain (cayana) fly depositing its eggs on the navels of the foals: as, however, man with a little care can rear horses in a tame state abundantly in Paraguay, the problem of its extinction is probably complicated by the greater exposure of the wild horse to occasional famine from the drought, to the attacks of the jaguar, & other such evils. In the Falkland Islands, the check to the increase of the wild horse, is said to be the loss of the sucking foals, from the stallions compelling the mares to travel across bogs & rocks in search of food: if the pasture on these lands decreased a little, the horse perhaps would cease to exist in a wild state, not from the absolute want of food, but from the impatience of the stallions urging the mares to travel, whilst the foals were too young.]

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acquaintance with domestic animals, we cannot conceive their extinction without some glaring agency; we forget that (they would undoubtedly) of nature (where other animals are ready to fill up their place), be acted on Key is undoubtedly in some part of their lives checked by a destroying agency, keeping their number on an average constant. If the common ox was known only as a wild S. African species, we should feel no surprise at hearing that it was a very rare species; & this rarity would be a stage towards its extinction. Even in man, so infinitely better known than any other inhabitant of this world, how impossible it has been found, without statistical calculations, to judge of the proportions of births & deaths, of the duration of life, & of the increase & decrease of population; & still less of the causes of such changes: & yet as so often has been repeated, decrease in numbers or rarity, seems to be the high-road to extinction. To marvel at the extermination of a species, appears to me to be the same thing, as to know that illness is the road to death, - to look at illness as an ordinary event, nevertheless to conclude that when the sick man dies, that his death has been caused by some unknown & violent agency. [In the following discussion, I shall class together extinct & local species, in as much as they are both known, their

Similarly if F. W. organisms must be discussed.

In a future part of this work, we shall show that as a general rule, groups of allied though different species gradually appear & disappear, one after the other, on the face of the earth, like the individuals of the same species: & we shall then endeavour to show the probable cause of this remarkable fact.

Chapter III Chapt. VI

It same species appear & fated to, my theory.

On the Geographical Distribution of organic beings in past & present times. (to p. 168.)

I think the bearing of each view to be better explained

For convenience sake, I shall divide this chapter into three sections. In the first place, I shall endeavour to state the laws of the distribution, of existing beings; in the second, that of extinct; & in the third section, I shall consider how far these laws accord with the theory of allied species having a common descent.

Section First. (to p. 140)

Distribution of the inhabitants in the different Continents: to p. 119.

In the following discussion I shall chiefly refer to terrestrial mammifers, in as much as they are better known; their differences in different countries, strongly marked; & especially as the necessary means of their transport are more evident, & confusion, from the accidental conveyance by man of species from one district to another district, is less likely to arise. It is known that all

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mammifers (as well as other organisms) are united in one great
that
system; but the different species, genera, or families of the same
order, inhabit different quarters of the globe. If we divide the
land into two divisions, according to the amount of differnce
& disregarding the numbers of, the terrestrial mammifers,
first
inhabiting them; we shall have Australia including
secondly
New Guinea, & the rest of the world: if we make a three-fold division,
we shall have Australia, S. America, & the rest of the world; I must
observe that North America is in some respects neutral land, from possess-
-ing some S. American forms, but therein it is more closely allied
(as it certainly is in its birds, plants & shells) with Europe. If our division
had been four-fold, we should have had, Australia, S. America,
Madagascar (though inhabited by few mammifers) & the remaining land:
if five-fold, Africa, especially the southern ~~extremity~~ western part,
would have to be added, or separated from the remainder. These differences in the
of the world.
mammiferous inhabitants of the several main divisions of the
globe, cannot it is well known, be explained by corresponding dif-
-ferences in their conditions; how similar are parts of Tropical
V. Hooker
America & Africa; & accordingly we find some analogical resem-
-blances, thus both have monkeys, both large feline animals,

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both large Lepidoptera, & large dung-feeding beetles; both

have Palms & epiphytas; & yet the essential difference between

their productions, is as great as between those of the arid plains

of the Cape of Good Hope & the grass-covered savannahs of La

Plata. Consider the distribution of the Marsupialia, which

are eminently characteristic of Australia, & in a lesser degree

of S. America; when we reflect that animals of this division,

feeding both on animal & vegetable matter, frequent the open,

or wooded plains & mountains of Australia, the humid impene-

-trable forests of new Guinea & Brazil; the dry rocky mountains

of Chile, & the grassy plains of Banda Oriental, we must look to

some other cause, than the nature of the country, for their

absence in Africa & other quarters of the world.

Furthermore it may be observed, that all the organisms inhabit-

-ing any country are not perfectly adapted to it; I mean by not being

perfectly adapted, only, that some few other organisms can gen-

-erally be found better adapted to the country, than some of the abori-

-gines. We must admit this, when we consider the enormous number

of horses & cattle, which have run wild during the three last

centuries in the uninhabited parts of St Domingo, Cuba, & S. America,

not in St Domingo?

These animals must have supplanted some aboriginal ones. I might also adduce the same fact in Australia, but perhaps it will be objected that 30 or 40 years has not been a sufficient period to test this power of struggling & overcoming the aborigines. We know the European mouse is driving before it, that of New Zealand, like the Norway rat has driven before it the old English species in England. Scarcely an Island can be named, where casually introduced plants have not supplanted some of the native species: in La Plata, the Cardoon covers square leagues of country on which some S. American plants must once have grown: the commonest weed over the whole of India is an introduced Mexican poppy. The geologist who knows that slow changes are in progress, replacing land & water, will easily perceive that even if all the organisms of any country were originally the best adapted to it, this could hardly continue so during succeeding ages, without extermination, or changes, first in the relative proportional numbers of the inhabitants of the country, & finally in their constitutions & structure.

Inspection of a map of the world, at once shows, that the five divisions, separated according to the greatest amount of difference in the mammifers inhabiting them, are likewise those

most separated from each other by barriers, which mammifers widely

could not pass: thus Australia is separated from new Guinea & some cannot

small adjoining islets only by a narrow & shallow Strait; whereas new

Guinea & its adjoining islets are cut off from the other East Indian

Islands by deep water. These latter islands, I may remark, which fall

into the great Asiatic group, are separated from each other & the con-

tinent only by shallow water; & where this is the case, we may suppose,

from geological oscillations of level, that generally there has been re-

-cent union. South America, including the southern part of Mexico,

is cut off from north America by the West Indies & the great table-

-land of Mexico, except by a mere fringe of tropical forests along

the coast: it is owing perhaps to this fringe, that N. America possess

some S. America forms. — Madagascar is entirely isolated. Africa

is also to a great extent isolated, although it approaches by many formations

& by lines of shallower sea to Europe & Asia: Southern Africa,

which is the most distinct in its mammiferous inhabitants, is separated

from the northern portion, by the Great Sahara Desert & the table-land

of Abyssinia. Care plants stop far south of Abyssinia.

That the distribution of organisms is related to barriers,

stopping their progress, we clearly see by comparing the distribution of

marine & terrestrial productions. The marine animals being different

The same laws seem to govern distribution of species & genera, as individuals in species.
~~as words~~

on the two sides of land tenanted by the same terrestrial animals; thus the tempera parts of the shells are wholly different on the opposite sides of South America, as they are (?) in the Red Sea & Mediterranean. We can at once perceive, that the destruction of a barrier would permit two geographical groups of organisms to fuse & blend into one. But the original cause of groups being different on opposite sides of a barrier, can only be understood on the hypothesis of each organism having been created or produced on one spot or area, & afterwards migrating as widely as its means of transport & subsistance permitted it.

Add better com later.

Relation of range in genera and species. 6 p. 120.

Genera & species within one continuous area

It is generally found, that where a genus or group ranges over near-by the entire world, many of the species, composing the group, have wide ranges: on the other hand, where a group is restricted to any one country, the species composing it, generally have, restricted ranges, in that country. Thus amongst mammifers the feline & canine genera are widely distributed, & many of the individual species have enormous ranges: the genus, mus, I believe, however, is a strong exception to the rule. Mr. Gould informs me that the rule holds with birds, as in the owl genus, which is mundane, & many of the species range widely. The rule holds, also, with land & fresh-water mollusca, with butterflies & very generally with plants. As instances of the converse

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nals, I may give that division of the monkeys, which is confined to S. America, & amongst plants, the cacti confined to the same conti-

(Hooker Proteaceæ) -nent, the species of both of which have generally narrow ranges. On the ordinary theory of the separate creation of each species, the cause of these relations is not obvious; we can see no reason, because many allied species have been created in the several main divisions of the world, that several of these species should have wide ranges; and on the contrary that of the same group species should have narrow ranges, if all have been created in one main division of the world. As the result of such & probably many other unknown relations, it is found that even in the same great class of beings, the different divisions of the world, are characterized by either merely different species, or genera, or even families: thus in cats, mice, foxes S. America differs from Asia & Africa in her cats, mice & foxes only in species; in her pigs, camels, monkeys, the difference is generic or greater. Again, whilst southern Africa and Australia differ more widely in their mammalia, than (Alca & Lesser.) do Africa & S. America; they are more closely (though very distantly) allied in their plants.

(Very) (indeed very)

(Distribution of the inhabitants in the same Continent. to p. 123.) If we now look at the distribution of the organisms in any one of the above main divisions of the world, we shall find it split up into many regions, with all or nearly all their species distinct, but yet partaking of one common

character. This similarity of type in the sub divisions of a great region, is equally well known with the dissimilarity of the inhabitants of the several great regions; but it has been less often insisted on, though more worthy of remark. Thus for instance, if in Africa or S. America, we go from South to north, or from lowland to upland, or from a humid to a dryer part, we find wholly different species of those genera or groups, which characterize the continent over which we are passing. In these subdivisions we may clearly observe, as in the main divisions of the world, that sub-barriers divide different groups of species, although the opposite sides of such sub-barriers may possess nearly the same climate, & may be in other respects nearly similar: thus it is on the opposite sides of the Cordillera of Chile, & in a lesser degree on the opposite sides of the Rocky mountains. Deserts, arms of the sea, & even rivers in other cases form the barriers. Mere space seems sufficient in several cases; thus Eastern & Western Australia, in the same latitude, with very similar climate & soil, has scarcely a plant, & few animals or birds, in common, although all belong to the peculiar genera, characterizing Australia. It is in short, impossible to explain the differences in the inhabitants, either of the main divisions of the world, or of their subdivisions, by the differences in their physical conditions, & by the adaptation of

their inhabitants. Some other cause must intervene. We can see that the destruction of sub-barriers would cause (as before remarked in the case of the main divisions) Two sub-divisions to fuse into one; & we can only suppose that the original difference in the species on the opposite sides of sub-barriers, is due to the creation or production of species in distinct areas, from which they have wandered, & are arrested by such sub-barriers. Although thus far it is pretty clear, it may be asked, why, when species in the same main division of the world, were produced on opposite sides of a sub-barrier, both exposed to similar conditions, & when exposed to widely different influences (as on alpine & lowland tracts, as on arid & humid soils, as in cold & hot climates) have they invariably been formed on a similar type, & that type confined to this one division of the world? Why was an Africa, produced in the southern parts of America, was it formed on the American type, instead of on the African or Australian types? why when hare-like & rabbit-like animals were formed to live on the Savannahs of La Plata, were they produced on the peculiar Rodent-Type of S. America, instead of on the true Hare-Type of North America, Asia, & Africa? Why when burrowing Rodents, & camel-like animals were formed to tenant the

Cordillera, were they formed on the same type with their repre-
-sentatives on the plains? Why were the nice & many birds of differ
-ent species on the opposite sides of the Cordillera, but exposed
to a very similar climate & soil, created on the same peculiar
S. American type? Why were the plants in Eastern & Western
Australia, though wholly different as species, formed on the same
peculiar Australian types? The generality of the rule, in so many
places & under such different circumstances, makes it highly
remarkable, & seems to demand some explanation.

Insular Faunas
to p. 127.

If we now look to the characters of the inhabitants of small islands,
we shall find that those situated close to other land, have a simi-
-lar fauna with that land; whilst those at a considerable distance
from other land often possess an almost entirely peculiar fauna.
The Galapagos archipelago is a remarkable instance of this fact;
here almost every bird, its one mammifer, its reptiles, land & sea
shells, & even fish, are almost all peculiar & distinct species, not
found in any other quarter of the world: so are the majority of its
plants. But although situated at the distance of between 500 & 600
miles from the S. American coast, it is impossible to even glance at
a large part of its Fauna, especially at the birds, without at once

seeing that they belong to the American type. Hence in fact, groups of islands thus circumstanced, form merely small, but well defined, subdivisions of the larger geographical divisions. But the fact is in such cases far more striking; for taking the Galapagos Archipelago as an instance; in the first place, we must feel convinced, seeing that every island is wholly volcanic & bristled with craters, that in a geological sense the whole is of recent origin comparitively with a continent; & as the species are nearly all peculiar, we must conclude that they have in the same sense recently been produced on this very spot; & although in the nature of the soil, & in a lesser degree in the climate, there is a wide difference with the nearer parts of the S. American coast, we see that the inhabitants have been formed on the same closely allied type. On the other hand, these islands, as far as their physical conditions are concerned, resemble closely the Cape de Verde volcanic group, & yet how wholly unlike are the productions of these two archipelagoes. The Cape de Verde group, to which may be added the Canary islands, are allied in their inhabitants (of which many are peculiar species) to the coast of Africa & southern Europe, in precisely the same manner, as the

Galapagos Archipelago is allied to America. We here clearly see that

mere geographical proximity affects, more than the relation of

adaptation, the character of species. How many islands in the Pacific

exist far more like in their physical conditions to Juan Fernandez,

than this island is to the coast of Chile, distant 300 miles; why then,

except from mere proximity, the this island alone be tenanted by

two very peculiar species of humming Birds, that form of birds,

which is so exclusively American? Many other similar cases might

be adduced.

The Galapagos archipelago offers another, even more remark-

-able, example of the class of facts we are here considering. Most

of its genera are as we have said, American, many of them even

mundane or found everywhere, & some, are either quite or nearly

confined to this archipelago. The islands are of absolutely similar

composition, & exposed to the same climate; most of them are in

sight of each other; & yet several of the islands are inhabited, each

by peculiar species (or in some cases perhaps only varieties) of

some of the genera characterizing the Archipelago. So that the

small group of the Galapagos islands, typifies, & follows exactly the same

laws in the distribution of its inhabitants, as a great Continent. How

wonderful that two or three closely similar but distinct species of a Mocking Thrush, should have been produced on three neighbouring & absolutely similar islands; & that these three species of Mocking Thrush, should be closely related to the other species inhabiting wholly different climates & different districts of America, ~~& no where else~~, & only in America. No similar case, so striking as this of the Galapagos Archipelago, has hitherto been observed; & this difference of the productions in the different islands, may perhaps be partly explained, by the depth of the sea between them. (showing that they could not have been united within recent geological periods) and by ~~on the one hand~~ the currents of the sea sweeping Straight between them, — & by storms of wind being rare, by which means seeds & birds could be blown from one island to another. There are, however, some similar facts. it is said, that the different, though neighbouring, islands of the East Indian Archipelago are inhabited by some different species of the same genera; & at the Sandwich Group, some of the islands have each their peculiar species of the same genera of Plants.

Islands standing quite isolated within the intra-tropical oceans, have generally very peculiar floras, related, though feebly, (as in the case of St Helena where almost every species is distinct) with the nearest continent: Tristan d'Acunha is feebly related, I believe, (in its plants) both to Africa

by sheets of communication &c.

imperfect sentence

& S. America, not by having species in common, but by ~~the~~ general character of the species, (The floras of the numerous scattered islands

(Hooker) of the Pacific are related to each other, & to all the surrounding continents;

(Lefson) but, it has been said, ~~with~~ more of an Indo-Asiatic, than America character. This is somewhat remarkable, as America is nearer to all the

Indo-?

Eastern islands, & lies in the direction of the trade-winds; on the other hand all the heaviest gales come from the Asiatic side. But even with the aid of these gales, it is not obvious on the ordinary theory of creation, how the possibility of migration, (without we suppose with extreme improbability that each species with an Indo-asiatic character, has actually travelled from the Asiatic shores, where such species do not exist) explains this asiatic character in the plants of the Pacific. This is no more obvious than that (as before remarked) there should exist a relation between the creation of closely allied species in several regions of the world, & the fact of many such species having wide ranges; & on the other hand, of allied species confined to one region of the world, having in that region narrow ranges.

Alpine Floras to p. 133.

We will now turn to the Floras of mountain-summits, which are well known to differ from the Floras of lowlands. In certain characters, such as dwarfness of stature, hairiness, &c, the species from the most distant

mountains frequently resemble each other, - a kind of analogy, like that, for instance, of the succulency of most desert-plants. - Besides this analogy, Alpine plants present some singularly curious facts in their distribution. In some cases, the summits of mountains, although immensely distant from each other, are clothed by the same identical species, which are likewise the same with those growing on the likewise very distant arctic shores. In other cases, although few or none of the species may be actually identical, they are closely related; whilst the plants of the lowland districts surrounding the two mountains in question will be wholly dissimilar. As mountain-summits, as far as their plants are concerned, are islands rising out of an ocean of land, in which the alpine species cannot live, nor across which is there any known means of transport, this fact appears directly opposed to the conclusion, which we have come to from considering the general distribution of organisms on continents & on islands: namely that the degree of relationship between the inhabitants of two points depends on the completeness or nature of the barriers between them. I believe, however, this anomalous case admits, as we shall presently see, of some explanation. We might have expected, that the Flora of a mountain-summit, & have presented the same relation to the flora of the surrounding country, which any isolated part of the continent does to the whole, or an island does to the mainland, from which it is separated by a rather wide space of sea. This is the

case, with the plants, clothing the summits of some mountains, which mountains, it may be observed, are particularly isolated; for instance all the species, are peculiar, but belong to the forms characteristic of the surrounding continent in which they are situated, on the mountains of Caraccas, of Van Diemen's Land & Ilevations of the Neighbouring of the Cape of Good Hope. On some other mountains, for instance Sierra del Fuego & in Brazil, some of the plants, though distinct species, are S. American forms; whilst others are allied to, or identical with the alpine species of Europe. In islands of which the whole Land Flora is distinct, but allied to that of the nearest continent, the alpine plants are sometimes (or perhaps mostly) eminently peculiar & distinct; this is the case on Tenerriffe, & in a less degree even on some of the Mediterranean islands.

If all alpine Floras had been characterized like that of Caraccas or of Van Diemen's Land &c, whatever explanation is possible of the general laws of Geographical distribution, would have applied to them. But the apparently anomalous case, about alluded to, namely of the mountains of Europe, of some in the United States & of the summits of the Himalaya, having many identical species in common, conjointly with the Arctic regions; & many species, though not identical, closely

allied, requires a separate explanation. The fact likewise of several of the species on the mountains of Sierra del Fuego, (& in a lesser degree on the mountains of Brazil) not belonging to American forms, but to those of Europe, though so immensely remote, requires also a separate explanation. [Now we may with confidence affirm, from the number of the then floating icebergs & low descent of the glaciers, that within a period so near, that species of shells have remained the same, the whole of central Europe & of North America, (& perhaps of Eastern Asia) possessed a very cold climate; & therefore, it is probable, that the Floras of these districts was the same as the present Arctic one, - as is known to have been, to some degree, the case with the existing sea-shells. At this period the mountains must have been covered with ice, of which we have evidence in the surfaces polished & scored by glaciers. What then would be the natural & almost inevitable effects of the gradual change into the present more temperate climate? The ice & snow would disappear from the mountains, & as new plants from the more temperate regions of the South migrated northwards, replacing the Arctic plants, these latter would crawl up the now uncovered mountains, & likewise be driven to the present Arctic shores. If the arctic flora of that period was nearly

Cause of the similarity in the Floras of some distant mountain t. p. 133.

+ then on Lima, & the other shores.

Forbes.

not clear

uniform one, as the present one is, then we should have the same plants on these mountain-summits & on the present arctic shores. On this view, the arctic flora of that period must have been a widely extended one, more so than even the present one; but considering how similar the physical conditions must always be of land bordering on perpetual frost, this does not appear a great difficulty; & may we not venture to suppose that the almost infinitely numerous icebergs, charged with great masses of rocks, soil & brushwood, often driven high up on distant beaches, might have been the means of widely distributing the seeds of the same species?

Tertiary strata checked & dated & fauna & flora noticed. Geology

I will only hazard one other observation, namely that during the change from an extremely cold climate to a more temperate, the one,

condition, both on lowland & mountain, would be singularly favourable for the diffusion of any existing plants, which could live on land, just freed from the ~~region~~ vigour of eternal winter; for it would possess no inhabitants & we cannot doubt, that pre-occupation is the chief bar to the diffusion (Many matters)

of plants. For, amongst many other facts, how otherwise can we explain, the circumstance that the plants on the opposite, though similarly constituted, sides of a wide river in Eastern Europe, (as I was informed by Humboldt) should be widely different; across which river birds,

swimming quadrupeds, & the wind must often transport seeds; we can only suppose that the plants already occupying the soil & freely seeding, check the germination of occasionally transported seeds.

At about the same period, when icebergs were transporting boulders in N. America as far as 36° South, where the Cotton-tree now grows, in South America, in Latitude 42°, (where the land is now clothed with forests having an almost tropical aspect, with the trees bearing epiphytes & entwined with canes) the same ice-action was going on; is it not, then, in some degree possible ~~can we then doubt, but~~ that at this period, the whole tropical parts (as Falconer asserts, India did) of the two Americas possessed a more temperate climate? In this case, the alpine plants of the long chain of the Cordillera, would have ascended much lower, & there would have been a broad high-road, connecting those parts of north & south America, which were then (too hypothetical) frigid. As the present climate supervened, the plants, occupying the districts, which now are become in both hemispheres temperate & even semi-tropical, must have been driven to the arctic & antarctic regions; & only a few of the loftiest points of the Cordillera can now retain their former connecting flora. The transverse chain of Chiquitos might perhaps would in a similar manner, during the ice-action-period, have served as a connecting road (through a broken one) for

(to become this island) Portion of Europe.

alpine plants from the Cordilleria to the high-lands of Brazil. It

may be observed, that some (though not strong) reasons can be assigned,

for believing that at about this same period, the two Americas were

not so thoroughly distinct, as they now are, by the West Indies & table-

-land of Mexico. I will only further remark, that the present (most) singular

-ly close similarity in the vegetation of the lowlands of Kerguelen Land

(Hooker) & of Tierra del Fuego, though so far apart, may perhaps be explained

by the dissemination of seeds, during this same cold period, by means

of icebergs, as before alluded to.

Finally, I think, we may safely grant from the foregoing facts &

reasoning, that the anomalous similarity in the vegetation of certain

very distant mountain summits, is not in truth opposed to the con-

-clusion, of the intimate relation subsisting between proximity

in space (in accordance with the means of transport in each class)

& the degree of affinity of the inhabitants of any two countries. In the

case of several quite isolated mountains, we have seen that the

general law holds good.

Whether the same species has been created more than once. to p. 137.

Ought this not to go first?

As the fact of the same species of plants having been found on

mountain-summits immensely remote, has been one chief cause

of the belief of some species having been contemporaneously produced

or errated at two different points, I will here briefly discuss this subject. On the ordinary theory of creation, we can see no reason why on two similar mountain-summits, two similar species may not have been errated; but the opposite view, independently of its simplicity, has been generally received from the analogy of the general distribution of all organisms, in which (as shown in this chapter) we almost always find that great & continuous barriers separate distinct series; & we are naturally led to suppose that the two series have been separately created. When taking a more limited view we see a river, with a quite similar country on both sides, with one side well stocked with a certain animal & on the other side not one, (as is the case with the Bizcacha on the opposite sides of the Plata) we are at once led to conclude that the Bizcacha was produced on some one point or area, on ~~the~~ the Western side of this river. Considering our ignorance of the many strange chances of diffusion, by birds (which occasionally wander to immense distances) & quadrupeds swallowing seeds & ova (as in the case of the flying water-beetle, which disgorged the eggs of a fish) & of whirlwinds carrying seeds & animals into ~~the~~ strong upper currents (as in the case of volcanic ashes & showers of hay, grain & fish) & of the possibility of species having survived for

(Lyell) short periods at intermediate spots, & considering our knowledge of the
a after ends, becoming extinct there;
great changes, which have taken place from subsidence & elevation in
the surface of the earth, & of our ignorance of the greater changes
which may have taken place; we ought to be very slow in admitting
the probability of double creations. In the case of plants on mountain-
-summits, I think, I have shown how almost necessarily they would under-
go past conditions of the northern hemisphere, be as similar, as are
the plants on the present arctic shores; & this ought to teach us a lesson of
caution.] [But the strongest argument against double creation may
be drawn from considering the case of mammifers, in which from their
nature & from the size of their offspring, the means of distribution are
more in view. There are no cases, where the same species is found
in very remote localities, except where there is a continuous belt of
land: the arctic region perhaps offers the strongest exceptions, & here we
(many authors) know that animals are transported on icebergs. The cases of lesser
difficulty, may all receive a more or less simple explanation; I will give
only one instance; the nutria, Helicus, on the Eastern coast of
S. America lives exclusively in fresh-water rivers, & I was much surprised
how they could have got into rivulets, widely apart, on the coast of Patagonia;
but on the opposite coast, I found these quadrupeds living exclusively in

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the sea; & hence their migration along the Patagonian coast is not surprising. There is no case of the same mammifer being found on an island far from the coast & on the mainland, as happens with plants, on the idea of double creation, it would be strange, if the same species of several plants should have been created in Australia & Europe, & no one instance of the same species of mammifer having been created, or aboriginally existing in two as nearly remote & equally isolated points. It is more philosophical, in such cases, as that of the same plants being found in Australia & Europe, to admit that we are ignorant of the means of transport. I will allude only to one other case, namely that of the Mydas, an alpine animal, found only on the distant peaks of the mountains of Java: who will pretend to deny that during the ice-period of the northern & southern hemisphere, & when India is believed to have been colder, the climate might not have permitted this animal to haunt a lower country, & thus have passed along the ridges from summit to summit.? Mr Lyell, has further observed, that, as in space, so in time, there is no reason to believe that after the extinction of a species, the self-same form has ever reappeared. I think then, we may, notwithstanding the many cases of difficulty, conclude with some confidence, that every species has been created

Where it is found besides Java?

not clear

what does area mean

or produced on a single point, or rather area.

(On the number of species, & of the clases to which they belong, in different regions. to p. 140)

The last fact in geographical distribution, which, as far as I can see, anyway concerns the origin of species, relates to the absolute number, & nature of the organic beings, inhabiting different tracts of land. Although every species is (more or less) adapted (but not necessarily better adapted than every other species, as we have seen in the great increase of introduced species) to the country & station, it frequents; yet it has been shown that the entire difference between of the species in distant countries, cannot possibly be explained by the difference of the physical condition of these countries. In the same manner, I believe, neither the number of the species, nor the nature of the great classes to which they belong, can possibly in all cases be explained by the conditions of their country. New Zealand, a linear island, stretching over about 700 miles of latitude, with forests, marshes, plains, & mountains reaching to the limits of perpetual snow, has far more diversified habitats than an equal area at the Cape of Good Hope; & yet I believe in the C. of Good Hope an area there are, of (as in N. Zealand.) Phanerogamic plants, from five to ten times the number of species. Why, on the theory of absolute creations, should this large & diversified island only have from 400 to 500 (? Dieffenbach) phanerogamic

plants? & why should the Cape of Good Hope, characterized by the uniformity of its scenery, swarm with more species of plants, than probably any other quarter of the world? Why on the ordinary theory should the Galapagos islands abound with terrestrial Reptiles, & why should many equal-sized islands in the Pacific, be without a single one, or with only one or two species? Why should the great islands of New Zealand, be without one mammiferous quadruped, except the mouse, & that probably introduced with the aborigines? Why should not our island (it can be shown, I think, that the mammals of Mauritius & St. Jago have all been introduced) in the open ocean, possess a mammiferous quadruped? Let it not be said that quadrupeds cannot live in islands; for we know that cattle, horses, & pigs, during a long period, have run wild in the West Indian & Falkland islands; goats & pigs at Juan Fernandez - Pigs & Cats at N. Zealand - pigs at St Helena; goats at Tahiti; asses in the Canary Islands; dogs in Cuba; cats at Ascension; Rabbits at Madeira & the Falklands; monkeys at St Jago & the Mauritius; even Elephants during a long time in one of the very small Sooloo islands; & European mice on very many of the smallest islands, far from the habitations of man. Nor let it be assumed that quadrupeds are more slowly created, than that the oceanic islands, which are generally of volcanic formation

are of too recent origin to possess them; for we know that new forms

of quadrupeds succeed each other quicker than Mollusca or
(Sclat)
Reptilia. Nor let it be assumed, (though such an assumption
would be no explanation) that quadrupeds cannot be created on
small islands; for islands not lying in mid-ocean do possess their
peculiar quadrupeds; thus many of the smaller islands of the
East Indian Archipelago possess quadrupeds; as does Fernando
Po on the west coast of Africa; as the Falkland Islands possess
a peculiar wolf-like fox; so does the Galapagos islands, a pe-
-culiar mouse of the S. American type. These two last are
the most remarkable cases, with which I am acquainted, in as
much as the islands lie further from other land. It is possible
that the Galapagos mouse may have been introduced in some
ship from the S. American coast, (though the species is at
present unknown there) for the aboriginal species soon
(Dr Richardson)
haunt the goods of man as I noticed in the roof of a newly
erected shed in a desert country, south of the Plata. The
Falkland Islands, though between 200 & 300 miles from the S. Amer.
coast, may in one sense be considered as intimately connected with it; for
it is certain, that formerly many icebergs, loaded with boulders, were stranded

on its southern coast, & the Ococnors which are occasionally now

stranded, show that the currents from Tierra del Fuego. This fact,

however, does not explain the presence of the Canis antarcticus

on the Falkland Island, unless we suppose that it formerly

lived on the main-land & became extinct there, but survived

on these islands, to which it was borne (as happens with its

northern congeners, the common wolf) on an iceberg; but this fact.

removes the anomoly of an island, in appearance especially sep-

-arated from other land, having its own species of quadruped, &

makes the case like that of Java & Sumatra, each having their

own Rhinoceros.] [Before summingup all the facts, given in this

section on the present distribution of organic beings, & endeavouring

How Hooked seeds!

to see how far they admit of explanation, it will be convenient to

state all such facts in the past geographical distribution of extinct

beings, as seem to concern the theory of descent.

Section second:- Geographical distribution of extinct organisms.

(p. 151.

I have stated that if the land of the entire world be divided into

(we will say) three sections, according to the amount of difference

apleiva nicht varying in vars of a species in Indica -
Blumea American Gs in America - Europa u Europe

of the terrestrial mammifers inhabiting them, we shall have

three unequal divisions of (1st.) Australia & its dependent islands. (2d.) South America, (3.) Europe, Asia & Africa. If we now look to the mammifers, which inhabited these three divisions during the later Tertiary period, we shall find them almost as distinct as at the present day, & intimately related, to the existing forms in that division.

(NW) in each division. This is wonderfully the case with the several fossil Marsupial genera in the caverns of New South Wales; & even more wonderfully so in South America, where we have the same peculiar group of monkeys, of a guanaco-like animal, of many rodents, of the marsupial Didelphys, of Armadillos & other Edentata. This last family is at present very characteristic of S. America, & in a late Tertiary epoch, it was even more so, as shown by the numerous enormous animals of the Megatheroid family, some of which were protected by an osseous armour like that, but on a gigantic scale, of the recent Armadillo. Lastly over Europe, the remains of the several deer, oxen, Bears, Foxes, Beavers, field-mice, show a relation to the present inhabitants of this region; & the contemporaneous remains of the Elephant, Rhinoceros, Hippotamus, Hyæna, show a relation with the grand Africo-Asiatic

division of the world. In Asia the fossil mammifers of the Himalaya,
(though mingled with forms long extinct in Europe) are equally related
to the existing forms of the Africo-asiatic division; but especially to
those of India itself. As the gigantic & now extinct quadrupeds of Europe
have naturally excited more attention than the other & smaller remains,
the relation, between the past & present mammiferous inhabitants
of Europe has not been sufficiently attended to. But in fact the mammifers of
Europe are at present, nearly as much Africo-Asiatic, as they were
when Europe had its elephants & Rhinoceroses &c:
formerly: Europe neither now nor then possessed peculiar groups
as does Australia & S. America. The extinction of certain peculiar
forms in one quarter, does not make the remaining mammifers of that
quarter, less related to its own great division of the world: Though Tierra
del Fuego possesses only a fox, three Rodents, & the Guanaco; no one
(as these all belong to South American types; but not to the most
characteristic forms) would doubt for one minute classifying this
district with S. America; if fossil Edentata, Marsupials & Monkeys
were to be found in T. del. Fuego, it wd not make this district more
than it now is.
truly S. American. So is it with Europe, & as far as is known with Asia,
for the lately past & present mammifers, all belong to the Africo-Asiatic
division of the world. In every case, I may add, the forms which a

country has, is of more importance in geographical arrangement,
than what it has not.

We find some evidence of the same general fact, in the relation
between the recent & Tertiary sea-shells in different main divisions of the
marine world. Upon plant. Dusmanian.

This general & most remarkable relation, between the lately-past
& present mammiferous inhabitants of the three main divisions
of the World, is precisely the same kind of fact, as the common rela-
tion between the species of the several different sub-regions in which the species, are
not identical, of any one of these main divisions. As we usually
associate great physical changes in the total extinction of our
with
series of beings, & its succession by another series, this identity of
relation between the past & present races of beings in the same quar-
ters of the globe, is more striking, than the same relation between ex-
isting beings in different sub-regions: but in truth we have no reason
for supposing that a change in the conditions has in any of these cases
supervened, greater than that, now existing between the temperate &
tropical, or between the high-lands & low-lands of the same main
under extinction
divisions, now tenanted by related beings. Finally then we clearly
see, that in each main division of the world, the same relation holds

good between its inhabitants, in time as over space.]

Changes in geographical distribution b. p. 147.

[If, however, we look closer we shall find that even Australia, in possessing a terrestrial Pachyderm, was so far less distinct from the rest of the world, than it now is; so was S. America, in possessing the Mastodon, Horse, Hyæna, & Antelope. — N. America, as I have remarked, is now in its Mammifers in some respects neutral ground between S. America & the great Africo-Asiatic division; formerly possessing the horse & mastodon, (mastodon & three Megatherioid animals, it was more nearly related to S. America; but in the Horse) & likewise in having the Elephant, oxen, sheep, & pigs, it was as much, if not more, related to the Africo-asiatic division. — Again northern India was much more closely related (in having the Giraffe, hippotamus, and certain Musk-deer) to southern Africa, than it now is; for Southern & Eastern Africa deserves, if we divide the world into five parts, to make one division by itself. Still considering mammifers, if we Turning turn to the dawn of the Tertiary period, we must, from our ignorance of other portions of the world, confine ourself to Europe; & at that period, in the presence of Marsupials & Edentata, we behold an entire blending of those forms, which now eminently characterize Australia & S. America.

If we now look at the distribution of sea-shells, we find the same

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changes in distribution
variations in range. The Red Sea & the Mediterranean, & the Eastern &

western sides of S. America were more nearly related than they now
northern shells

are. In different parts of Europe, (on the other hand,) during the Miocene period, the sea
A

shells seem to have been more different than at present. In the Tertiary

period, according to Lyell, the shells of N. America & Europe were

less related than at present, & during the Cretaceous still less like;

whereas during this same Cretaceous period, the shells of India &
(calc. this conclusion)
Than at present.)

Europe were more like. But going further back to the Carboniferous

period, in N. America & Europe, the productions were much more

like than they now are. These facts harmonise with the conclusions,

drawn from the present distribution of organic beings, for we have seen,

that from species being created in different points or areas, the formation

of a barrier would cause or make two distinct geographical areas;

& the destruction of a barrier, would permit their diffusion. And as

long geological changes, must both destroy & make barriers, we might
-continued

expect, the further we looked backwards, the more changed should

we find the present distribution. This conclusion is worthy of atten-

tion; because, finding in widely different parts of the same main

division of the world, & in volcanic islands formed near it, groups
them,

of distinct, but related, species; - and finding that a singularly analogous

relation holds good with respect to the beings of past times, when none of the present species were living, a person might be tempted to believe in some mystical relation between certain areas of the world, & the production of certain organic forms; but we now see, that such an assumption would have to be complicated by the admission, that such a relation, though holding good for long revolutions of years, is not truly persistent.

I will only add one more observation to this section: Geologists finding in the most remote period, with which we are acquainted, namely in the Silurian period, that the shells & other marine productions, in N. (& South?) America, in Europe, southern Africa & Western Asia, are much more similar, than they now are at these distant points, appear to have imagined that in these ancient times, the laws of geographical distribution were quite different, than what they now are: but we have only to suppose that great continents were extended East & West, thus did not divide the inhabitants of the temperate & tropical seas, as the continents now do; & it would then become probable that the inhabitants of the seas would be much more similar than they now are. In the immense space of ocean, extending from the East coast of Africa to the eastern islands of the Pacific, which space is connected either by lines of tropical coast, or by islands not very distant from each other, we

know (Cuming) that many shells, perhaps even as many as 200, are common to the Zanzibar Coast, the Philippines, & the eastern islands of the Low or Dangerous Archipelago in the Pacific. This space equals that from the Arctic to the Antarctic Pole!— Pass over the space of quite open ocean, from the Dangerous Archipelago to the West Coast of S. America, & every shell is different: pass over the narrow space of S. America, to its eastern shores, & again every shell is different! Many fish, I may add, are also common to the Pacific & & Indian oceans.

Summary on the distribution of living & extinct organic beings. to p. 151.

Let us sum up the several facts, now given in the past & present with respect to geographical distribution of organic beings. In a previous chapter, by universal catastrophes, & it was shown, that species are not ~~universally~~ exterminated ~~from~~ slowly produced: we ~~now~~ see, also, that each species is probably only once produced, on one point or area; & that each diffuses itself, as far as barriers & its conditions of life permit. If we look at any one main division of the land, we find in the different parts, whether exposed to different conditions, or to the same conditions, ~~if~~ ~~separated by barriers, wide spaces fully tenanted by other organisms being a sufficient barrier~~ many groups of species, wholly or nearly distinct as species, nevertheless intimately related. We find

the inhabitants of islands, though distinct as species, similarly related to the inhabitants of the nearest continent: we find in some cases, that even the different islands of one such group, are inhabited by species distinct, though intimately related one to another, & to those of the nearest continent;- thus typifying the distribution of organic beings over the whole world. We find the Floras of mountain summits, either very similar (which admit, as shown, of a simple explanation) or very distinct but related to the Floras of the surrounding region; & in this case, the Floras of two mountain-summits, although exposed to closely similar conditions, will be very different. On the mountain-summits of islands, characterized by peculiar Faunas, the plants are often eminently peculiar. The dissimilarity of the organic beings inhabiting nearly similar countries, is best seen, by comparing the main divisions of the world; in each of which, some districts may be found very similarly exposed, yet the inhabitants are wholly unlike; far more unlike than those in very dissimilar districts in the same main division. We see this striking-ly, in comparing two volcanic archipelagoes, with nearly the same climate, but situated not very far from two different continents; in which case, their inhabitants are totally unlike. In the different main divisions of the world, the amount of difference between the organisms, even in the same class,

is widely different; ~~in some families~~ each main division has only ~~distinct~~ species, ~~in others quite distinct genera~~. The distribution of aquatic

distinct in some families, in other families having the genera distinct.

organisms, is very different from that of the terrestrial organisms; unnecessarily so, from the barriers to their progress, being quite unlike. The nature of the conditions in an isolated district, will not explain the number of species inhabiting it; nor the absence of one class, or the presence of another class. We find that terrestrial mammifers are not present on islands far removed from other land. We see in two regions, that the species though distinct are more or less related, according to the greater or less possibility of the transportal in past & present times of species from one to the other region; although we cannot admit that all the actual species have been transported from the first to the second region, & since have become extinct in the in such cases first: we see this law, in the presence of the fox on the Falkland Islands; in the European character of some of the plants of Tierra del Fuego; in the Indio-asiatic character of the plants of the Pacific; in the circumstance of these genera, which range widest, having many species with wide ranges; & those genera with restricted ranges having species with restricted ranges. Finally, we find in each of the main divisions of the land, & probably of the sea, that the existing organisms

are related to those ~~lastest~~ lately extinct. Looking further backwards we see that the past geographical distribution of organic brings was different from the present; & indeed considering that geology shows that all our land was once under water, & that where water now extends, land is forming, this could hardly have been possible. [Now these several facts, though evidently all more or less connected together, must by the creationist (though the geologist may explain some of the anomalies) be considered as so many ultimate facts. He can only say that it so pleased the Creator, that the organic brings of the plains, deserts, mountains, tropical & temperate forests of S. America, should all have some affinity together; that the inhabitants of the Galapagos archipelago should be related to those of Chile; & that some of the species on the similarly constituted islands of this archipelago, though most closely related, should be distinct; that all its inhabitants should be totally unlike those of the similarly volcanic & arid Cape de Verd & Canary Islands; - that the plants of the summit of Teneriffe should be eminently peculiar; - that the diversified isl. of New Zealand should have not many plants, & not one, or only one, mammifer; that the mammifers of S. America, Australia & Europe should be clearly related to their ancient + exterminated prototypes; and so on with other facts. But it is absolutely

opposed to every analogy, drawn from the laws imposed by the Creator on inorganic matter, that facts, when connected, should be considered as ultimate, & not the direct consequences of more general laws.

Section, Third. An attempt to explain the foregoing laws of geographical distribution, on the theory of allied species having a common descent. (to p. 168.)

(Could This be worked up as a summary of the last chapter?)

First let us recall the circumstances most favourable for variation under domestication, as given in the First Chapter;- viz (1st) a change, or repeated changes, in the conditions to which the organism has been exposed, continued through several terminal (i.e. not by buds or division) generations; 2d Steady selection of the slight varieties, thus generated, tending towards some form or end in view: 3, isolation, as perfect as possible, of such selected varieties; that is, the preventing their crossing with other forms. This latter condition applies to all terrestrial animals, to most, if not all plants, & perhaps even to most (or all) aquatic organisms. It will be convenient, here, to show the advantage of isolation, in the formation of a new breed, by comparing the progress of two persons (to neither of whom, let time be any consequence), endeavouring to select & form some very peculiar, new breed: let one of these persons work on the vast area of

This agrees with CD's MS p 116

DD

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cattle on the plains of La Plata, & the other on a small stock of 20 or 30 animals, in an island. The latter might have to wait centuries (by the hypothesis of no importance) before he obtained a "sport" approaching to what he wanted; but when he did, & saved the greater number of his offspring, their offspring again, he might hope that his whole little stock would be in some degree affected, so that by continued selection, he might gain his end. (to his desired form,

But on the Pampas, though the man might get his first approach sooner, how hopeless would it be, to attempt by saving its offspring amongst so many of the common kind, to affect the whole herd: the effect of this one peculiar "sport", wd be quite lost, before he could obtain a second original "sport" of the same kind. If, however, he could separate a small number including of cattle, with the offspring of the desirable "sport", he might hope, like the man on the isd, to effect his end. If there be organic beings, of which two individuals never unite, then simple selection, whether or continuent or island, would be equally serviceable to make a new & desirable breed; & this new breed might be made, (in surprisingly few years,) from the great & geometrical powers of propagation, in surprisingly few years to beat out the old breed; as has happened (notwithstanding crossing) where good breeds of dogs & pigs have been introduced into a limited country, - for instance into the islands of the Pacific.

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Let us now take the simplest natural case, of an islet uplifted by the volcanic or subterranean forces in a deep sea, at such a distance from other lands, that only a few organic beings, at rare intervals, were transported to it, whether borne by the sea (like the seeds of plants to coral-reefs) or by hurricanes, or by floods or on rafts, or in roots of large trees, or the germs of one plant or animal attached to or in the stomach of some other animal, or by the intervention (in most cases the most probable means) of other islands, once sunk or destroyed. It may be remarked, that when one part of the earth's crust is raised, it is probably the general rule, that another part sinks. Let this island go on slowly, century after century, rising foot by foot; & in the course of time we shall have, instead a small mass of rock, lowland & high-land, moist woods, & dry, sandy spots, various soils, marshes, streams & pools: under water, on the sea shore, instead of a rocky steeply shelving coast, we shall have bays in some parts, with mud, sandy-beaches, & rocky shoals. The formation itself of the island must often slightly affect the surrounding climate. It is impossible that the first few transported organisms could be perfectly adapted to all these stations; and it will be a chance, if those successively transported will be so adapted. The greater number would probably come from the lowlands of the nearest country; & not even all these would be perfectly adapted to the new islet whilst

if continued

low, & exposed to coast-influences. Moreover, as it is certain, that all organ-

-isms are nearly as much adapted, in their structure, to the other in-

-habitants of their country, as they are to its physical conditions; so the

more fact, that a few beings (& these taken in great degree by

chance) were in the first case transported to the islet, would in itself

greatly modify their conditions. As the island continued rising, we might

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also, expect an occasional new visitant; I repeat that even one new

bring must often affect, beyond our calculation, by occupying the room

& taking part of the subsistance of another (& this again, from another

& so on), several or many other organisms. Now as the first transported &

any occasional successive visitants, spread or tended to spread over the

growing island, they would undoubtedly be exposed, through several

generations, to new & varying conditions: it might, also, easily happen

that some of the species, on an average, might obtain an increase

of food, or food of a more nourishing quality. — According then to every

analogy, with what we have seen takes place in every country with nearly

every organic being under domestication, we might expect that some

of the inhabitants of the island would "sport," or have their organization

rendered in some degree

plastic. As the the number of the inhabitants are supposed to be few,

& as all these cannot be so well adapted to their new & varying conditions,

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as they were in their native country & habitat; we cannot believe that
every place or office in the economy of nature is (the island, could be as)
well filled, as on a continent where the number of aboriginal species is far greater,
& where they consequently hold a more strictly limited place. against
a far severer struggle. We might therefore expect on our island, that
although very many, slight variations, were of no use to the plastic
individuals, yet that occasionally, in the course of a century, (an individual)
might be born, of which the structure or constitution in some slight
degree would tend to allow it better to fill up some office in the
insular economy, & to struggle against other species. If such
were the case, the individual & its offspring would have a better
chance of surviving, & beating out its parent form; & if (as is likely)
it, & its offspring, crossed with the common parent form, yet the
number of the individuals being not very great, there would be a
better chance of the new & more serviceable form being (new shelf)
slight degree preserved. The struggle for existance would go on (annually)
selecting such individuals, until a new race or species was formed.

Either few or all the first visitants to the island, might become modified according as the physical conditions of the island, & those resulting from the kind & number of other transported species, were

different ~~& continued varying~~ from those of the parent-country,- according to the difficulties offered to fresh immigration,— & according to the length of time, since the first inhabitants were introduced. It is obvious, that whatever was the country, generally the nearest, from which the first tenants were transported, they would show an affinity, even if all had become modified, to the natives of that country. Thus On this view, we can at once understand the cause & meaning of the affinity of the Flora Fauna of the Galapagos islands, with that of the coast of S. America; & consequently, why the inhabitants of these islands, show not the smallest affinity with those, inhabiting other volcanic islands, with a very similar climate, near the coast of Africa. ~~Instances of the first in the~~ To return once again to our island, if by the continued action of sub-aerial forces, other neighbouring islands were formed, these would generally be stocked by the inhabitants of the first island, or by a few immigrants from the neighbouring main-land; but if considerable obstacles were opposed to any communication between the terrestrial productions of these islands, & their conditions were different, (perhaps only by the number of different species on each island) a form transported from one island to another, might become altered, in the same manner as one from the continent; & we should have several of the islands tenanted

by representative races or species, as is so wonderfully the case

with the different islands of the Galapagos archipelago. As the

islands became mountainous, if mountain-species were not intro-

-duced, as would rarely happen, a greater amount of variation & se-

-lection would be requisite to adapt the species, which originally came

from the lowlands of the nearest continent, to the mountain-summit,

than to the lower districts of our islands; for the lowland species would

have first to struggle against other species & other

conditions, on the ~~mid and slopes of the island & afterwards on the alpine~~

~~summits when formed, & hence~~, we can understand why the Faunas

of insular mountain-summits are, as in the case of Tenneriffe, emin-

-ently peculiar. Putting on one side the case of the Flora

~~Islands species~~ being driven up the mountain summits, during

a change of climate from cold to temperate; we can see, why in other

cases, the floras of mountain summits, (or as I have called them islands

in a sea of land) should be tenanted by peculiar species, but related to

those of the surrounding lowlands, as are the inhabitants of a real island

to the nearest continent.

Let us now consider the effect of a change of climate, or of other

conditions, on a continent & an isolated island, without a change

of level. On a continent the chief effect would be changes in the numerical proportion of the individuals of the different species; for whether the climate became warmer or colder, dryer or damper, more uniform or extreme, some species are at present adapted to its diversified districts; if, for instance, it became cooler, species would migrate from its more temperate parts & from its higher land; if damper, from its damper regions &c. On a small & isolated island, however, with few species, & these not adapted to much diversified conditions, such changes, instead of merely increasing the number of certain species already adapted to such new conditions, & decreasing the number of other species, would be apt to affect the constitutions of some of the insular species: thus if the island became damper, it might well happen that there were no species living in any part fit, adapted to the consequences resulting from more moisture. In this case, therefore, & still more (as we have seen) during the production of new stations from the elevation of the land, an island would be a far more fertile source, as far as we can judge, of new specific forms, than a continent. ~~From such islands~~ These new forms (thus generated on an island, we might expect,) would occasionally (be enable) to emigrate, be transported by, accident, or ~~emigrate~~ through long-continued geographical changes, and thus (slowly) become diffused.

But if we look to the origin of a continent; almost every geologist will admit, that

in most cases, it will have first existed as separate islands, which gradually

increased in size; & therefore, all that which has been said concerning

the probable changes of the forms, tenanting a small archipelago, is

applicable to a continent in its early state. Furthermore a geologist,

who reflects on the geological history of Europe (the only region well

known) will admit, that it has been many times depressed, raised & left

stationary. During the sinking of a continent, & the probable, generally

accompanying, changes of climate, the effect would be little, on the species, except

on their numerical proportions, & the (from the upgrowing of rivers, the origin

of marshes, & the conversion of high-lands, into low &c) extinction of some or many of

the species.

be small. As soon, however, as the continent became divided into many

isolated portions or islands, preventing free immigration from one

part to another, & with considerable changes of climate, the effect

of climatic & other changes

on the species, would be greater. But let the now broken continent,

forming isolated islands, begin to rise, & new stations thus to be formed,

exactly as in the first case of the upheaved volcanic islet; & we shall have

equally favourable conditions for the modification of old forms, that is the

formation of new races or species. Let the islands become reunited into a

continent; & then the new & old forms, would all spread, as far as barriers,

and the means of subsistence, & the pre-occupation of the land by other transported

species, would permit, probably becoming extinct, & some perhaps crossing Some of the new species or races would probably become

& blending together. We should thus have a multitude of forms, adapted would cross

to all kinds of slightly different stations, & diverse groups of either to antagonist or

food-serving species. The oftener these oscillations of level had taken

place (& therefore generally the older the land), the greater the number of species

would tend to be formed. The inhabitants of a continent being thus driven

in the first stage, from the same original parents; & subsequently from the

inhabitants of one wide area, since often broken up & reunited, all would be obvi-

-ously related together, & the inhabitants of the most dissimilar Stations, on the same

continent, would be more closely allied, than the inhabitants of two very similar

Stations on two of the main divisions of the world.

I need hardly point out, that we now can obviously see why the number of species

in two districts, independently of the number of stations afforded by them, in such districts,

should be in some cases, as widely different, as in New Zealand & the

Cape of Good Hope. We can see, knowing the difficulty in the transport

of terrestrial mammals, why islands, far from main-lands, do not poss-

-ess them; we see the general reason, namely accidental transport,

(though not the precise reason), why certain islands should, & others should not,

possess members of the class of Reptiles. We can see, why an ancient

channel of communication between two distant points, as the Cordillera

a former sea point;

probably was between Southern Chile & the United States during the ~~the~~ Tertiary

period; Glaciers between the Falkland Islands & Tierra del Fuego; & galapagos, at a

former or present time, between the Asiatic shores of the Pacific and

in this ocean;

eastern islands, is connected with (or we may now say causes) an affinity be-

tween the species, though distinct, in the two such districts. We can see how

the better chance of diffusion, from several of the species of any genus hav-

ing wide ranges in their own countries, explain the presence of other

species of the same genus in other countries; & on the other hand, of species

of restricted powers of ranging, forming genera with restricted ranges. ~~As~~

[As every one would be surprised, if two exactly similar, but peculiar, varieties

by natural selection

of any species were raised by man, in two different countries, or at two

very different periods, so we ought not to expect that an exactly similar

form could be produced, from the modification of an other one, in two distinct

for in such places & times

countries or at two distinct periods, where or when they would probably be

exposed to somewhat different climates, & almost certainly to different

associates. Hence we can see, why each species appears to have been

produced singly, in space & in time. I need hardly remark, that according

to this theory of descent, there is no necessity of modification in a species,

very rotten! when it reaches a new & isolated country, if it is able to survive, & very slight

variations, are not strictly ~~are not selected~~ better adapted to the new conditions, it might

retain (as far as we can see) its old form for an indefinite time. As we

see, that some subvarieties, produced under domestication, are more va-

-riable than others; so in nature, perhaps, some species & genera are more

variable than others. either in certain countries or over the whole world.

The same precise form, however, would, probably be seldom preserved

through successive geological periods, or in widely & differently con-

-ditioned countries.

Finally, during the long periods of time & oscillations of level, necessa-

-ary for the formation of a continent, we may conclude (as above

explained), that many forms would become extinct. These extinct forms

& those surviving (either ~~not~~ modified), will all be related together in

each continent, in the same manner & degree, as are the inhabitants of

any two different sub-regions in that same continent. I do not mean to

say that the present Marsupials of Australia, or Edentata & Rodents, for instance,

of S. America, have descended from any one of the few fossils of the

same or allied, which have been discovered in these countries. It is

possible, that, in a very few instances, this may be the case; but gener-

-ally they must be considered as merely co-descendants of common stocks:

~~that the present species are direct descendants of those found there,~~

I believe this, from the improbability, considering the vast number of

in this,

species, which (as explained in the last Chapter) must by our theory have existed, that the comparatively few fossils which have been found, should be the immediate & linear progenitors of those now existing. Recent as the fossil mammifers of S. America are, who will presume to say, that very many intermediate forms may not have existed? Moreover we shall see in the ensuing chapter, that the very existence of genera & species can be explained, only by a few species of each epoch leaving modified successors to a future period; & the more distant that future period, the fewer will be the linear heirs of the epoch. As by our theory, all mammifers must have descended from the same parent stock, so it necessary, that each land now possessing terrestrial mammifers, shall at some time have been so far united to other land, as to permit the passage of mammifers; & it accords with this necessity, that in looking far back into the earth's history, we find, first changes in the geographical distribution, & secondly a period, ~~in Europe~~ when the mammiferous forms, most characteristic of two of the present main divisions of the world, were living together.

I think then I am justified in asserting, that ~~also~~ most of the above enumerated, & often trivial points in the geographical distribution of past & present organisms, (which points must be viewed by the

creationist, as so many ultimate facts) follow as a simple consequence

of specific forms being mutable, & being adapted by natural selec-

-tion to diverse ends, conjoined with their powers of dispersal, and the

geologico-geographical changes, now in slow progress & which undoubted-

-ly have taken place. This large class of facts being thus explained, far more

than counterbalances many separate difficulties & apparent objections, in

convincing my mind of the truth of this theory of common descent.

Improbability of finding fossil forms, intermediate between existing species. to p. 168.

There is one observation of considerable importance that may be here introduced, with regard to the improbability of the chief transitional forms between

any two species being found fossil. With respect to the finer shades of

transition, I have before remarked, that no one has any cause to expect

to trace them in a fossil state, without he be bold enough to imagine,

that geologists at future epoch will be able to trace from fossil bones,

the gradations between the Short-Horns, Herefordshire & Alderneybreed

of cattle. I have attempted to show that rising islands, in process of for-

-mation, must be the best nurseries of new specific forms; & these

points are the least favourable for the embedment of fossils. I

, as evidence,

appeal to the state of the numerous scattered islands in the several

great oceans: how rarely do any sedimentary deposits occur on them;

& when present, they are mere narrow fringes of no great antiquity,

which the sea is generally wearing away & destroying. The causes of this, lies, in isolated islands being generally volcanic & consequently rising points; & the effects of subterranean elevation is to bring up the surrounding newly-deposited strata within the destroying action of the coast-waves: the strata, deposited at greater distances & therefore in the depths of the ocean, will be almost barren of organic remains. These remarks may be generalized;- periods of subsidence will always be most favourable to an accumulation of great thicknesses of strata, & consequently to their long preservation; for without one formation be protected by successive strata, it will seldom be preserved to a distant age, owing to the enormous amount of denudation, which seems to be a general contingent of time. I may refer, as evidence of this remark, to the vast amount of subsidence, evident in the great pile of the European formations, from the Silurian epoch to the end of the Secondary, & perhaps to even a later period. Periods of elevation, on the other hand, cannot be favourable to the accumulation of strata & their preservation to distant ages, from the circumstance just alluded to, viz, of elevation tending to bring to the surface the circumlittoral strata (always abounding most in fossils) & destroying them. The bottom of tracts of deep water (little favourable, however, to life) must be excepted from

this unfavourable influence of elevation. In the quite open oceans prob-
-ably no sediment is accumulating, or at a rate so slow as not to preserve
fossil remains, which will always be subject to disintegration. Caverns,
no doubt, will be equally likely to preserve terrestrial fossils in periods
of elevation & of subsidence; but, whether it be owing to the enormous
amount of denudation, which all land seems to have undergone, no cavern
with fossil bones, has been found belonging to the Secondary periods.

Hence many more remains will be preserved to a distant age, in any region
of the world, during periods of its subsidence, than of its elevation.
But during the subsidence of a tract of land, its inhabitants (as before
shown) will, from the decrease of space & of the diversity of its stations, &
from the land being fully preoccupied by species fitted to diversify & mean
of subsistance, be little liable to modification from selection, although
many may, or rather must, become extinct. With respect to its circum-marine
inhabitants, although during the change from a continent to a great
archipelago, the number of stations fitted for marine beings, will be in-
-creased, their means of diffusion (an important check to change of form) will
be greatly improved; for a continent stretching North & South, or a quite
open space of ocean, seems to be to them the only barrier. On the other
hand, during the elevation of a small archipelago & its conversion into a

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continent, we have, whilst the number of stations are increasing both for aquatic & terrestrial productions, & whilst these stations are not fully pro-=occupied by perfectly adapted species, the most favourable conditions for the selection of new specific forms; but few of them in their early transi-=tional states will be preserved to a distant epoch, for we must wait during an enormous lapse of time, until long-continued subsidence shall have ta-=ken the place of elevation in this quarter of the world for the best condition of the elevatory proces, of embedment & preservation of its inhabitants. Generally the great mass of the strata in every country, from having been chiefly accumulated during subsidence, will be the tomb not of transitional forms, but of those either becom-=ing extinct or remaining unmodified.

The state of our knowledge & the slowness of the changes of level, do not per-=mit us to test the truth of these remarks, by observing whether there are more transitional or "fine" (as naturalists would term them) species, on a rising & enlarging tract of land, than on an area of subsidence. Nor do I know whether there are more "fine" species, on isolated volcanic islands in process of formation, than on a continent; but I may remark, that at the Galapagos Archipelago, the number of forms, which according to some naturalists are true species, & according to others are mere races, is con-=siderable: this particularly applies to the different species or races of

(a) It is scarcely applicable to treatment: groups of aquatic, & vegetation feeders & carnivorous or mixed
search each other; but only as it is. So with plants = and artificial classification than accounted for.
Most at here enter in detail,

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the same genera, inhabiting the different islands of this archipelago.

Furthermore it may be added, (as bearing on the general facts discussed in this chapter) that when naturalists confine their attention to any one country, they have comparatively little difficulty in determining what forms to call species, & what to call varieties; that is, those, which or cannot can be traced or shown to be probably descendants of some other form: but the difficulty begins, & increases, as species are brought from many stations, countries, & islands. It was this increasing, (but I believe in few cases insuperable) difficulty, which seems chiefly to have urged Lamarck to the conclusion, that species are mutable.

Chapter XV VII

On the nature of the affinities & classification of organic beings. (to p. 185.)

It has been observed from the earliest times, that organic beings fall into groups, & these groups into others of several values, such as species into genera, these into sub-families, into families, orders, &c. The same fact holds with those

The doctrine of descent alone present it being remarkable, (a)
beings, which no longer exist. Groups of species seem to follow the same laws

Gradual appearance and disappearance of groups. to p. 169.

This does not come in with them, yet perhaps must come in: title origin of genera explained.
in their appearance & extinction, as do the individuals of any one species:

We have reason to believe that, first, a few species appear, that their

numbers increase; & that, when tending to extinction, that the numbers of species

decrease, till finally the group becomes extinct, in the same way as a species becomes extinct, by the individuals becoming rarer & rarer.

Moreover, groups, like the individuals of a species, appear to become extinct at different times, in different countries. The Palæotherium was extinct much sooner in Europe, than in India:- the Trigonia was extinct in early ages in Europe, but now lives in the seas of Australia. As it happens that one species of a family will endure for a much longer period than another species; so we find that some whole groups, such as mollusca, tend to retain their forms, or to remain persistent, for longer periods, than other groups, for instance than the mammalia.- Groups, therefore, in their appearance, extinction, & rate of change or succession, seem to follow nearly the same laws with individuals of a species.

What is the Natural System. } to p. 173.

The proper arrangement of species into groups, according to the natural system, is the object of all naturalists; but scarcely two naturalists will give the same answer to the question What is the natural system? How are we to recognize it? The most important characters, it might be thought, (as it was by the earliest classifiers) ought to be drawn, from those parts of the structure, which determine its habits & place in the Economy of nature,

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which we may call the final end of its existence. But nothing is far-
-ther from the truth than this; how much external resemblance there is
between the little Otter (Chironectes) of Guiana, & the common Otter; or
again between the common swallow & the Swift; & who can doubt that the
means & ends of their existence are closely similar; yet how grossly wrong
would be the classification, which put close to each other a marsupial
& placental animal, & two birds with widely different skeletons. Relations,
such as in that ~~that~~ in the two latter cases, or as that between the whale & fishes, are de-
-nominated "analogical"; or are sometimes described as "~~adaptive~~ relation & adaption".
They are infinitely numerous, & often very singular; but are of no use in the
classification of the higher groups. How it comes, that certain parts of the struc-
-ture, by which the habits & ~~places~~ functions of the species are settled, are of no use in
classification, whilst other parts, formed at the same time, are of the greatest,
it would be difficult to say, on the theory of separate creations.]

[Some authors, as Lamarck, Whewell &c. believe that the degree of affinity on the
natural System, depends on the degrees of resemblance in organs, more or less
physiologically important for the preservation of life. This scale of import-
-ance in the organs, is admitted to be of difficult discovery. But quite inde-
-pendent of this, the proposition, as a general rule, must be rejected as false;
though it may be partially true. For it is universally admitted that the same

part or organ, which is of the highest service in classification in one group,
is of very little use in another group;
in another, though in both groups, as far as we can see, the part or organ is of equal physiological importance.
Moreover, characters, quite unimportant physiologically, such as whether the
covering of the body consists of hair or feathers, whether the nostrils com-
-municate with the mouth &c &c, are of the highest generality in classifica-
tion, even colour, which is so inconstant in many species, will sometimes will
characterize even a whole group of species.- Lastly, the fact that no
one character, is of so much importance in determining to what great group
an organism belongs, as the forms through which the embryo passes from
the germ upwards to maturity, cannot be reconciled with the idea,
that natural classification follows, according to the degrees of resemblance in the
parts of most physiological importance. The affinity of the common rock-
Barnacle with the Crustacean, can hardly be perceived in more than a single
character in its mature state, but whilst young, ~~but whilst young~~, locomotive,
& furnished with eyes, its affinity cannot be mistaken. The cause of the great-
-er value of characters, drawn from the early stages of life, can, as we
shall in a succeeding chapter see, be in a considerable degree explai-
-ned, on the theory of descent, although inexplicable on the views of the
creationist.

Practically, naturalists seem to classify according to the resemblance

of those parts or organs, which in related groups are most uniform, or vary

least: thus the æstivation, or manner in which the petals &c are folded over

each other, is found to afford an unvarying character in most families of plants,

& accordingly any difference in this respect would be sufficient to cause the rejection

(D. Don) of a species from many families; but in the Rubiaceæ the æstivation is a

varying character, & a Botanist would not lay much stress on it, in deciding whether or

not to class a new species in this family. But this rule is obviously so

arbitary a formula, that most naturalists seem to be convinced, that some-

-thing ulterior is represented by the Natural System; they appear to think

that we only discover by such similarities, what the arrangement of the System is, not that such similarities make,

~~that it is only by such similarity, we can discover this System.~~ We can only

thus understand Linnæus's well-known saying, that the characters do not make

the genus; but that the genus gives the characters: for a classification, independent

of characters, is here presupposed. Hence many naturalists have said that the

natural System reveals the plan of the Creator, but without it be specified.

Whether order in time or place, or what else is meant by the plan of the Creator,

such expressions appear to me to leave the question exactly where it was.

Some naturalists consider that the geographical position of a species

may enter into the consideration of the group into which it should be placed;

& most naturalists (either tacitly or openly) give value to the different groups,

not solely by their relative differences in structure, but by the number of

forms included in them. Thus a genus containing a few species might be
has often been, raised into a family on the discovery of several other
species. Many natural families are retained, although most closely
related to other families, from including a great number of closely similar
species. The more logical naturalist, would perhaps, if he could, reject
these two contingents in classification. From these circumstances, and
especially from the undefined objects & criterions of the natural system, the
number of divisions, such as genera, sub-families, families &c &c has
been quite arbitrary; without the clearest definition, how it can be hereafter poss-
-ible to decide whether two groups of species are of equal value, & of what
value? whether they should both be called genera or families; or whether one
should be a genus, & the other a family?

for the difficulty in classifying,
Hence, Linnæus

I discuss this, because if Linnæus true, I false.

on the kind of relation between distinct groups. to p. 175.

I have only one other remark on the affinities of organic beings; that is, when
two quite distinct groups approach each other, the approach is generally generic
& not special; I can explain this, most easily by an example; of all Rodents, the
Bizcacha, by certain peculiarities in its reproductive system, approaches near-
-est to the Marsupials; of all marsupials, the Phascolomys, or other the otherhand,
appears to approach in the form of its stomach & intestines, nearest to the Rodents;
but there is no special relation between these two genera; the Bizcacha is
no nearer related to the Phascolomy than to any other marsupial, in the points

(Waterhouse)

in which it approaches this division; nor again is the Phascolomys, in the points of structure in which it approaches the Rodents, any nearer related to the Bizcacha, than to any other Rodent.— Other examples might been chosen, but I have given (from Waterhouse) this example, as it illustrated another point, namely the difficulty of determining what are analogical or adaptive, & what real affinities;- it seems that the teeth of the Phascolomys, though appearing closely to resemble those of a Rodent, are found to be built on the marsupial type; & it is thought that these teeth & consequently the intestines may have been adapted to the peculiar life of this animal, & therefore may not shew any real relation. The structure in the Bizcacha, that connects it with the marsupials, does not seem a peculiarity related to its manner of life, & I imagine no one would doubt that this shows a real affinity, though not more with any one marsupial species, than with another. The difficulty of determining what relations are real & what analogical, is far from surprising, when no one pretends to define the meaning of the term, relation, or the ulterior object of all classification. We shall immediately see, on the theory of descent, how it comes that there should be "real" & "analogical" affinities; & why the former alone should be of value in classification;- difficulties, which it would be, I believe, impossible to explain on the ordinary theory of separate creations.

Classification of races or varieties. } Let us now for a few minutes, turn to the classification of the generally acknowledg-

=ed varieties & subdivisions of our domestic beings; we shall find them system-

=atically arranged in groups of higher & higher value. Decandolle has treated

the varieties of the Cabbage, exactly as he would have done a natural family,

with various divisions & sub-divisions. In dogs again, we have one main

division, which may be called the family of hounds; of these there are seve-

ral (we will call them) genera, such as Blood-Hounds, Fox-hounds, & Harriers;

of each of these, we have different species, as the blood-hound of Cuba & that

of England; & of the latter even again, we have breeds, truly producing their own kind,

which may be called races or varieties. Here we see a classification,

practically used, which typifies on a lesser scale that, which holds good in

nature. (Both amongst true species in nature.) In the natural system, & amongst domestic races, the number

of divisions or groups, instituted between those most alike (and those most unlike,) seems to

be quite arbitary. The number of the forms in both cases, seems practi-

=cally to (whether or not it ought theoretically) influence the denomination of groups including them. In

both, geographical distribution has sometimes been used as an aid to

classification; amongst varieties, I may instance, the cattle of India or

the Sheep of Siberia, which (from) possessing some characters in common, per-

=mit a classification of Indian & European cattle, or Siberian and

European sheep. Amongst domestic varieties we have seen something

very like the relations of "anarlogy" or "adaption"; thus the Common and
Swedish turnip are both artificial varieties, which strikingly resemble
each other, & they fill nearly the same end in the œconomy of the farm
-yard; but although the Swede so much more resembles a turnip, than its
presumed parent the Field Cabbage, no one thinks of putting it out of the
Cabbages into the Turnips. Thus the Greyhound & Racehorse, having been se-
-lected & trained for extreme fleetness for short distances, present an analo-
-gical resemblance of the same kind, but less striking, as that between the
Little Otter (marsupial) of Guyana & the Common Otter; though these two
others are really less related than is the horse & dog. We are ever cautioned
by authors treating on varieties, to follow the natural, in contradistinction
of an artificial system, that, for instance, to class two varieties of the
(W. Wood)
Pine-Apple near each other, because their fruits accidentally resemble
each other closely (though the fruit may be called the final end of this
plant in the œconomy of its world, the hot house) but to judge from the
general
resemblance of the entire plants. Lastly, varieties often become extinct,
sometimes from unexplained causes, sometimes from accident, but more often
from the production of more useful varieties, & the less useful ones being destroy-
-ed or bred out.

I think it cannot be doubted, that the main cause of all the varieties which have

descended from the aboriginal dog or dogs, or from the aboriginal wild
like or
cabbage, not being equally unlike, but on the contrary, obviously falling
into groups & sub-groups, must in chief part be attributed to different degrees
of true relationship; - for instance, that the different kinds of blood-hounds
have descended from one stock, whilst the harriers have descended from
and
another stock, & that both these have descended from a different stock
from that, which has been the parent of the various kinds of grey-hounds.
We often hear of a florist having some choice variety, & breeding from it a
whole group of sub-varieties, more or less characterized by the peculiarities
of the parent. The case of the Peach & Nectarine, each with their many varieties
might have been introduced. No doubt, the relationship of our different do-
-mestic breeds has been obscured, in an extreme degree, by their crossing;
likewise
& from the slight difference between many breeds, it has probably often
happened, that a "sport" from one breed, has less closely resembled its parent
breed, than some other breed, & has therefore been classed with the latter.
Moreover, the effects of a similar climate may in some cases have more
than counterbalanced the similarity, consequent on a common descent, though
I should think the similarity of the breeds of cattle of India or sheep of Siberia,
was far more probably due to the community of their descent, than to the effects of climate
on animals descended from different stocks.

Notwithstanding these great sources of difficulty, I apprehend every one would admit, that if it were possible, a genealogical classification of our domestic varieties, would be the most satisfactory one; & as far as varieties were concerned, would be the Natural System: (; in some cases it has been followed.) In attempting to follow out this object, a person would have to class a variety, whose parentage he did not know, by its external characters; but he would have a distinct ulterior object in view, namely its descent, in the same manner, as a regular systematist seems also to have an ulterior, but undefined, end in all his classifications. Like the regular systematist, he would not care whether his characters were drawn from more or less important organs, as long as he found in the tribe which he was examining, that the character from such parts were persistent; thus amongst cattle, he does value a character drawn from the form of the horns, more than from the proportions of the limbs & whole body, for he finds that the shape of the horns is (to a considerable degree) persistent amongst cattle, whilst the bones of the limbs & body vary. No doubt, as a frequent rule, the more important the organ, as being less related to external influences, the less liable it is to variation; but he would expect that according to the object, for which the races had been selected, parts more or less important might differ; so that characters drawn from parts, generally most liable to vary, as colour, might in some

(Marshall)

instances be highly serviceable, as is the case. He would admit that general resemblances, scarcely definable by language, might sometimes serve to allocate a species by its nearest Congener. He would be able to assign a clear reason, why the close similarity of the fruit in two varieties of pine-apple, & of the so-called root in the Common & Swedish turnips, & why the similar gracefulness of form in the grey-hound & race-horse, are characters of little value in classification; namely because they are the result, not of community of descent, but either of selection for a common end, or of the effects of similar external conditions.

Classification of "races" a species similar.

Thus seeing that both the classifyer of species, & of varieties, works by the same means, makes similar distinctions in the value of the characters, & meets with similar difficulties, & that both seem to have in their classification, an ulterior object in view; I cannot avoid strongly suspecting that the same cause, which has made amongst our domestic varieties, groups & sub-groups, has made similar groups, (but of higher values) amongst species; & that this cause, is the greater or less propinquity of actual descent. The simple fact of species, both those long since extinct & those now living, being divisible into genera, families, &c/ orders;- divisions analagous to those, into which varieties are divisible, is otherwise an inexplicable fact, & only not so remarkable from its familiarity.

Origin of genera & families. ↳ p. 183

[Let us suppose, for example, that a species spreads & arrives at

six or more different regions, or being already diffused over one wide area, let this area be divided into six distinct regions, exposed to different conditions with stations slightly different, not fully occupied with other species, so that six different races or species were formed by selection, each best fitted to its new habits & station. I may must remark that in every case, if a species becomes modified in any one sub-region, it is probable that it will become modified in some other of the sub-regions over which it is diffused, for its organization is shown to be capable of being rendered plastic; its diffusion proves that it is able to struggle with the other inhabitants of the several sub-regions; & as the organic beings of every great region are in some degree allied, & as the physical conditions are often in some respects alike, we might expect that a modification in structure, which gave our species some advantage over antagonist species in one sub-region, would be followed by other modifications in other of the sub-regions. The races or new species supposed to be formed would be closely related to each other; I would either form a new genus or sub-genus, or would rank (probably forming a slightly different section) in the genus to which the parent species belonged. In the course of ages, & during the contingent physical changes, it is probable that some of the six new species would be destroyed; but

the same advantage, whatever it may have been (whether mere tenacity

to vary, or some peculiarity of organization, power of mind, or means of

distribution) which in the parent-species & in its six selected & changed

species-offspring, caused them to prevail over other antagonist species,

would generally tend to preserve some or many of them for a long period.

If these two or three of the six species were preserved, they in their turn

would, during continued changes, give rise to as many small groups of

species: if the parent species of these small groups, were closely simi-

-lar, the new species would form one great genus, barely perhaps

divisible into two or three sections: but if the parent species were

considerably unlike, their species-offspring would, from inheriting most of the

peculiarities of their parent stocks, form either two or more sub-genera

or (if the course of selection tended in different ways) genera. And last-

-ly species descending from different species of the newly formed first genera, would form new

genera, & such genera collectively would form a family.

The extermination of species will follow from changes in the external con-

-ditions, & from the increase or immigration of more favoured species, &

their modifications: & as species, which are undergoing modification, in any those

one great region (& spread over the world) will very often be allied ones from

(as just explained)

partaking of many characters, & therefore advantages in common; so the species,

, whose pla ce the new or more favoured ones are seizing, from partaking of

a common inferiority (whether in any particular point of structure, or, gen-
-eral powers of mind, of means of distribution, of capacity & of variation &c &c) will apt
to be allied. Consequently species of the same genus will slowly, one after the other,
tend to become rarer & rarer in numbers, & finally extinct; & as each last species
of several allied genera fails, even the family will become extinct. There may
of course be occasional exceptions to the entire destruction of any genus or
family. From what has gone before, we have seen, that the slow & successive
formation of several new species from the same stock, will make a new genus, & the
slow & successive formation of several other new species from another allied stock will
make another genus; if these two stocks were allied, & such genera will make a new family. Now, as far
as our knowledge serves, it is in this slow & gradual manner, that groups of
species appear or & disappear from the face of the earth.

The manner in which, according to our theory, the arrangement of species in
groups is due to partial extinctions, will perhaps be rendered clearer in the
following way. Let us suppose in any one great class, for instance in the
Mammalia,
~~Vertebrata~~ that every species & every variety during each successive age
had left down one unaltered descendant (either fossil or living) to the present
time; we should then have had one enormous series, including 63 small gra-
-dations every known form of the Vertebrata; & consequently the existence of
mammiferous

gaps &c — groups or chasms in the series which in some parts are of greater width & in some

of this is solely due to former species & whole groups of species not hav-

-ing thus sent down descendants to the present time.

With respect to the 'analogical' or 'adaptive' resemblances between

organic beings which are not really related, I will only add that

probably the isolation of different groups of species is an important

production of such characters:
element in their formation: thus we can easily see, that in a large

increasing island, or even continent like Australia, stocked with

only certain orders of the main classes, that the conditions would be

highly favourable for species from these orders to become adapted

to play parts in the economy of nature, which in other countries were performed

by parts.
by tribes especially adapted to such ends. We can understand how it might

happen, that an Otter-like animal in Australia, or in America if at any time

in Australia
excluded only by marsupials, might have been formed by slow selection from the

more carnivorous marsupial types: thus we can understand that curious

case in the southern hemisphere, where there are no Auks, (but many

Petrels) of a Petrel having been modified into the external general

so as
form to play the same office in nature, with the Auks of the northern hem-

-isphere; although the habits & form of the Petrels & Auks, are normally so

wholly different. It follows from our theory, that two orders must have

descended from one common stock at an immensely remote epoch; two-

can perceive, when a species in either order, or in both, shows some

affinity to the other orders, why the affinity is usually generic & not particular

;- that is why, the Viscacha amongst Rodents, in the points in which it is

related to the Marsupial, is related to the whole group, & not particu-

-larly to the Phascolomys, which of all Marsupialia is related most to

the Rodents. For the Viscacha is related to the present Marsupialia, only

from being related to their common parent-stock, as the Phascolomys is

not to any one species in particular.

related to the parent-stock of the Rodents. And generally, it may be observed

in the writings of most naturalists, that when an organism is described as

intermediate between two great groups, its relations are not to particular

species of either group, but to both groups, as wholes. A further reflection

will show how exceptions (as that of the Lepidosiren, a fish closely related

(Owen) to particular reptiles) might occur, namely from a few descendants of

those species, which at a very early period branched out from the common

parent-stock of the two orders or groups, having survived, in nearly their origin-

-al state, to the present time.

What an error!

Finally then we see, that all the leading facts in the affinities & classifica-

-tion of organic beings, can be explained on the theory of the natural System,

being simply a genealogical one. The similarity of the principles in classifying

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between varieties & species both living & extinct, is at once explained;

the rules followed & difficulties met with bring the same. The existence of genera, families, orders &c, & their mutual relations, naturally ensues from extinction going on at all periods, amongst the diverging descendants of a common stock. These terms of affinity, relations, families, adaptive characters &c, which naturalists cannot avoid using, though metaphorically, cease being so, & are full of plain signification.

Chapter VIII

Unity of Type in the Great Classes; and morphological structures.

(to p. 204.)

Unity of Type (to p. 186.)

Scarcely anything is more wonderful, or has been oftener insisted on, than that the organic beings, in each great class, though living in the most distant climes & at periods immensely remote, though fitted to widely different ends in the economy of nature, yet that all, in their internal structure, evince an obvious uniformity. What, for instance, is more wonderful than that, the hand to clasp, the foot or hoof to walk, the Bat's wing to fly, the porpoises fin to swim, should all be built on the same plan? & that the bones in their position & number should be so similar, that they

can all be classed & called by the same names. Occasionally some of the bones are merely represented by an apparently useless, smooth style, or are soldered close to other bones; but the unity is not by this destroyed & hardly rendered less clear. We see in this fact some deep bond of union between the organic beings of the same great class;— to illustrate which is the object & foundation of the Natural System. The perception of this bond, I may add, is the evident cause that naturalists make an ill defined distinction between true & adaptive affinities.

Morphology. } to p. 189.

There is another allied, or rather almost identical, class of facts admitted by and the least visionary naturalists, included under the name of Morphology: These facts show that in an individual organic being, also several of its organs consist of some other organ metamorphosed: thus the sepals, petals, stamens, pistils &c of every plant, can be shown to be metamorphosed leaves, & thus not only the number, position, & transitional states, of these several organs, but likewise their monstrous changes, can be most lucidly explained. It is believed, that the same laws hold good with the (Forbes) gemmiferous vesicles of Zoophytes. In the same manner, the number & position of the extraordinarily complicated jaws & palpi of crustacea & of insects, & likewise their differences in the different groups, all become or rather by the metamorphosed appendages simple, on the view of these parts being metamorphosed legs. The

skulls, again, of the Vertebrata are composed of three metamorphosed vertebra,

& thus we can see a meaning, in the number & strange complication of the bony

case of the brains. In this latter ~~case~~ instance, & in that of the jaws of the Crustacea,

it is only necessary to see a series, taken from different groups of ~~animals~~ each

class, to admit the truth of these views. It is evident, that when in each species

of a group, its organs consist of some other part metamorphosed, that there

must also be a "unity of type" in such a group. And in the cases, as

that above given, in which the foot, hand, wing & paddle are said to be

constructed on a uniform type; if we could perceive in such parts or organs,

traces of an apparent change from some other use or function, we should

strictly include such parts & organs in the department of morphology:

thus, if we could trace in the limbs of the vertebrata, as we can in their

ribs, traces of an apparent change from being processes of the vertebra, it

of the vertebrata,

would be said that in each species the limbs were "metamorphosed spinal

processes", & that in all the species, throughout the class, the limbs displayed

a "unity of type".

These wonderful facts of the hoof, foot, hand, wing, paddle, both in living

& extinct animals, being all constructed on the same framework; — & again

of the petals, stamina, germens &c being metamorphosed leaves, can, by the

creationist, be viewed only as ultimate facts, incapable of explanation.

How quite the saying I own.

Whilst on our theory of descent, these facts all necessarily follow; for by this theory all the livings of any one class, say of the mammalia, are supposed to be descended from one parent-stock, & to have been altered by such slight steps, as man effects by the selection of chance domestic variations. Now we can see, according to this view, that a foot might be altered with longer & longer bones, & wider connecting membranes, till it became a swimming organ, & so on till it became an organ by which to flap along the surface, or to glide over it, & lastly to fly through the air: but in such changes, there would be no tendency to alter the framework of the internal, inherited structure. Parts might become lost (as the tail in dogs, or horns in cattle, or the pistil in flowers) others might become united together, (as in the feet of the Lincolnshire breed of pigs, & in the stamens of many garden flowers); & similar parts might become increased in number (as the vertebræ in the tails of pigs &c &c, & the fingers & toes in six-fingered Stamens & toy plants
races of men & in the Dorking fowls), but analogous differences are deemed variations take place in nature, & are not considered by naturalists to destroy the uniformity of the type. We can, however, conceive such changes to be carried to such length, that the unity of type might be obscured, & finally be unaistinguishable; & the paddle of the Pleiosaurus has been advanced, as an instance, in which, (C. Bell) the uniformity of type can hardly be recognized. If after long & gradual changes, in the structure of the descendants from any parent-stock, evidence

How do you limit the tendency to change? & selecting the parts most to your ends

Good Internal Endowment

(either from monstrosities or from a graduated series) could be still traced

of the function, which certain parts or organs played in the parent-stock,

these parts or organs might be strictly denominated by their former func-

-tion, with the term "metamorphosed" appended. Naturalists have used this

metaphorical
term, in the same manner, as they have been obliged to use the terms of affin-

-ity & relation; ~~metaphorically~~; & when they affirm, for instance, that the jaws

to the crab he has legs & jaws [illegible] than the other.
of a Crab are metamorphosed legs, they are far from meaning that the jaws,

either during the life of the individual Crab or of its progenitors, were really

legs. By our theory this term assumes its literal meaning; & this wonderful

fact of the complex jaws of an animal, retaining numerous characters,

which they would probably have retained, if they had really been meta-

-morphosed during many successive generations from true legs, is

simply explained.

Embryology. } The unity of type in the great classes, is shown in another & very striking
to p. 200. }

manner, namely in the stages, through which the embryo passes in coming

to maturity. Thus, for instance, at one period of the embryo, the wings of

the bat, the hand, hoof, or foot of the quadruped, & the fin of the porpoise,

do not differ, but consist of a simple undivided boar. At a still earlier

period, the embryo of the fish, Bird, Reptile & Mammal all strikingly res-

Dude
-emble each other. Let it not be supposed this resemblance is only

external; for on dissection the arteries are found to branch out & run in a peculiar course, wholly unlike that in the full-grown mammal & Bird, but much less unlike that in the full-grown fish; for they run as if to aërate blood by branchiæ on the neck, of which, even the slit-like orifices can be discerned. How wonderful is it, that the branchiæ should be present in the embryos of animals, about to be developed into such different forms, & of which two great classes of which breath only in the air. Moreover, as the embryo of the mammal is matured in the parents body, & that of the bird in an egg in the air, & that of the fish in an egg in the water, we cannot believe, that this course of the arteries is related to any external conditions. In all shell-fish (Gasteropods) the embryo passes through a state analogous to that of the Pteropodous Mollusca: amongst insects again, even the most different ones, as the moth, fly, & beetle, the crawling larvæ are all closely analogous:

amongst the Radiata, the jelly-fish, in its embryonic state resembles a polyps, & in a still earlier state an infusorial animalcule;—as does likewise the embryo of the Polyps. From the fact of the embryo of a mammal, at one period, resembling a fish more than its parent-form; from the larvæ of all orders of insects, more resembling the simpler Articulate animals, than their parent insect; & from such other causes the embryo of the jelly-fish resembling a polyps, much nearer than a perfect jelly-fish; it has often been asserted, that the higher animal in each

class, passes through the state of a lower animal; for instance that the mammal amongst the vertebrata passes through the state of a fish: but Müller denies this, & affirms that the young mammal is at no time a fish, as does Owen assert that the embryonic jelly-fish, is at no time a polypes, but that mammal & fish, jelly-fish & polyps pass through the same state; the mammal & jelly-fish only being further developed or changed.

As the embryo, in most cases, possesses a less complicated structure, than that into which it is to be developed; it might have been thought that the resemblance of the embryo to less complicated forms in the same great class, was in some manner a necessary preparation for its higher development; but in fact the embryo during its growth, may become less, as well as, more complicated. Thus certain female Epizoic Crustaceans, in their mature state have neither eyes nor any organs of locomotion; they consist of a mere sack, with a simple apparatus for digestion & procreation; when once attached to the body of the fish, on which they prey, they never move again during their whole lives: in their embryonic condition, on the other hand, they are furnished with eyes, & actively swim about with well articulated limbs & seek their proper object to become attached to. The larvæ, also, of some moths are as complicated & more active

than the wingless & limbless females, which never leave their pupa-case,

never feed & never see the daylight.

attempt to explain the facts of Emb^y Resp to p. 200

I think considerable light can be thrown by the theory of descent on these wonderful embryological facts, which are common, in a greater or less degree, to the whole animal kingdom, & in some manner to the vegetable kingdom;—on the fact, for instance, of the arteries in the embryonic mammal, bird, Reptile, & fish, running & branching in the same courses & nearly in the same manner, with those in the full-grown fish; on the fact, I may add, of the high importance to systematic naturalists, of the characters & resemblances in the embryonic State, in ascertaining the true position in the Natural System, of mature organic beings. The following are the considerations which throw light on these curious points.

In the economy, we will say of a feline animal, the feline structure of the embryo of the sucking kitten, is of quite secondary importance to it; hence, if a feline animal varied (assuming for the time the possibility of this) & if some place in the economy of nature favoured the selection of a longer-limbed variety, it would be quite unimportant to the production by natural selection of a long-limbed breed, whether the limbs of the embryo kitten were elongated, if they became so, as soon as the animal had to provide food for itself. And if it were found, after continued selection & the production of several

new breeds from one parent stock, that the successive variations had supervened, not very early in the youth or embryonic life of each breed, (we have just seen, that it is quite unimportant, whether it does so, or not), then it obviously follows that the young or embryos of the several breeds, will continue resembling each other, more closely than their adult parents: And again, if two of these breeds, became each the parent-stock of several other breeds, forming two genera, the young & embryos of these would still retain a greater resemblance to the one original stock, than when in an adult state. Therefore if it could be shown, that the period of the slight successive variations, does not always supervene at a very early period of life, the greater resemblance, or closer unity in type, of animals in the young, than in the full-grown state, would be explained.

Set long hyperm.

Before practically endeavouring to discover, in our domestic races, whether the structure or form of the young, has or has not changed in an exactly corresponding degree, with the changes of full-grown animals, it will be well to show, that it is at least quite possible for the primary germinal vesicle to be impressed with a tendency to produce some change in the growing tissues, which will not be fully effected, till the animal is advanced in life.

Omit [ ] in first part.

[From the following peculiarities of structure being inheritably - namely and appearing only when the animal is full-grown

general size, tallness (not consequent on tallness of the infant) - fatness either over the whole body or local; change of colour in hair &c &c; deposition of bony matter on the legs of horses; blindness & deafness, that is changes of structure in the eye & ear; - gout & consequent deposition of chalk-stones; & many other diseases, as of the heart & brain &c &c, producing ~~organic changes more or less late in life~~, from all such tendencies, I repeat, being inheritable, we clearly see that the germinal vesicle, is impressed with some power which is wonderfully preserved, during the production of infinitely numerous cells in the ever changing tissues, till the part ultimately to be affected is formed, & the time of life arrived at. We see this clearly, when we select cattle with any peculiarity of their horns, or poultry with any peculiarity of their second plumage, for such peculiarities cannot reappear till the animal is mature. Hence it is certainly possible, that the germinal vesicle may be impressed with a tendency to produce a long-limbed animal, the length of whose limbs shall appear only when the animal is mature.

In several of the cases just enumerated, we know that the first cause of the peculiarity, when not inherited, lies in the conditions to which the animal is exposed during mature life; thus to a certain extent, general size & fatness, - lameness in horses, & in a lesser degree blindness, gout

, are certainly in some degree caused & accelerated by the habits of life;

& some other diseases, & these peculiarities, when ~~intensified~~, reappear at
transmitted to the offspring of the affected parent
a nearly corresponding
~~the same~~ time of life. In medical works it is asserted generally, that-

at whatever period an hereditary disease appears in the parent, it
tends to reappear in the offspring at the same period. Again, we find
that
early maturity, the season of reproduction, & longevity, ~~is~~ are transmitted
to corresponding periods of life. Dr. Holland has insisted much on children
of the same family, exhibiting certain diseases in similar & peculiar
manners; my Father has known three brothers die in very old age
in a singular comatose state; now to make these cases strictly
clear, the children of such families ought similarly to suffer at cor-
-responding times of life; this is probably not the case, but such facts
show that a tendency in a disease to appear at particular stages of
life, can be transmitted through the germinal vesicle to different
individuals of the same family. It is possible that diseases, affecting
widely different periods of life, can be transmitted. So little attention
is paid to very young domestic animals, that I do not know whether any
case is on record of selected peculiarities in young animals, for instance
in the first plumage of birds, being transmitted to their young. If however
we turn to silk worms, we find that the caterpillar & cocoon (which
must correspond to very early periods of the embryonic life of mammalia) vary,

& that these variations reappear in the offspring caterpillars & coccoons.

[I think these facts are sufficient to render it probable, that at whatever

period of life any peculiarity (capable of being inherited) appears, whether

or caused by the action of external influences during mature life, or

from an affection of the primary germinal vesicle, it tends to reappear

in the offspring at the corresponding period of life. Hence, (I may add)

whatever effect training, that is the full employment or action of every

newly selected slight variation, has in fully developing & increasing such

variation, would only show itself in mature age, corresponding to the period

of training; in the second chapter, I showed that there was in this respect,

a marked difference in natural & artificial selection, man not re-

gularly exercising or adapting his varieties to new ends, whereas

selection by nature presupposes such exercise & adaptation in

each selected & changed part. The foregoing facts show & presuppose that

slight variations occur at various periods of life after birth; the

facts of monstrosity, on the other hand, show that many changes take place

all such cases as extra fingers,

before birth, for instance, hare-lip & all sudden & great alterations in

appear during the embryonic period in the offspring.

structure; & these, when inherited, I will only add that at a period even an-

terior to embryonic life, namely during the egg-state, that varieties

appear in size & colour (as with the Hertfordshire duck with blackish eggs) which

reappear in the egg; in plants, also, the capsule & membranes of the

seed are very variable & inheritable.

If then, the two following propositions are admitted (& I think the first

can hardly be doubted) viz that variation of structure takes place

at all times of life, though, no doubt, far less in amount & seldom or in

quite mature life (& then generally taking the form of disease); and

secondly, that these variations tend to reappear at a corresponding

period of life, which seems at least probable, then we might a priori,

have expected that in any selected breed, the young animal would

not partake in a corresponding degree the peculiarities characterizing

the full-grown parent; though it would in a lesser degree. For during the

thousand or ten thousand selections of slight increments in the length

of the limbs of individuals necessary to produce a long-limbed breed, we might

expect that such increments would take place in different individuals (as

we do not certainly know at what period they do take place), some earlier &

some later in the embryonic state, & some during early youth; & these

increments would reappear in their offspring only at corresponding periods.

Hence the entire length of limb in the new long-limbed breed, would only

be acquired at the latest period of life, when that one, which was latest

of the thousand primary increments of length, supervened. Consequently

the fœtus of the newborn, during the earlier part of its existence, would remain much less changed in the proportions of its limbs, & the earlier the period, [illegible] existence the less would the change be.

Whatever may be thought of the facts on which this reasoning is ground-ed, it shows how the embryos & young of different species might come to remain less changed, than their mature parents; & practically we find that the young of our domestic animals, though differing, differ less than their full-grown parents. Thus if we look at the young puppies of the Grey-hound & Bull-dog, (the two most obviously modified of the breeds of dog) - we find their puppies, at the age of six days, with legs, & noses (measured from the eyes to the tip) of the same lengths; though in their proportional thicknesses & general appearance there is a great difference. So it is with cattle, though the young calves of different breeds are easily recognizable, yet they do not differ so much in their proportions, as the full grown animals: We see this clearly in the fact, that it shows the highest skill to select the best forms early in life, either in horses, cattle or poultry; no one would attempt it only a few hours after birth; & it requires great discrimination to judge with accuracy even during their full youth, & the best judges are sometimes deceived. This shows that the ultimate proportions of the body are not acquired till near mature

ages. If I had collected sufficient facts to firmly establish the proposition, that in artificially selected breeds, the embryonic & young animals are not changed in a corresponding degree with their mature parents, I might have omitted all the foregoing reasoning, & the attempts to explain how this happens; for we might safely have transferred the proposition to the breeds or species naturally selected; and the ultimate effect would necessarily have been, that in a number of races or species descended from a common stock, & forming several genera & families, that the embryos would have resembled each other more closely than full-grown animals. Whatever may have been the form or habits of the parent-stock of the Vertebrata, - in whatever course the arteries ran & branched, the selection of variations supervening after the first formation of the arteries in the embryo, would not tend to alter their course at that period: hence the similar course of the arteries in the Mammal, Bird, Reptile & Fish, must be looked at as a most ancient record of the embryonic structure of the common parent-stock of these four great classes.

A long course of selection might cause a form to become more simple, as well as more complicated; - thus the adaptation of a crustaceous animal to live attached during its whole life to the body of a fish might permit

with advantage great simplification of structure; & on this view, the

singular
~~singular~~ fact of an embryo, being more complex than its parent, is

On the graduated complexity in each great class.

at once explained. I may take this opportunity of remarking, that naturalists have observed, that in most of the great classes, a series exists from very complicated to very simple beings; - thus in Fish, what a range there is between the sand-eel & shark, - in the Articulata between the common Crab & the Daphne -, between the aphis & butterfly, & between a mite & a spider. Now this observation just made, namely that selection might tend to simplify, as well as to complicate, explains this; for we can see, that during the endless geological-geographical changes, & consequent isolation of species, a station occupied in other districts by less complicated animals, might be left unfilled, the occupier by a degraded form of a higher or more complicated class; & it would by no means follow, that when the two regions became united, that the degraded organism would give way to the aboriginally lower organism. According to our theory, there is obviously no power tending constantly to exalt species, except the mutual struggle between the different individuals & classes; but from the strong & general hereditary tendency, we might expect to find some tendency to progressive complication, in the successive production of new organic forms.

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modification by selection, of the forms of immature animals. 6 p. 202.

I have above remarked that the feline form is quite of secondary importance to the embryo & to the kitten. Of course during any great & prolonged change of structure in the mature animal, it might, & often would be, indispensible that the form of the embryo should be changed; & this could be effected, owing to the hereditary tendency at corresponding ages, by selection, equally well as in mature age: thus if the embryo tended to become, or to remain, either over its whole body or in certain parts, too bulky, the female parent would die or suffer more during parturition; & as in the case of the calves with large hinder quarters, this peculiarity must be either eliminated, or the species become extinct. Where an embryonic form has to get its own food, its structure & adaptation is just as important to the species, as that of the full-grown animal; & as we have seen that a peculiarity, appearing in a caterpillar (or in a child, as shown by the hereditariness of peculiarities in the milk-teeth) ~~as in life~~ reappears in its offspring, so we can at once see, that our common principle of the selection of slight accidental variations, would modify & adapt a caterpillar to a new or changing condition, precisely as in the full-grown butterfly. Hence probably it is, that caterpillars of different species of the Lepidoptera, differ

more than those embryos, at a corresponding early period of life, which do remains inactive in the womb of their parents. The parent during suc-cessive ages, continuing to be adapted by selection for some one object, & the larva for quite another one, we need not wonder at the difference becoming wonderfully great between them; even as great as between that the fixed Rock-barnacle, & its free, crab-like offspring, furnished with which is eyes & well articulated locomotive limbs.

Importance of Embryology in Classification.

[We are now prepared to perceive, why the study of embryonic forms is of such acknowledged importance in classification. For we have seen that a variation, supervening at any time, may aid in the modification & adaptation of the full-grown being; but for the modification of the embryo, only the variations which supervene at a very early period can be seized on and perpetuated by selection: hence there will be less power & less tendency (for the structure of the embryo is mostly unimportant) to modify the young; & hence we might expect to find at this period, similarities preserved between different groups of species, which had been obscured and quite lost in the full-grown animals. I conceive on the view of separate creations, it would be impossible to offer any explanation of the affinities of organic beings, thus being plainest, & of the greatest import-ance, at that period of life, when their structure is not adapted to the final

part, they have to play in the economy of nature.

Order in time in which the great classes have first appeared.

[It follows strictly from the above reasoning, only, that the embryos of (for instance) existing vertebrata, resemble more closely the embryo of the parent-stock of this great class, than do the full-grown existing ver-=tebrata, resemble their full-grown parent-stock. But it may be argued with much probability, that, in the earliest & simplest condition of things, that the parent & embryo must nearly have resembled each other; & that the of any animal passage through embryonic forms is entirely due to subsequent variations affecting only the more mature periods of life. If so, the embryos of the existing vertebrata will shadow forth the full-grown structure of some of the forms of this great class, which existed at the earlier periods of the earth's history: & accordingly animals with a fish-like structure, ought to have preceded Birds & mammalia; & of fish, that higher organised division with the vertebræ extending into one division of the tail, ought to have preceded the equal-tailed, because the embryos of the latter have an un-=equal tail; & of Crustacea, entomostraca ought to have preceded the ordi-=nary crabs and barnacles;— polypes ought to have preceded jelly-fish; and to have preceded infusorial animalcule, before both. This order of precedence, in time, in some of these cases is believed to hold good; but I think, our evidence is so exceedingly incomplete, regarding the number & kinds of organisms,

which
~~Heat~~ have existed during all, especially the earlier, periods of the earth's

history, that I should put no stress on this accordance, even if it held true

-ly, that it probably does in our present state of knowledge.

Chapt. VI (17)

Abortive or rudimentary organs. (to p. 212.)

The abortive organs of Naturalists. to p. 207

Parts of structure are said to be "abortive", or when in a still lower state of development, "rudimentary", when the same reasoning power, which convinces us that in some cases similar parts are beautifully adapted to certain ends, declares that in others they are absolutely useless. Thus the Rhinoceros, the Whale &c have, when young, small but properly formed teeth, which never protrude from the jaws:- certain bones, & even the entire extremities are represented by mere little cylinders or points of bones, often soldered to other bones: many beetles have exceedingly minute but regularly formed wings lying under their wing cases, which are united never to be opened: latter many plants have, instead of stamens, mere filaments or little knobs; petals are reduced to scales, & whole flowers to buds, (as in the feather hyacinth) which never expand. Similar instances are almost innumerable; & are justly considered wonderful: probably scarcely one organic being exists, in which not

some part does not bear the stamp of inutility; for what can be clear-
-er, as far as our reasoning powers can reach, than that teeth are for
eating, extremities for locomotion, wings for flight, stamens & the entire
flower for reproduction; yet for these clear ends, the parts in question
are manifestly unfit. Abortive organs are often said to be mere representa-
-tives, (a metaphorical expression) of the similar parts in other organic
beings; but in some cases, they are more than representatives, for they seem
to be the actual organ not fully grown or developed: thus the existence
of mammæ in the male Vertebrata, is one of the oftenest adduced cases
of abortion; but we know that these organs in man (& in the Bull) have
performed their proper function, & secreted milk: the cow has normally
four mammæ & two abortive ones, but these latter in some instances
are largely developed and even (??)
give milk: again in flowers, the representatives of stamens & pistils
can be traced to be really these parts not developed; Kolreuter
has shown by crossing a diœcious plant (a Cucubalus) having a rudi-
-mentary pistil, with another species, having this organ perfect, that in
the hybrid offspring, the rudimentary part is more developed, though the
remaining abortive; now this shows how intimately related in nature
the mere rudiment & the fully developed pistil must be.

Abortive organs, which must be considered as useless as far as their

ordinary & normal purpose is concerned, are sometimes adapted to other

uses: thus the marsupial bones, which properly serve to support the

(Owen) young in the mother's pouch, are present in the male, & serve as the

fulcrum for muscles connected only with male functions: in the

(C. Sprengel) male of the marygold, flower, the pistil is abortive for its proper end, & being impregnated, but

serves to sweep the pollen out of the anthers, ready to be borne by

insects to the perfect pistils in the other florets. It is likely in many

cases, yet unknown to us, that abortive organs perform some useful

function; but in other cases, for instance in teeth embedded in the

solid jaw-bone, or in mere knobs, the rudiments of stamens & pistils,

the boldest imagination will hardly venture to ascribe to them any

function. Abortive parts, even when wholly useless to the individual

(A. Braun) species, are of great signification in the system of nature; for they

are often found to be of very high importance in a natural classi-

fication; thus the presence & position of entire abortive flowers, in the

grasses, cannot be overlooked in attempting to arrange them according

to their true affinities. This corroborates a statement in a previous

chapter, that the physiological importance of a part is no index of

its importance in classification. Finally, abortive organs are sometimes

(proportionally with other parts, often only developed in the embryonic

or young state of each species: this again, especially considering the classi-

ficatory importance of abortive organs, is evidently part of the same law, (stated

in the last chapter) that the highest affinities of organisms, are often best

seen in the stages (towards maturity,) through which the embryo passes. On the ordinary view of

individual creations, I think, that scarcely any class of facts in Natural History,

are more wonderful, or less capable of receiving explanation.

The aborting organs of physiologists. b p. 208.

(and medical men) Physiologists apply the term "abortive," in a somewhat different sense from

naturalists; their application is probably the primary one; namely, to parts,

which from accident or disease before birth, are not developed or do not grow:

thus, when a young animal is born with a (little) stump, in the place of a fin-

ger or of the whole extremity, or with a little button instead of a head, or

with a mere (a) bead of bony matter instead of a Tooth, or with a stump instead

of a tail, these parts are said to be aborted. Naturalists on the other

hand, as we have seen, apply this term to parts, not stunted during the

growth of the embryo, but which are as regularly produced in successive

generations, as any other (most) essential (parts of the structure) of the individual: Nat-

uralists, therefore, use this term in a metaphorical sense. These two

classes of facts, however, blend into each other; for parts accidentally

aborted, during the embryonic life of one individual, becoming hereditary in

the succeeding generations: thus a cat or dog, born with a stump, instead of a

tail, tends to transmit stumps to their offspring; & so it is with stumps,

representing the extremities; & so again with flowers, with a reflection

which are in new flower-buds & even in
rudimentary parts annually produced, & with successive seedlings. The

strong hereditary tendency to reproduce every other congenital or slowly acquired

structure, whether useful or injurious to the individual, has been shown

in the first part; so that we need feel no surprise at these truly abortive

parts, becoming hereditary. A curious instance of the force of hereditary,

is sometimes seen in two little loose hanging horns, quite useless as

far as the function of a horn is concerned, which are produced in horn-

-less races of our domestic cattle. Now, I believe, no real distinction can be

drawn between a stump, representing a tail or a horn or the extremities; or

a short shrivelled stamen, without any pollen; or a dimple in a petal, representing

rudiments
a nectary, when such parts are regularly reproduced in a race or family,

& the true abortive organs of naturalists. And if we had reason to believe,

(which I think we have not) that all abortive organs had been at some period

suddenly produced during the embryonic life of an individual, & afterwards

become inherited, we should at once have a simple explanation of the

origin of abortive & rudimentary organs. In the same manner, as during changes

of pronunciation, certain letters in a word may become useless in pronouncing it,

but yet may aid us in searching for its derivation, so we can see that

rudimentary organs, no longer useful to the individual, may be of high importance in ascertaining its descent, that is, its true classification in the natural system. There seems to be some probability that continued disuse of any part or organ, & the selection of individuals with such parts slightly less developed, would in the course of ages produce in organic beings, under domesticity, races with such parts abortive. We have no reason to believe that every part & organ in an individual becomes fully developed that it becomes developed only with exercise of its functions, in a somewhat lesser degree, with less exercise; & if forcibly precluded from all action, such part will often become atrophied. Every peculiarity, let it be remembered, tends especially where both parents have it, to be inherited. The less power of flight in the common duck, compared with the wild, must be partly attributed to disuse during successive generations; & as the wing is probably adapted to flight, we must consider our domestic duck in the first stage towards the state of the apteryx, in which the wings are seriously abortive. Some naturalists have attributed (& possibly with truth) the falling ears, so characteristic of most domestic dogs, some rabbits, oxen, cats, goats, horses &c &c, as the effects of the lesser use of the muscles of these flexible parts, during successive generations of inactive life; & muscles, which cannot perform their functions, must be

Abortion from gradual disuse. to p. 210

considered verging towards abortion. In flowers, again, we see the gradual abortion during successive seedlings (though this is more properly a conversion) of stamens into imperfect petals, & finally into perfect petals. When the eye is blinded in early life, the optic nerve sometimes becomes atrophied; may we not believe that where this organ, as is the case with the subterranean Tuco-tuco, is frequently imperfect & lost, that in the course of generations the whole organ would become abortive, as it normally is in some burrowing quadrupeds, having nearly similar habits with the Tuco-tuco?

In as far, then, as it is admitted as probable, that the effects of disuse (together with occasional sudden abortions, during the embryonic period) would cause a part to be less developed, & finally to become abortive, disuse (if ever can be called useless, which in each particular instance, it may be presupposed, if present, would be of use); then, during the infinitely numerous changes of habits in the many descendants from a common stock, we might fairly have expected, that cases of organs become abortive, would have been numerous. The preservation of the stump of the tail, as usually happens when an animal is born tailless, we can only explain by the strength of the hereditary principle: but on the theory of disuse, gradually obliterating a part, we can see, according to the principles explained in the last chapter, viz (of hereditariness at corresponding periods of life, together with the use

& discuss of the part in question structures not being brought into play in early embryonic life,) that organs (or parts) would tend not to be entirely obliterated, but to be reduced to that state, in which they exist in early embryonic life: (an "embryonic condition". One can speak of a part in a full-grown animal, being in a state of life.—) Moreover we can thus see, why abortive organs are most developed at an early period.

Again, by gradual selection, we can see, how an organ reduced abortive in its primary use, might be converted to other purposes;—a duck's wing might come to serve for a fin, as does that of the Penguin,— an abortive bone might come to serve, by the slow increment & change of place in the muscular fibres, as a fulcrum for a new series of muscles; the pistil of the Marigold might become abortive as a reproductive part, but be continued in its function of sweeping the pollen out of the anthers; for if, in this latter respect, the abortion has not been checked by selection, the species must have become extinct from the pollen remaining enclosed in the capsules of the anthers.

[Finally then, I must repeat that these wonderful facts of organs, formed with traces of exquisite care, but now either absolutely useless, or adapted to and wholly different from their ordinary end, being present & forming part of the structure of almost every inhabitant of this world both in long-past & present times,— being best developed & often only discoverable at a very early embryonic period, & being full of signification in arranging the

long series of organic brings, in a natural system, – these wonderful facts not only accept receive a simple explanation, on the theory of long-continued selection of many species from a few common parent-stocks, but necessarily follow from this theory. If this theory be rejected, these facts remain quite inexplicable; – without, indeed, we rank as an explanation, such loose metaphors, as that of Decandolle's, in which the Kingdom of nature is compared to a well-contrived table, & the abortion organs are considered as put in for the sake of symmetry! –

Chapter VII

Recapitulation and Conclusion.

(More fully with respect to the former parts, & briefly with the latter.)

Recapitulation to p. 223.

I will now recapitulate the course of this work. In the first Chapter, we have seen that most, if not all, organic brings, when taken by man out of their natural conditions, & bred during several generations, vary: that this variation is partly due to the direct effect of the new external influences, & partly to the indirect effect on the reproductive system, rendering making the organization of the offspring in some degree plastic. Of the variations, thus produced, man when uncivilized naturally preserves the life, & therefore unintentionally breeds from those individuals most useful to him in his

different states: when domesticated, he intentionally separates & breeds from such individuals. Every part of the structure seems occasionally to vary in a very slight degree, & the extent to which all kind of peculiari=-ties in mind & body, when congenital and often slowly acquired either from external influences, from exercise, or from disuse, is truly wonderful. When several breeds are once formed, then, crossing is the most fertile source of new breeds. Variation must be ruled, of course, by the health of the new race; by the tendency to return to the ancestral forms, & unknown laws, determining the proportional increase & symmetry of the body. The amount of variation, which has been effected under domestication, is quite unknown in the majority of domestic brings.

In the Second Chapter, it was shown that wild organisms undoubtedly vary in some slight degree: What the kind of variation, though much less in de=-gree, is similar to that of domestic organisms. It is highly probable, that every organic being, if subjected during several generations to new & varying conditions, would vary. It is certain, that organisms living in an isolated country, which is undergoing geological changes, must in the course of time be so subjected to new conditions; moreover an organism, when by chance transported into a new station, for instance into an island, will often be exposed to new conditions, & be surrounded by a new series of organic brings.

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If there were was no power at work selecting every slight variation, which

opened new sources of subsistence to a being thus situated, the effects of

crossing & the constant tendency to reversion to the old parent-forms would

prevent the production of new races. If there were any selective agency at

work, it seems impossible to assign any limit to the complexity & beauty of the

adaptive structures, which might thus be produced; for certainly the limit

of possible variation of organic beings, either in a wild or domestic state, is

not known.][It was then shown, that from the geometrically increasing tendency

of each species to multiply (as evidenced from what we know of mankind &

of other animals, when favoured by circumstances) & from the means of subsistence

of each species on an average remaining constant, that during some part

of the life of each, or during every few generations, there must be a str-

-ife Struggle for existence; & that, a grain in the balance will determine, which individuals shall live & which perish. In a country,

therefore, undergoing changes and cut off from the free immigration of

species better adapted to the new station & condition, it cannot be doubted that

there is a most powerful means of selection, tending to preserve even the

slightest variation, which aided the subsistence or defence of those organic

beings, (any part of their whole existence)

beings, whose organsation had been rendered plastic. Moreover in an-

-imals, in which the sexes are distinct, there is a sexual struggle, by which

the most vigorous, & consequently the best adapted, will oftener procreate their

kind. [A new race thus formed by natural selection, would be undistin-

-guishable from a species: For comparing, on the one hand, the several

species of a genus, on the other hand, several domestic races from a common-

-stock, we cannot discriminate them by the amount of external differences,

but only, first, by domestic races not remaining so constant or being so 'true', as

species are; and secondly by races always producing fertile offspring when crossed.

And it was then shown, that a race naturally selected, from the variation

being slower, from the selection steadily leading towards the same ends, and

from every new slight change ——— in structure being adapted (as is

implied by its selection) to the new conditions & being fully expressed, & lastly

from the freedom from occasional crosses with other species, would almost

necessarily be "true", than a race selected by ignorant, & capricious

& short-lived man. With respect to the Sterility of species, when crossed, it

was shown, not to be a universal character, when present to vary in de-

-gree: Sterility was also shown, probably, to depend, less on external than on

constitutional differences, & it was shown, that when individual animals

and plants are placed under new conditions, they become, without loosing

their healths, as Sterile, in the same manner & to the same degree, as

hybrids; & it is therefore conceivable, that the crossed offspring between two species having

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different constitutions, might would have its constitution affected, in the same peculiar manner, as when an individual animal or plant is placed under new conditions. Man in selecting domestic races has little wish, & still less power, to adapt the whole frame to new conditions; in nature, however, where each species survives by a struggle against other species & external nature, the result must be very different. [Races descending from the same stock, of the same species, were then compared with species of the same genus, & they were found to present some striking analogies. The offspring, also, of races when crossed, that is mongrels, were compared with the cross-bred offspring of species, that is hybrids, & they were found to resemble each other in all their characters, with the one exception of sterility, & even this, when present, often becomes after some generations variable in degree. The chapter was summed up, & it was shown that no ascertained limit to the amount of variation, is known; or could be predicated with our time & changes of condition greater, is known. It was then admitted, that although the production of new races, undistinguishable from true species, is probable, we must look to the relations in the past & present geographical distribution of the infinitely numerous beings, by which we are surrounded, to their affinities, & to their structure, for any direct evidence.]

[In the Third Chapter, the inheritable variations in the mental phenomena

of domestic & wild organic beings, were considered. It was shown, that we

are not concerned with the first origin of the leading mental qualities; but that,

tastes, passions, dispositions, consensual movements, & habits all become,

either congenitally or during mature life modified, & were inherited.

Several of these modified habits, were found to correspond in every essential

character with true instincts; & they were found to follow the same laws.

Instincts & dispositions &c, are fully as important to the preservation &

increase of a species, as its corporeal structure; & therefore the nat=

=ural means of selection would act on, & modify them, equally with cor=

=poreal structures. This being granted, as well as the proposition, that

mental phænomena are variable, & that the modifications are in=

=heritable; the possibility of the several most complicated instincts

being slowly acquired was considered; & it was shown, from the very

imperfect series in the instincts of the animals now existing, that we

are not justified in primâ facie, rejecting a theory of the common

descent of allied organisms, from the difficulty of imagining the transitional

stages in the various now most complicated & wonderful instincts. We

were, then, led on to consider the same question with respect, both

to highly complicated organs, & to the aggregate of several such organs,

that is individual organic beings; & it was shown by the same method of

taking the existing most imperfect series, that we ought not at once
to reject the theory, because we cannot trace the transitional
stages in such organs, or conjecture the transitional habits of such
individual species.

In the Second Part, the direct evidence of allied forms ~~species~~ having descend-
ed from the same stock, was discussed. It was shown, that this theory
requires a long series of intermediate forms between the species &
groups in the same class;- forms not directly intermediate between
existing species, but intermediate with a common parent. It was ad-
-mitted, that if even all the preserved fossils & existing species were
collected, such a series would be far from being formed; but it was
shown that we have no good evidence, that the oldest known deposits
are contemporaneous with the first appearance of living beings; or
that the several subsequent formations are nearly consecutive; or that
any one formation preserves a nearly perfect Fauna of even the hard ma-
-rine organisms, ~~living~~ which lived in that quarter of the world. Consequently, we have
no reason to suppose, that more than a small fraction of the organisms,
which have lived at any one period, have ever been preserved; & hence that
we ought not to expect to discover the fossilized sub-varieties between
any two species. On the other hand, the evidence, though extremely

imperfect, drawn from fossil remains, as far as it does go, is in favour
of such a series of organisms, having existed, as that required. This want-
of evidence of the past existence of almost infinitely numerous inter-
mediate forms, is, I conceive, much the weightiest difficulty on the theory
I must think that this
of common descent; but ~~I am convinced that~~ is due to ignorance, necessarily
resulting from the imperfection of all geological records.

In the second chapter, it was shown, that new species gradually, ap-
pear, & that old ones die & disappear from the earth, and this strictly accords with
our theory. The extinction of species seems to be preceded by their
rarity; & if this be so, no one ought to feel more surprise at a species,
being exterminated, than at its being rare. Every species which is
not increasing in number, must have its geometrical tendency to
increase, checked by some agency, seldom accurately perceived by
us. Each slight increase in the power of this unseen checking agency, would
cause a corresponding decrease in the average numbers of that species,
& the species
& we become rare: we feel not the least surprise at one species
of a genus being rare & another abundant; why then should we be sur-
prised at its extinction, when we have good reason to believe, that
this very rarity is its regular precursor, & cause.

In the Third Chapter, the leading facts in the geographical distribution

of organic brings, were considered; - namely, the dissimilarity, in areas widely & effectually separated, of the organic brings exposed to very similar conditions (as for instance within the tropicae of Africa & America, or on the adjoining volcanic islands, of Africa & America) - also, the striking similarity and genral relations of the inhabitants of the same dissimilarity of the inhabitants, on the opposite sides of barriers within great continents, conjoined with a lesser degree of dissimilarity therein the same area or continent, or on different islands of the same in the inhabitants, living on opposite sides of the barriers, in the same archipelago, whether exposed to like or unlike conditions, their isolating it, - whether or not these opposite sides are exposed dissimilarity however, of the inhabitants of the same continents, to similar conditions; - also the dissimilarity, though in a still lesser degree, in the inhabitants of different islands, in the same archipelago, together with their similarity, taken as a whole, will the inhabitants of the nearest continent, whatever its character may be, - again, the peculiar relations of alpine floras; - the absence of mammifers on the smaller, isolated islands, & the comparative prowess of the plants & other organisms on islands with diversified stations; - the connexion, between the possibility of occasional transportal from one country to another, with an affinity, though not identity, of the organic brings inhabiting them; - and lastly the clear & striking relations between the living & the extinct, in the same great divisions of the world; which relation, if we look very far backwards, seems to die away. These facts, if we bear in mind the grological changes in progress, all

simply follow from the proposition of allied organic beings having line-
=arly ascended from common parent-stocks. On the theory of independent
creations, they must remain, though evidently connected together, inex-
=plicable & disconnected.

In the Fourth Chapter, the relationship or grouping of extinct & recent species; the appearance & disappearance of groups; the ill-defined objects of the natural classification, not depending on the similarity of organs physiologically im-
=portant, not being influenced by adaptive (or analogical characters, though these often govern) the whole economy of the individual, or analogous characters, but depending on any character which varies least, & especially on the forms through which the embryo passes, &, as was afterwards shown, on the presence of rudimen-
=tary & useless organs;- the alliance between the nearest species indistinct groups being general & not special;- the close similarity in the rules & objects in classifying domestic races & species- all these facts were shown to follow, on the Natural System being a genealogical System.

[In the Fifth Chapter, the unity of structure throughout large groups, in species adapted to the most different lives, & the wonderful metamorphosis (used metaphorically by naturalists) of one part or organ in another, were shown to follow simply on new species being produced by the selection & inherit-
=ance of successive small changes of structure. The unity of type is

wonderfully manifested, by the similarity of structure, during the embryonic period, in the species of entire classes: to explain this, it was shown that the different races of our domestic animals differ less, during their young state, than when full-grown; & consequently, if species are produced like races, the same fact, on a greater scale, might have been expected to hold good with them. This remarkable law of nature, was attempted to be explained, through establishing by sundry facts, that originally slight variations first appear during all periods of life, & that when inherited, they tend to appear at the corresponding period of life; according to these principles, in several species descended from the same parent-stock, their embryos would almost necessarily much more closely resemble each other, than would these species, when full-grown: the importance of these embryonic resemblances, in making out a natural or genealogical classification, thus becomes at once obvious. The occasional greater simplicity of structure in the mature animal, than in the embryo;— the gradation in complexity of the species in the great classes;— the adaptation of the larvæ of animals to independant powers of existence;— the immense difference in certain animals in their larval & mature states, were all shown on the above principles to present no difficulty.

In the last Chapter, the frequent & almost general presence of organs



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ana parts, called by naturalists, abortive or rudimentary, which though formed with exquisite care, are generally absolutely useless; though sometimes applied to uses not normal — which cannot be considered as representative parts, for they are sometimes capable of performing their proper function; — which are always best, sometimes only, developed during a very early period of life; — which are of admitted high importance in classification, — were shown to be simply explicable on our theory of common descent.

Why do we wish to reject the Theory of common descent? to p. 228.

[Thus have many general facts, or laws, been included under one explanation; & the difficulties encountered, are those which would naturally result from our acknowledged ignorance. And why should we not admit this theory of descent? Can it be shown, that organic beings in a natural state, are all absolutely invariable? Can it be said, that the limit of variation, or the number of varieties capable of being formed under domestication, are known? Can any distinct line be drawn between a race & a species? To these three questions, we may certainly answer in the negative. As long as species were thought to be divided & defined by an impassable barrier of sterility; whilst we were ignorant of geology, & imagined that the world was of short duration, & the number of its past inhabitants

few, we were justified in assuming individual creations, or

in saying with Whewell, that the beginnings of all things are

hidden from man. Why then do we feel so strong an inclination

to reject this theory; - especially when the actual case of any two

species or even races, is adduced; & one is asked have these two,

originally descended from the same parent womb? I believe it

is, because we are always slow to admit any great change, of which we do not

see the intermediate steps; because the mind cannot grasp the

full meaning of the term of a million years & consequently

add up & perceive the full effects of small successive variations.

The difficulty, so to speak, is the same with that, which with most geologists

it has taken long years to remove, & which by all profoundest that great valleys

& the bed of the sea have been hollowed out, by the slow action of the waves of the sea.

A man may long view a grand precipice, without actually believing,

though he may not deny it, that thousands of feet in thickness of solid

rock, once extended over many square miles, where the open sea

now rolls; without fully believing, that the same sea which breaking

the rock at its feet, has been the sole removing power.

Shall we, then, allow that the three distinct species of Rhinoceros,

which separately inhabit Java, Sumatra & the neighbouring

mainland of Malacca, were created, male & female, out of the inor-
=ganic materials of these countries? Without any adequate cause,
as far as our reason serves, shall we say, that, they were merely from
living near each other, or created very like each other, so as to form
a section of the genus, dissimilar from the African species, some section, some
of the species of which section
of which inhabit very similar & some very dissimilar stations; — that
shall we say, that without any apparent cause
they were created on the same generic type with the ancient
woolly Rhinoceros of Siberia, & of the other species, which formerly
inhabited the same main division of the world: — that they were
created, on less & less closely related, but still with interbranching
affinities, with all the other living & extinct mammalia; — that
without any apparent adequate cause, their short necks should contain
the same number of vertebræ with the Giraffe; that their thick legs should
be built on the same plan, with those of the antelope, of the mouse, of the
hand of the monkey, of the wing of the bat, & of the fin of the porpoise; — that
in each of these species, the second bone of their leg should show clear
traces of two bones having been soldered & united into one; — that the com-
=plicated bones of their head should become intelligible, on the supposi-
=tion of their having been formed of three expanded vertebræ; that if the
jaws of each, when dissected young, there should exist small teeth, which

never come to the surface; that in possessing these useless abortive teeth, & in other characters, these three Rhinoceroses in their embryonic state, should much more closely resemble other mammifera, than they do when mature; & lastly, that in a still earlier period of life, that their arteries should run & branch, as in a fish, to carry the blood to gills, which do not exist. Now these three species of Rhinoceros closely resemble each other; more closely than many generally acknowledged races of our domestic animals; these three species, if domesticated would almost certainly vary, & races, adapted to different ends, might be selected out of such variations. In this state they would probably breed together, & their offspring possibly would be quite, & probably in some degree fertile; & in either case by continued crossing, one form of these might be absorbed & lost in another. I repeat, shall we then say that a pair, or a gravid female, of each of these three species of Rhinoceros were separately created, with deceptive appearances of relationship, with the stamp of inutility on some parts & of conversion in other parts, out of the inorganic elements of Java, Sumatra & Malacca? or have they descended, like our domestic races, from the same parent-stock? For my own part, I could no more admit the former proposition, than I could admit that the planets move in their courses, & that a stone falls to the ground, not through the true

very good
improvement

intervention of the secondary & appointed law of gravity, but from the
but by the Creator applying a different law (only apparently
direct volition of the Creator. similar to us) in each case.

Before concluding it will be well to show, although this has incidentally
appeared, how far the theory of common descent can legitimately be
extended. If we once admit that two true species of the same genus,
can have descended from the same parent, it will not be possible to
deny that two species of two genera may also have descended from a
common stock. For in some families the genera approach almost as
closely, as species of the same genus; & in some orders, for instance
in the monocotyledonous plants, the families run closely into each
other. We do not hesitate to assign a common origin to dogs or cabbages,
because they are divided into groups, analogous to the groups in nature.
Many naturalists, indeed, admit that all groups are artificial; & that
they depend entirely on the extinction of intermediate species. Some
naturalists, however, affirm, that though driven from considering
sterility as the characteristic of species, that an entire incapacity to
propagate together, is the best evidence of the existence of natural
genera. Even if we put on one side, the undoubted fact that some species
of the same genus will not breed together, we cannot possibly admit the
above rule, seeing that the grouse & pheasant (considered by some

good ornithologists as forming two families) the bull-finch and
the Jumper & arbor-vita,
canary-bird have bred together. No

No doubt the more remote two species are from each other, the
weaker the arguments become in favour of their common Descent.=
In species of two distinct families, the analogy from the variation
of Domestic organisms, & from the manner of their intermarrying,
fails; & the arguments from their geographical distribution, quite
quite,
or almost fails. But, if we once admit, the general principles of
can be made out
this work, as far as a clear unity of type in groups of species, ad-
-apted to play diversified parts in the economy of nature, can be
made out, whether shown in the structure of the embryonic or
mature being, & especially if shown by a community of abortive
parts, we are legitimately led to admit, their community of descent.
Naturalists dispute how widely this unity of type extends: most,
however, admit, that the vertebrata are built on one type; the
articulate on another; the mollusca on a third; & the Radiata
on probably more than one: Plants, also, appear to fall under three
or four great types. On this theory, therefore, all the organisms,
yet discovered, are descendants of probably less than ten parent-
forms.

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Conclusion

My reasons have now been assigned, for believing that specific forms

are not immutable creations. The terms used by naturalists, of affinity,

unity of type, adaptive characters, the metamorphosis & abortion

of organs, cease to be metaphorical expressions, & become

intelligible facts. We no longer look at an organic being, as

a savage does at a ship or other great work of art, as at a thing

wholly beyond his comprehension, but as a production, has

a history, for we can look to examine into it. How interesting do all

instincts become, when we speculate on their origin, as hereditary

habits, or as slight congenital modifications of former instincts,

perpetuated by the individuals so characterized having been pres-

-erved & selected. We look at every complex instinct & mechan-

-ism, as the summing up of a long history of contrivances, each

most useful to its possessor, nearly in the same way, as when we look

at a great mechanical invention, as the summing up of the labour,

the experience, the reason, & even the blunders of numerous workmen.

How interesting does the geographical distribution of all organic beings,

past & present, become, as throwing light on the ancient geography

of the world. Geology loses glory from the imperfection of its archives, but

it gains in the immensity of its subject. There is much grandeur in looking at every existing organic being, either as the lineal successor of some form now buried under thousands of feet of solid rock, or as being the co-descendant with that buried form, of some more ancient & utterly lost inhabitant of this world. It accords with what we know of the laws impressed by the Creator, on matter, that the production & extinction of forms, should, like the birth & death of individuals, be the result of secondary means. It is derogatory, that the Creator of countless Universes, should have made by individual acts of His will, the myriads of creeping parasites & worms, which since the earliest dawn of life, have swarmed over the land & in the depths of the ocean. We cease to be astonished, that a group of animals should have been formed to lay their eggs in the bowels & flesh of other sensitive beings; — that some animals should live by, & even delight in cruelty; — that animals should be led away by false instincts; — that annually there should be an incalculable waste of the pollen, eggs, & immature beings; for we see in all this, the inevitable consequences of one great law, of the multiplication of organic beings not created immutable. From death, famine, & the struggle for existence, we see that the most exalted end, which we are capable of conceiving, namely

the creation of the higher animals, has directly proceeded. Doubt-
less our first impression, & to disbelieve, that any Secondary law-
could produce infinitely numerous organic beings, each charac-
terized by the most exquisite workmanship & widely extended
adaptations: it at first accords better with our faculties, to
suppose, that each required the fiat of a Creator. There is a
simple grandeur in the view of life, with its powers of assim-
ilating, [food], of reproduction, having been originally breathed
into matter under a few forms; & that, whilst this planet has
gone cycling onwards according to the fixed laws of gravity,
& land & water have gone on replacing each other, - that from
so simple an origin, through the selection of infinitesimal
varieties, endless forms most beautiful & most wonderful,
have been evolved.



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Sketch sent to Asa Gray 1857. Now in Gray Herbarium at Harvard; copy at DAR

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