THE DARWIN—WALLACE 1858 EVOLUTION PAPER

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INTRODUCTION

The names of **Charles Robert Darwin** (1809-1882) and **Alfred Russell Wallace** (1823-1913) have long been joined with the modern concept of "evolution" and the theory of "natural selection." The story of the interrelationship between the two men over their professional careers is one of gentlemanly strain: Darwin, the country squire, living off inherited wealth and sound investments on a small estate working leisurely in the **pursuit of evolution**, and Wallace, the committed socialist, saved ultimately from abject poverty by Darwin and his friends who arranged a Crown pension, laboring seemingly forever in other's shadow. Their coming together was itself a random event that neither anticipated. Darwin, the procrastinator at least on this subject, was forced into action only when he saw his own **ideas**—formed over some twenty years—expressed in a letter written by Wallace in a span of a few days. So sudden did this happen, and so similar were many of Wallace's concepts that the gentleman in Darwin felt it was imperative that Wallace's letter be published. Only through actions of his friends, the geologist **Charles Lyell** (1797-1875) and the botanist Joseph Dalton Hooker (1817-1911), was it possible for Darwin's long efforts to be acknowledged jointly with those of Wallace. The **paper** that is made available here is the result of that forced union.

The story is simple.

After a voyage around the world aboard H.M.S. Beagle (1831 until 1836), Darwin settled in Cambridge and London to process his specimens, to arrange for the description of his newly found plants and animals, to write about his voyage, and to marry (in 1839) his first cousin Emma Wedgwood (1808-1896). Among the many questions he considered while at sea were the processes by which species came into existence. To this end, Darwin began a "Notebook on Transmutation of Species" in 1837, and his 1838 reading of Thomas Malthus' (1766-1834) Essay on the Principle of Population crystallized many of his ideas into a coherent hypothesis. The importance of the observations he made aboard the Beagle began to make an impact.

He had seen the enormous diversity of life in the tropical rain forest of Brazil, an abundance of fossils buried in the dry pampas of Patagonia, an array of adaptations among the living creatures on the wind-swept Falkland Islands and Tierra del Fuego, and the curious combinations of plants and animals in the temperate rain forest of southern Chile and on the Galapagos Islands. He also discovered that humans could be savage and so far removed from the "elements of Christianity" that the question was: Could such creatures be members of his own species?

Darwin witnessed the geological consequence of a major earthquake in Chile where new land was raised from the sea, and he found fossilized marine shells several thousand feet in elevation in the Andes. Both were to confirm some of the concepts articulated by Charles Lyell in his three volume work Principles of Geology. In the Indian Ocean Darwin studied the formation of coral rifts, noting the slow but steady growth of such geological formation, and began to realize the earth was probably hundreds of thousands if not millions of years old. As a geologist, which was his training, he was troubled by the prevailing beliefs of many that the earth was only a few thousand years old and all species were created de nov when a new place for a creature came into existence.

In 1842, while Wallace was studying botany, Darwin wrote a "Sketch" on natural selection which he revised and had copied in 1844 (and retitled "Essay"). In an off-hand comment, Joseph Hooker stated that those who were interested in the process of speciation ought to have some taxonomic experience of dealing with them. Stung by the remark, Darwin was uncertain how to proceed and it was not until January of 1847 that he handed Hooker a fair copy of the 231 page manuscript to read and

comment upon. Hooker, like Darwin, a veteran of a prolonged sea voyage aboard a surveying ship into the southern hemisphere, and like his father, Sir William Jackson Hooker (1785-1865), a plant taxonomist, was not immediately impressed with Darwin's hypothesis. He essentially made no comment. Another reason for this was that Hooker was about to set off for India on a major collecting trip, destined to be away until March of 1851.

That same year of 1844, Wallace accepted a position at a collegiate school at Leicester, but his meeting with the British naturalist Henry Walter Bates (1825-1892) changed his career. The younger Bates encouraged Wallace to abandon botany and concentrate on insect. A decade and half ago, while Darwin was a student at Edinburgh (1825-1827) and later at Cambridge (1827-1831), the rage had been beetles but now it was insects. In 1848, Wallace with Bates sailed to the Amazon with Wallace amassing a huge collection, much of which was lost when his ship sunk while returning to England. In 1853, Wallace's adventures were recorded in A Narrative of Travels on the Amazon and Rio Negro. Meanwhile, Darwin was immersed in barnacles and the perennial question—what is a species?

From 1846 until 1854, Darwin's home, now Down House in the village of Downe about sixteen miles south of London, was filled with preserved specimens of barnacles along with boxes of fossilized species. He work diligently on the lot, ignoring the whole problem of natural selection. Hooker, however, was not ignoring the problem for while he was collecting plants in India (even while held as a prisoner by a local warlord) for his father then director of the Royal Botanic Garden at Kew, he was testing some of Darwin's ideas in the field. Hooker had been the only naturalist to whom Darwin had shown a copy of his "Essay" and without Hooker's full support, Darwin was unwilling to move forward, especially given the reactions to the anonymously published book Vestiges of the Natural History of Creation, written, we now know, by Robert Chambers. In 1851 and then in 1854, Darwin published his two volumes on barnacles; he now had a thorough appreciation for the working systematist's definition of a species!

In 1854, Wallace traveled to the Malay Archipelago to collect for various museums and private collectors. He was looking specifically for evidence that related forms were found in both the Amazon Basin and on the Archipelago. If he could find evidence that closely related species were found in widely dispersed regions of the world, this might bring into question the idea that each species was created independently. In 1855 he published a cryptic note in guarded language entitled "On the Law Which Has Regulated the Introduction of New Species" in the Annals and Magazine of Natural History. Here he maintained that new species arose from related, pre-existing species. Darwin did not fully comprehend what Wallace was saying and considered him to be a "creationist" but Lyell did realize what Wallace had in mind and at a visit to Down House shortly thereafter, Darwin discussed his "Essay" and Lyell urged him, in May of 1856, to published immediately to establish priority.

Still Darwin delayed.

And yet, Darwin was busy on natural selection. He was now writing extensive new sections, sending them off to Hooker for review and comment. He was attempting to gather an abundance of supporting evidence to fully justify his hypotheses. His "Essay" was rapidly becoming a large book. By March of 1858, Darwin's manuscript consisted of ten chapters and amounted to some 250,000 words. By his own calculation, he was two-thirds the way to a finished product. While Darwin sought information on the evolution of obscure plants and animals, public debate that same month raged over the up-start Thomas H. Huxley's (1825-1895) public challenge at the Royal Institute of Richard Owen's (1804-1892) just proposed establishment of a new subclass for human, taxonomically isolating Homo sapiens well away from the other primates. Darwin was determined to avoid the question of the origin and evolution of man; barnacles, finches and widely distributed species of plants were far safer.

In February of 1858, while on the island of Halmahera (then called "Gilolo") in the Moluccas, Wallace was bed-ridden and suffering from an attack of malaria. Ill and fevered, he suddenly realized the importance of Malthus' observations on populations, and drafted his ideas on "the survival of the fittest" during a single evening. He worked over the draft the next two evenings with the idea of sending it to

Darwin. On 9 March 1858 he mailed his letter by mail-boat from the island of Ternate with the request that if Darwin thought the ideas worthy that he send the letter on to Lyell.

Darwin got the letter on 18 June, and wrote immediately to Lyell:

Some year or so ago, you recommended me to read a paper by Wallace in the Annals, which had interested you & as I was writing to him, I knew this would please him much, so I told him. He has to day sent me the enclosed & asked me to forward it to you. It seems to me well worth reading. Your words have come true with a vengeance that I sh[d]. be forestalled. You said this when I explained to you here very briefly my views of "Natural Selection: depending on the Struggle for existence.—I never saw a more striking coincidence. if Wallace had my M.S. sketch written out in 1842 he could not have made a better short abstract! Even his terms now stand as heads of my Chapters.

Please return me the M.S. which he does not say he wishes me to publish; but I shall of course at once write & offer to send to any Journal. So all my originality, whatever it may amount to, will be smashed. Though my Book, if it will ever have any value, will not be deteriorated; as all the labour consists in the application of the theory.

I hope you will approve of Wallace's sketch, that I may tell him what you say.

There was no question in Darwin's mind that Wallace's letter must be published, but what of his own efforts? In his letter to Lyell dated 25 June, Darwin noted that Hooker had seen his 1844 "Essay" and the American botanist, Asa Gray (1810-1888), had been sent a long abstract in 1857:

I am very sorry to trouble you, busy as you are, in so merely personal an affair. But if you will give me your deliberate opinion, you will do me as great a service, as ever man did, for I have entire confidence in your judgment & honour.—

I sh[d]. not have sent off your letter without further reflexion [sic, reflection], for I am at present quite upset, but write now to get subject for time out of mind. But I confess it never did occur to me, as it ought, that Wallace could have made any use of your letter.

There is nothing in Wallace's sketch which is not written out much fuller in my sketch copied in 1844, & read by Hooker some dozen years ago. About a year ago I sent a short sketch of which I have copy of my views (owing to correspondence on several points) to Asa Gray, so that I could most truly say and prove that I take nothing from Wallace. I should be extremely glad now to publish a sketch of my general views in about a dozen pages or so. But I cannot persuade myself that I can do so honourably. Wallace says nothing about publication, & I enclose his letter.—But as I had not intended to publish any sketch, can I do so honourably because Wallace has sent me an outline of his doctrine?—I would far rather burn my whole book than that he or any man sh[d]. think that I had behaved in a paltry spirit. Do you not think his having sent me this sketch ties my hands? I do not in least believe that that he originated his views from anything which I wrote to him.

If I could honourably publish I would state that I was induced now to publish a sketch (& I sh[d]. be very glad to be permitted to say to follow your advice long ago given) from Wallace having sent me an outline of my general conclusions.—We differ only, that I was led to my views from what artificial selection has done for domestic animals. I could send Wallace a copy of my letter to Asa Gray to show him that I had not stolen his doctrine. But I cannot tell whether to publish noew would not be base & paltry: this was my first impression, & I sh[d]. have certainly acted on it, had it not been for your letter.—

this is a trumpery affair to trouble you with; but you cannot tell how much obliged I sh[d]. be for your advice.—

By the way would you object to send this & your answer to Hooker to be forwarded to me, for then I shall have the opinion of my two best & kindest friends.—This letter is miserably written & I write it now, that I may for time banish [the] whole subject. And I am worn out with musing.

I fear we have case of scarlet-fever in House with Baby.—Etty is weak but is recovering.—

My good dear friend forgive me.—This is a trumpery letter influenced by trumpery feelings.

The next day, Darwin added an extended postscript:

Forgive me for adding P.S. to make the case as strong as possible against myself. Wallace might say "you did not intend publishing an abstract of your views till you received my communication, is it fair to take advantage of my having freely, though unasked, communicated to you my ideas, & thus prevent me forestalling you?" The advantage which I should take being that I am induced to publish from privately knowing that Wallace is in the field. It seems hard on me that I should be thus compelled to lose my priority of many years standing, but I cannot feel at all sure that this alters the justice of the case. First impressions are generally right & I at first thought it w^{d}. be dishonourable in me now to publish.— … I have always though you would have made a first-rate Lord Chancellor; & I now appeal to you as a Lord Chancellor

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The 1858 Darwin-Wallace Paper

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III. *On the Tendency of Varieties to depart indefinitely from the Original Type.* By Alfred Russel Wallace.]

One of the strongest arguments which have been adduced to prove the original and permanent distinctness of species is, that varietiesproduced in a state of domesticity are more or less unstable, and often have a tendency, if left to themselves, to return to the normal form of the parent species; and this instability is considered to be a distinctive peculiarity of all varieties, even of those occurring among wild animals in a state of nature, and to constitute a provision for preserving unchanged the originally created distinct species.

In the absence or scarcity of facts and observations as to varieties occurring among wild animals, this argument has had great weight with naturalists, and has led to a very general and somewhat prejudiced belief in the stability of species. Equally general, however, is the belief in what are called "permanent or true varieties,"—races of animals which continually propagate their like, but which differ so slightly (although constantly) from some other race, that the one is considered to be a variety of the other. Which is the variety and which the original species, there is generally no means of determining, except in those rare cases in which the one race has been known to produce an offspring unlike itself and resembling the other. This, however, would seem quite incompatible with the "permanent invariability of species," but the difficulty is overcome by assuming that such varieties have strict limits, and can never again vary further from the original type, although they may return to it, which, from the [Page 54] analogy of the domesticated animals, is considered to be highly probable, if not certainly proved.

It will be observed that this argument rests entirely on the assumption, that varieties occurring in a state of nature are in all respects analogous to or even identical with those of domestic animals, and are governed by the same laws as regards their permanence or further variation. But it is the object of the present paper to show that this assumption is altogether false, that there is a general principle in nature which will cause many varieties to survive the parent species, and to give rise to successive variations departing further and further from the original type, and which also produces, in domesticated animals, the tendency of varieties to return to the parent form.

The life of wild animals is a struggle for existence. The full exertion of all their faculties and all their energies is required to preserve their own existence and provide for that of their infant offspring. The possibility of procuring food during the least favourable seasons, and of escaping the attacks of their most dangerous enemies, are the primary conditions which determine the existence both of individuals

and of entire species. These conditions will also determine the population of a species; and by a careful consideration of all the circumstances we may be enabled to comprehend, and in some degree to explain, what at first sight appears so inexplicable—the excessive abundance of some species, while others closely allied to them are very rare.

The general proportion that must obtain between certain groups of animals is readily seen. Large animals cannot be so abundant as small ones; the carnivora must be less numerous than the herbivora; eagles and lions can never be so plentiful as pigeons and antelopes; the wild asses of the Tartarian deserts cannot equal in numbers the horses of the more luxuriant prairies and pampas of America. The greater or less fecundity of an animal is often considered to be one of the chief causes of its abundance or scarcity; but a consideration of the facts will show us that it really has little or nothing to do with the matter. Even the least prolific of animals would increase rapidly if unchecked, whereas it is evident that the animal population of the globe must be stationary, or perhaps, through the influence of man, decreasing. Fluctuations there may be; but permanent increase, except in restricted localities, is almost impossible. For example, our own observation must convince us that birds do not go on increasing every year in a geometrical ratio, as they would do, were there not [Page 55] some powerful check to their natural increase. Very few birds produce less than two young ones each year, while many have six, eight, or ten; four will certainly be below the average; and if we suppose that each pair produce young only four times in their life, that will also be below the average, supposing them not to die either by violence or want of food. Yet at this rate how tremendous would be the increase in a few years from a single pair! A simple calculation will show that in fifteen years each pair of birds would have increased to nearly ten millions ! whereas we have no reason to believe that the number of the birds of any country increases at all in fifteen or in one hundred and fifty years. With such powers of increase the population must have reached its limits, and have become stationary, in a very few years after the origin of each species. It is evident, therefore, that each year an immense number of birds must perish—as many in fact as are born; and as on the lowest calculation the progeny are each year twice as numerous as their parents, it follows that, whatever be the average number of individuals existing in any given country, twice that number must perish annually,—a striking result, but one which seems at least highly probable, and is perhaps under rather than over the truth. It would therefore appear that, as far as the continuance of the species and the keeping up the average number of individuals are concerned, large broods are superfluous. On the average all above one become food for hawks and kites, wild cats and weasels, or perish of cold and hunger as winter comes on. This is strikingly proved by the case of particular species; for we find that their abundance in individuals bears no relation whatever to their fertility in producing offspring. Perhaps the most remarkable instance of an immense bird population is that of the passenger pigeon of the United States, which lays only one, or at most two eggs, and is said to rear generally but one young one. Why is this bird so extraordinarily abundant, while others producing two or three times as many young are much less plentiful? The explanation is not difficult. The food most congenial to this species, and on which it thrives best, is abundantly distributed over a very extensive region, offering such differences of soil and climate, that in one part or another of the area the supply never fails. The bird is capable of a very rapid and long-continued flight, so that it can pass without fatigue over the whole of the district it inhabits, and as soon as the supply of food begins to fail in one place is able to discover a fresh feeding-ground. This example strikingly shows us that the procuring a constant supply [Page 56] of wholesome food is almost the sole condition requisite for ensuring the rapid increase of a given species, since neither the limited fecundity, nor the unrestrained attacks of birds of prey and of man are here sufficient to check it. In no other birds are these peculiar circumstances so strikingly combined. Either their food is more liable to failure, or they have not sufficient power of wing to search for it over an extensive area, or during some season of the year it becomes very scarce, and less wholesome substitutes have to be found; and thus, though more fertile in offspring, they can never increase beyond the supply of food in the least favourable seasons. Many birds can only exist by migrating, when their food becomes scarce, to regions possessing a milder, or at least a different climate, though, as these migrating birds are seldom excessively abundant, it is evident that the countries they visit are still deficient in a constant and abundant supply of wholesome food. Those whose organization does not permit them to migrate when their food becomes periodically scarce, can never attain a large population. This is probably the reason why woodpeckers are scarce with us, while in the tropics they are among the most abundant of solitary birds. Thus the house sparrow is

more abundant than the redbreast, because its food is more constant and plentiful,—seeds of grasses being preserved during the winter, and our farm-yards and stubble-fields furnishing an almost inexhaustible supply. Why, as a general rule, are aquatic, and especially sea birds, very numerous in individuals? Not because they are more prolific than others, generally the contrary; but because their food never fails, the sea-shores and river-banks daily swarming with a fresh supply of small mollusca and crustacea. Exactly the same laws will apply to mammals. Wild cats are prolific and have few enemies; why then are they never as abundant as rabbits? The only intelligible answer is, that their supply of food is more precarious. It appears evident, therefore, that so long as a country remains physically unchanged, the numbers of its animal population cannot materially increase. If one species does so, some others requiring the same kind of food must diminish in proportion. The numbers that die annually must be immense; and as the individual existence of each animal depends upon itself, those that die must be the weakest—the very young, the aged, and the diseased,—while those that prolong their existence can only be the most perfect in health and vigour—those who are best able to obtain food regularly, and avoid their numerous enemies. It is, as we commenced by remarking, "a struggle for existence," in [Page 57] which the weakest and least perfectly organized must always succumb.

Now it is clear that what takes place among the individuals of a species must also occur among the several allied species of a group,—viz. that those which are best adapted to obtain a regular supply of food, and to defend themselves against the attacks of their enemies and the vicissitudes of the seasons, must necessarily obtain and preserve a superiority in population; while those species which from some defect of power or organization are the least capable of counteracting the vicissitudes of food, supply, &c., must diminish in numbers, and, in extreme cases, become altogether extinct. Between these extremes the species will present various degrees of capacity for ensuring the means of preserving life; and it is thus we account for the abundance or rarity of species. Our ignorance will generally prevent us from accurately tracing the effects to their causes; but could we become perfectly acquainted with the organization and habits of the various species of animals, and could we measure the capacity of each for performing the different acts necessary to its safety and existence under all the varying circumstances by which it is surrounded, we might be able even to calculate the proportionate abundance of individuals which is the necessary result. If now we have succeeded in establishing these two points—1st, that the animal population of a country is generally stationary, being kept down by a periodical deficiency of food, and other checks; and, 2nd, that the comparative abundance or scarcity of the individuals of the several species is entirely due to their organization and resulting habits, which, rendering it more difficult to procure a regular supply of food and to provide for their personal safety in some cases than in others, can only be balanced by a difference in the population which have to exist in a given area—we shall be in a condition to proceed to the consideration of varieties, to which the preceding remarks have a direct and very important application.

Most or perhaps all the variations from the typical form of a species must have some definite effect, however slight, on the habits or capacities of the individuals. Even a change of colour might, by rendering them more or less distinguishable, affect their safety; a greater or less development of hair might modify their habits. More important changes, such as an increase in the power or dimensions of the limbs or any of the external organs, would more or less affect their mode of procuring food or the range of [Page 58] country which they inhabit. It is also evident that most changes would affect, either favourably or adversely, the powers of prolonging existence. An antelope with shorter or weaker legs must necessarily suffer more from the attacks of the feline carnivora; the passenger pigeon with less powerful wings would sooner or later be affected in its powers of procuring a regular supply of food; and in both cases the result must necessarily be a diminution of the population of the modified species. If, on the other hand, any species should produce a variety having slightly increased powers of preserving existence, that variety must inevitably in time acquire a superiority in numbers. These results must follow as surely as old age, intemperance, or scarcity of food produce an increased mortality. In both cases there may be many individual exceptions; but on the average the rule will invariably be found to hold good. All varieties will therefore fall into two classes—those which under the same conditions would never reach the population of the parent species, and those which would in time obtain and keep a numerical superiority. Now, let some alteration of physical conditions occur in the district—a long period of drought, a destruction of vegetation by locusts, the irruption of some new carnivorous animal seeking

"pastures new"—any change in fact tending to render existence more difficult to the species in question, and tasking its utmost powers to avoid complete exterminations; it is evident that, of all the individuals composing the species, those forming the least numerous and most feebly organized variety would suffer first, and, were pressure severe, must soon become extinct. The same causes continuing in action, the parent species would next suffer, would gradually diminish in numbers, and with a recurrence of similar unfavourable conditions might also become extinct. The superior variety would then alone remain, and on a return to favourable circumstances would rapidly increase in numbers and occupy the place of the extinct species and variety.

The variety would now have replaced the species, of which it would be a more perfectly developed and more highly organized form. It would be in all respects better adapted to secure its safety, and to prolong its individual existence and that of the race. Such a variety could not return to the original form; for that form is an inferior one, and could never compete with it for existence. Granted, therefore, a "tendency" to reproduce the original type of the species, still the variety must ever remain preponderant in numbers, and under adverse physical conditions again alone survive. [Page 59] But this new, improved, and populous race might itself, in course of time, give rise to new varieties, exhibiting several diverging modifications of form, any of which, tending to increase the facilities for preserving existence, must, by the same general law, in their turn become predominant. Here, then, we have progression and continued divergence deduced from the general laws which regulate the existence of animals in a state of nature, and from the undisputed fact that varieties do frequently occur. It is not, however, contended that this result would be invariable; a change of physical conditions in the district might at times materially modify it, rendering the race which had been the most capable of supporting existence under the former conditions now the least so, and even causing the extinction of the newer and, for a time, superior race, while the old or parent species and its first inferior varieties continued to flourish. Variations in unimportant parts might also occur, having no perceptible effect on the life-preserving powers; and the varieties so furnished might run a course parallel with the parent species, either giving rise to further variations or returning to the former type. All we argue for is, that certain varieties have a tendency to maintain their existence longer than the original species, and this tendency must make itself felt; for though the doctrine of chances or averages can never be trusted to on a limited scale, yet, if applied to high numbers, the results come nearer to what theory demands, and, as we approach to an infinity of examples, become strictly accurate. Now the scale on which nature works is so vast—the numbers of individuals and periods of time with which she deals approach so near to infinity, that any cause, however slight, and however liable to be veiled and counteracted by accidental circumstances, must in the end produce its full legitimate results.

Let us now turn to domesticated animals, and inquire how varieties produced among them are affected by the principles here enunciated. The essential difference in the condition of wild and domestic animals is this,—that among the former, their well-being and very existence depend upon the full exercise and healthy condition of all their senses and physical powers, whereas, among the latter, these are only partially exercised, and in some cases are absolutely unused. A wild animal has to search, and often to labour, for every mouthful of food—to exercise sight, hearing, and smell in seeking it, and in avoiding dangers, in procuring shelter from the inclemency of the seasons, and in providing for the subsistence and safety of its offspring. There is no muscle of [Page 60] its body that is not called into daily and hourly activity; there is no sense or faculty that is not strengthened by continual exercise. The domestic animal, on the other hand, has food provided for it, is sheltered, and often confined, to guard it against the vicissitudes of the seasons, is carefully secured from the attacks of its natural enemies, and seldom even rears its young without human assistance. Half of its senses and faculties are quite useless; and the other half are but occasionally called into feeble exercise, while even its muscular system is only irregularly called into action.

Now when a variety of such an animal occurs, having increased power or capacity in any organ or sense, such increase is totally useless, is never called into action, and may even exist without the animal ever becoming aware of it. In the wild animal, on the contrary, all its faculties and powers being brought into full action for the necessities of existence, any increase becomes immediately available, is strengthened by exercise, and must even slightly modify the food, the habits, and the whole economy of

the race. It creates as it were a new animal, one of superior powers, and which will necessarily increase in numbers and outlive those inferior to it.

Again, in the domesticated animal all variations have an equal chance of continuance; and those which would decidedly render a wild animal unable to compete with its fellows and continue its existence are no disadvantage whatever in a state of domesticity. Our quickly fattening pigs, short-legged sheep, pouter pigeons, and poodle dogs could never have come into existence in a state of nature, because the very first step towards such inferior forms would have led to the rapid extinction of the race; still less could they now exist in competition with their wild allies. The great speed but slight endurance of the race horse, the unwieldy strength of the ploughman's team, would both be useless in a state of nature. If turned wild on the pampas, such animals would probably soon become extinct, or under favourable circumstances might each lose those extreme qualities which would never be called into action, and in a few generations would revert to a common type, which must be that in which the various powers and faculties are so proportioned to each other as to be best adapted to procure food and secure safety,—that in which by the full exercise of every part of his organization the animal can alone continue to live. Domestic varieties, when turned wild, must return to something near the type of the original wild stock, or become altogether extinct.

[Page 61] We see, then, that no inferences as to varieties in a state of nature can be deduced from the observation of those occurring among domestic animals. The two are so much opposed to each other in every circumstance of their existence, that what applies to the one is almost sure not to apply to the other. Domestic animals are abnormal, irregular, artificial; they are subject to varieties which never occur and never can occur in a state of nature: their very existence depends altogether on human care; so far are many of them removed from that just proportion of faculties, that true balance of organization, by means of which alone an animal left to its own resources can preserve its existence and continue its race.

The hypothesis of Lamarck—that progressive changes in species have been produced by the attempts of animals to increase the development of their own organs, and thus modify their structure and habits—has been repeatedly and easily refuted by all writers on the subject of varieties and species, and it seems to have been considered that when this was done the whole question has been finally settled; but the view here developed renders such an hypothesis quite unnecessary, by showing that similar results must be produced by the action of principles constantly at work in nature. The powerful retractile talons of the falcon- and the cat-tribes have not been produced or increased by the volition of those animals; but among the different varieties which occurred in the earlier and less highly organized forms of these groups, those always survived longest which had the greatest facilities for seizing their prey. Neither did the giraffe acquire its long neck by desiring to reach the foliage of the more lofty shrubs, and constantly stretching its neck for the purpose, but because any varieties which occurred among its antitypes with a longer neck than usual at once secured a fresh range of pasture over the same ground as their shorter-necked companions, and on the first scarcity of food were thereby enabled to outlive them. Even the peculiar colours of many animals, especially insects, so closely resembling the soil or the leaves or the trunks on which they habitually reside, are explained on the same principle; for though in the course of ages varieties of many tints may have occurred, yet those races having colours best adapted to concealment from their enemies would inevitably survive the longest. We have also here an acting cause to account for that balance so often observed in nature,—a deficiency in one set of organs always being compensated by an increased development of some others—powerful wings accompanying weak [Page 62] feet, or great velocity making up for the absence of defensive weapons; for it has been shown that all varieties in which an unbalanced deficiency occurred could not long continue their existence. The action of this principle is exactly like that of the centrifugal governor of the steam engine, which checks and corrects any irregularities almost before they become evident; and in like manner no unbalanced deficiency in the animal kingdom can ever reach any conspicuous magnitude, because it would make itself felt at the very first step, by rendering existence difficult and extinction almost sure soon to follow. An origin such as is here advocated will also agree with the peculiar character of the modifications of form and structure which obtain in organized beings—the many lines of divergence from a central type, the increasing efficiency and power of a particular organ through a succession of allied species, and the remarkable persistence of unimportant parts such as colour, texture of plumage and hair, form of horns or

crests, through a series of species differing considerably in more essential characters. It also furnishes us with a reason for that "more specialized structure" which Professor Owen states to be a characteristic of recent compared with extinct forms, and which would evidently be the result of the progressive modification of any organ applied to a special purpose in the animal economy.

We believe we have now shown that there is a tendency in nature to the continued progression of certain classes of varieties further and further from the original type—a progression to which there appears no reason to assign any definite limits—and that the same principle which produces this result in a state of nature will also explain why domestic varieties have a tendency to revert to the original type. This progression, by minute steps, in various directions, but always checked and balanced by the necessary conditions, subject to which alone existence can be preserved, may, it is believed, be followed out so as to agree with all the phenomena presented by organized beings, their extinction and succession in past ages, and all the extraordinary modifications of form, instinct, and habits which they exhibit.

Ternate, February, 1858.