DARWIN'S NOTEBOOKS ON TRANSMUTATION OF SPECIES PART I. FIRST NOTEBOOK (JULY 1837—FEBRUARY 1838)

Edited with an Introduction and Notes

BY

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DARWIN'S NOTEBOOKS ON TRANSMUTATION OF SPECIES

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PART I. FIRST NOTEBOOK (JULY 1837–FEBRUARY 1838)

INTRODUCTION

IN Darwin's *Journal*[1] the year 1837 contains an entry which runs, " In July opened first notebook on ' Transmutation of Species '—Had been greatly struck from about month of previous March on character of S. American fossils—& species on Galapagos Archipelago. These facts origin (especially latter) of all my views." This notebook is transcribed and printed below and forms the subject of the present study.

The four Notebooks on Transmutation of Species are the first implementation of the suggestion put forward by Darwin in his Ornithological Notebook[2] referring to his visit to the Galapagos Islands in September and October 1835. There he wrote :—" When I recollect the fact, that from the form of body, shape of scale and general size, the Spaniards can at once pronounce from which Isd. any tortoise may have been brought :—When I see these Islands in sight of each other and possessed of but a scanty stock of animals, tenanted by these birds but slightly different in structure and filling the same place in Nature, I must suspect they are only varieties. The only fact of a similar kind of which I am aware is the constant asserted difference between the Wolf-like Fox of East and West Falkland Islands.—If there is the slightest foundation for these remarks, the Zoology of Archipelagoes will be well worth examining ; for such facts would undermine the stability of species ".

The First Notebook, begun in July 1837, represents the state of Darwin's opinion as it developed six months after his return to England, the results of his consulting the literature on the subject, and the first formulation of his conviction that the stability of species had been " undermined ".

It will be noticed that the passage from the *Journal* quoted above must have been a retrospective entry written at a later date, for if he only began his Notebook in July 1837 he could not then have known what " all his views " were. In this First Notebook itself Darwin stated that he finished it " probably " in February 1838,

[1] " Darwin's Journal ", edited by Sir Gavin de Beer, *Bull. Brit. Mus.* (*Nat. Hist.*) Historical Series, vol. 2, p. 1, 1959.

[2] *Charles Darwin and the Voyage of the Beagle*, edited by Nora Barlow, London 1945, p. 246. It is not known at what exact date these words were written.

and this was nine months before he read Malthus's *Essay on Population* which, as he said[1] (and Wallace also admitted[2] in his own case) supplied him with the remaining piece that he required to complete the construction of his argument. What that argument was is known from Darwin's[3] *Sketch* of 1842 and *Essay* of 1844, from which the *Origin of Species* was elaborated without much novelty of principle.

The First Notebook is therefore of great importance in tracing the course of his thoughts and the extent of his knowledge before his cognisance of Malthus's work, and will throw light on what it was in the latter which gave Darwin that extra idea which acted as a spark and launched him on his course.

At the outset, however, it must be made clear that the Notebooks all suffer from a grave defect. In the First Notebook Darwin himself wrote on the first page[4]: " All useful pages cut out. December 7, 1856. (and again looked through April 29, 1873)." In spite of all attempts to trace the missing fifty pages, in the Cambridge University Library where Mr P. J. Gautrey searched for them, at Down House and the Royal College of Surgeons where Miss J. Dobson looked for them, and in the British Museum (Natural History) where Miss M. Skramovsky hunted for them among the letters addressed to Darwin deposited by Mr Robin Darwin, they could not be found. The nature of their contents can only be surmised after a close study of the two hundred and thirty pages that remain, and an estimate can be made of what is missing from the information and the argument.

Another reason why the Notebooks are important is because Darwin has from time to time been reproached for having obtained information from the writings of other men without acknowledging the source. The *Origin of Species*, as is well known, contains the names of Darwin's authorities for the facts stated, but not their bibliographical references, for Darwin regarded his book as only an abstract from the much larger work on which he was then engaged but never finished. The *Sketch* of 1842 and the *Essay* of 1844, likewise, contain names without bibliographical references, but they were written only as an exercise in reviewing the state of his own argument and not intended for publication. The Notebooks, as will be seen, contain names and references.

Before any conclusion can be drawn on Darwin's indebtedness to his predecessors three considerations must be borne in mind. The first is the precise identification of what the original contribution to science was which Darwin himself claimed to have made. This is known from a letter[5] which he sent on 18th January 1860 to Baden Powell. " No educated person ", he wrote, " not even the most ignorant, could suppose that I meant to arrogate to myself the origination of the doctrine that species had not been independently created. The only novelty in my work is the attempt to explain *how* species became modified, & to a certain extent how the

[1] *The Autobiography of Charles Darwin*, edited by Nora Barlow, London 1958, p. 120.

[2] Alfred Russel Wallace, " Note on the passages of Malthus's ' Principles of Population ' which suggested the idea of natural selection to Darwin and myself." *The Darwin and Wallace Celebration held on Thursday, 1 July 1908 by the Linnean Society of London*, London 1908, pp. 111–118 ; especially p. 117.

[3] Darwin's *Sketch* of 1842, and *Essay* of 1844 are reprinted in Charles Darwin and Alfred Russel Wallace : *Evolution by Natural Selection* with a Foreword by Sir Gavin de Beer, Cambridge 1958.

[4] All page references to Darwin's Notebooks on transmutation of species are to the pagination of the original manuscripts indicated in the margin of the transcription printed below.

[5] " Some unpublished letters of Charles Darwin ", edited by Sir Gavin de Beer, *Notes and Records of the Royal Society of London*, vol. 14, 1959, p. 52.

theory of descent explains certain large classes of facts ; & in these respects I received no assistance from my predecessors."

In arriving at a just appraisal of Darwin's character, this quoted passage is very important, and his contention is correct. Some of his predecessors, as will be seen, acknowledged evolution but had no notion of any mechanism adequate to explain its cause, let alone any idea of natural selection ; two contemporaries[1] recognized natural selection but used it to prove that evolution could not occur. Unknown to Darwin, two other men[2] had, before him, grasped the solution of the problem and stated that natural selection could cause modification of species ; but they were very far from being able to appreciate the significance of what they had done, provide evidence to support it, or work out its consequences.

The second consideration to bear in mind is that while Darwin was always on the look-out for facts, what he most hoped for in the works of his predecessors and contemporaries was ideas.

The third consideration is the necessity of appreciating what information and opinions, correct and false, were available in 1837 when Darwin " opened " his Notebook. Chief among these was the folk-belief in the inheritance of acquired characters. As Conway Zirkle has shown,[3] this is based on an uncritical combination of two propositions each of which by itself is approximately correct. The first is that organisms can be changed, often in an adaptive manner, by the conditions of the environment. The blacksmith's muscles are enlarged as a result of wielding his hammer. The second proposition is that organisms tend to produce offspring like themselves not only in physical features but in functional characters like gait and voice. Hence the conclusion is drawn that parents modified by the environment will produce offspring showing the same modifications.

This syllogism is invalidated because its middle term (resemblance between parent and offspring) is not only undistributed, but, as modern genetics has proved, fallacious. Offspring are not the product of their parents, but of germ-cells of which the parents are only the life-custodians. The old block produces no chip but is the elder brother, and the chip resembles him, if he does, because both are the product of the same line of germ-plasm.

The old wives' tale of the hereditary effect of environmentally evoked modifications or inheritance of acquired characters is deeply built-in to folk lore. It appears in one of the earliest Greek myths. When Phaethon drove his father Apollo's chariot across the sky, the horses got out of control and carried the sun much too near Abyssinia with the result that the Ethiopians' skins were scorched black, and their offspring became the negroes.

In the form of hereditary transmission of maternal impressions, it also appears in the Old Testament.[4] Jacob when working for Laban agreed that he could not have any white sheep or unspotted goats, but if any lambs were born brown or any goats spotted and speckled, he might have them for himself. Jacob thereupon

[1] Charles Lyell and Edward Blyth.
[2] William Charles Wells and Patrick Matthew.
[3] Conway Zirkle. " The early history of the idea of the inheritance of acquired characters and of pangenesis ", *Trans. Amer. Phil. Soc.*, vol. 35, 1946, p. 91.
[4] *Genesis*, 30, 30–42.

selected the strongest animals and presented to their eyes striped patterns of green leaves and white rods just before they conceived, with the result that they " brought forth cattle ringstraked, speckled, and spotted " which therefore belonged to Jacob ; the weaker, untreated animals produced offspring which remained true to the specification of Laban's property.

In the revival of science in the 18th century, Maupertuis, Diderot, Buffon, Erasmus Darwin, and Lamarck accepted the hereditary transmission of environmentally induced modifications as a matter of course.[1] It would never have occurred to them, or to Darwin, to doubt it. Nor would it have occurred to Darwin that in making use of this notion he was in any way indebted to Lamarck. In all the history of science before 1800 only three names stand out in opposition to the old fallacy : Lucretius, because he believed in particulate inheritance with " atoms " of inheritance derived from previous generations ; Charles Bonnet, whose theory of *emboitement* of all future generations within the parent involved predetermination which could not admit of modification ; and Immanuel Kant, who repudiated it because otherwise evolution would have occurred, and he believed that it had not.

As Loren Eiseley[2] has remarked, it only remains to underline the irony with which this fallacy has been identified with the name of Lamarck who did not invent it. The term " Lamarckism " should in all justice be applied to evolution itself, since he was the first to advocate it as a co-ordinated system.

Belief in the inheritance of acquired characters was a consequence of the total ignorance of the nature of hereditary transmission. For incontrovertible experimental knowledge of this process, science had to wait not only for Gregor Mendel to publish his results in 1866, but for scientists to rediscover them in 1900 ; for T. H. Morgan and his colleagues to extend them and correlate them with the results of research in chromosome cytology, developed to a marvellous degree by C. Stern and C. D. Darlington ; and for Sir Ronald Fisher[3] to produce his great synthesis in 1930, wherein he demonstrated that the mechanism of particulate inheritance of Mendelian genes which remain uncontaminated, segregate, recombine, self-copy, and occasionally mutate, provides exactly what Darwinian selection theory requires to explain the source of variation ; that Selection provides exactly what Mendelian theory requires to explain why some genes become dominant, others recessive, and others again suppressed ; and that no mechanism other than selection will explain all the facts.[4]

In Darwin's day there was nothing to go on at all except the age-old belief that like tends to beget like, and that when parents differed their offspring represented an average between them. This view is referred to as " blending inheritance ", and it permeates Darwin's work and caused him the greatest trouble since it supposed that variance was halved at each generation and obliterated in ten generations, which therefore made it so difficult to account for the necessary supply of variation.

It is not easy today to realize the difficulty presented in Darwin's time by the

[1] Jean Rostand. *L'évolution des espèces*, Paris 1932, and *L'atomisme en biologie*, Paris 1956.
[2] Loren Eiseley. *Darwin's Century*, London 1959, p. 204.
[3] R. A. Fisher. *The Genetical Theory of Selection*, Oxford 1930.
[4] R. A. Fisher. " The bearing of genetics on the theory of evolution ", *Science Progress*, vol. 27, 1932, p. 15.

extinction of species. To admit that species of plants or animals could become extinct involved the admission that the protection of divine providence had been withheld from such species, and a considerable part of Darwin's early work was devoted to this problem, which was really a necessary corollary to the view that species were mutable. If in accordance with the hypothesis of mutability species split and gave rise to other species, the problem of the disposal of old obsolete species necessarily arose, and its solution by accepting the fact of extinction was not only an inevitable conclusion, but a help to Darwin in explaining why the gaps between some species were larger than those between others.

There was another fallacy which obstructed the progress of biological science, especially in Great Britain during the twenties and thirties of the nineteenth century, namely the quinarian theory[1] associated with the name of William Sharp MacLeay. This was the mystical system of classification built on the supposition that at all levels the animal kingdom is based on five groups arranged in a circle, each with affinities to its neighbours on both sides, each containing five sub-groups arranged in a comparable manner with affinities to their neighbours, and so on. According to MacLeay, " There are five great circular groups in the animal kingdom which possess each a peculiar structure," and " these, when connected by means of five smaller osculant groups, compose the whole province of zoology."[2] In the Crustacean circle, itself one of the five groups of the Annulosa, the Decapoda " have relations of analogy " with the Araneidea of the Arachnid circle while the latter's Acaridea have " relations of analogy " with the Diptera of the neighbouring insect circle.

Presently, Edward Newman improved on MacLeay's quinarian system by substituting the number 7 for 5 because of the 7th day of Creation, etc. " Most groups of animals with which we are tolerably well acquainted are divisible into seven ; we shall never find the number greater, and when less, we shall invariably perceive that the deficiency exists in groups of which our knowledge is particularly limited."[3]

There would be no need to make mention of such abject nonsense were it not for the fact that at the time when Darwin opened his Notebook these notions were current, and, as will be seen, (pp. 46, 129), Darwin himself had to struggle through them when considering the problem of affinities between different groups.

Next, it will be profitable to consider the legacies of Darwin's immediate predecessors and the contributions of his contemporaries that were known to him. First comes Erasmus Darwin.[4]

Erasmus Darwin believed in the transmutation of species and evolution because of the observed changes undergone by organisms during their life-history, the changes brought about by domestication and resulting from hybridization, and monstrous

[1] William Sharp MacLeay. *Horae entomologicae*, London 1819–21. The Quinarian System was also adopted by William Swainson : *The natural history and classification of birds, Lardner's Cabinet Cyclopaedia*, London 1837, vol. 2, pp. 56 and 100.

[2] MacLeay. *op. cit.* p. 318.

[3] Edward Newman. *Sphinx vespiformis* : *an essay*, London 1832, p. 15. Since nature possesses the tendency for the formation of globes or circles (e.g. the sun and its planets), he agrees with the principle of MacLeay's quinarian system, but substitutes the number 7 for 5, because God rested on the 7th day, Noah took 7 clean animals into the ark, there were 7 plagues, 7 years of famine, 7 years of plenty, 7 golden candlesticks, 7 churches, 7 angels, 7 spirits of God.

[4] Erasmus Darwin. *Zoonomia* ; *or, the laws of organic life*, vol. 1, London 1794.

births. He was aware of the general similarity of structure shown by vertebrate animals, and he believed that the modification of species was brought about by the satisfaction of wants for " lust, hunger, and danger ",[1] and as a result of " their own exertions in consequence of their desires and aversions, of their pleasures and pains, or of irritations, or of associations ; and many of those acquired forms or propensities are transmitted to their posterity."[2] He therefore accepted the inheritance of acquired characters.

In his work, an astonishing number of principles can be found which echo later developments in Darwin's hands. Adaptation, protective colouration, the struggle for existence, artificial selection, sexual selection, vestigial organs, the importance of cross-fertilization, the significance of monsters as proof against preformation in primordial germs, and the occurrence of mutations such as polydactylous cats and rumpless fowls, are all touched on. But when Erasmus Darwin ascribed the production of adaptation to " the power of acquiring new parts, attended with new propensities, directed by irritations, sensations, volitions, and associations ; and thus possessing the faculties of continuing to improve by its own inherent activity, and of delivering down those improvements to its posterity, world without end ",[3] a " power working from within ", and " internal impulse ", or a " living force ," it is easy to see why such a hard-headed scientist as Darwin should have been " much disappointed, the proportion of speculation being so large to the facts given " in the work of his grandfather.

One observation Darwin did cull from Erasmus Darwin's *Zoonomia*, as the First Notebook shows (p. 1), namely that sexual reproduction is conducive to variation, whereas asexual reproduction allows of none.[4] This fact, which has no direct bearing on Erasmus Darwin's views on evolution, became the basis of Darwin's views on the supply of variation.

Lamarck[5] believed in the mutability of species because of the difficulty of distinguishing between species and varieties,[6] and having with a stroke of genius substituted for the old static scale of beings a dynamic branching tree,[7] his was the first scientific formulation of the " transformism " of species, although he only assumed it as axiomatic and provided no evidence to support it. He was familiar with the fact of the struggle for existence[8] and the importance of adaptation ; he realized the vast amount of time required for evolution to have taken place, but appeared to think that species had not suffered extinction but had instead become transformed.[9]

Before proceeding to consider Lamarck's attempt to provide an explanation of

[1] Erasmus Darwin. *op. cit.* p. 503.
[2] Erasmus Darwin. *op. cit.* p. 503.
[3] Erasmus Darwin. *op. cit.* p. 505, cf. also p. 500 : " in the more advanced state of the fetus, it evidently possesses volition ; as it frequently changes its attitude, though it seems to sleep the greatest part of its time ; and afterwards the power of volition contributes to change or alter many parts of the body during its growth to manhood, by our early modes of exertion in the various departments of life."
[4] Erasmus Darwin. *op. cit.* p. 487.
[5] Jean Baptiste de Lamarck. *Philosophie Zoologique*, Paris 1809.
[6] Lamarck. *op. cit.* vol. 1, p. 73.
[7] Lamarck. *op. cit.* vol. 1, p. 76 : " une série rameuse."
[8] Lamarck. *op. cit.* vol. 1, p. 112.
[9] Lamarck. *op. cit.* vol. 1, p. 93.

the cause of " transformism "[1] or " evolution " as Lyell[2] termed it, there is a matter which calls for attention in the reasoning behind Lamarck's argument by which he reached the conclusion that transformism had occurred. It was based on the notion that the greater the number of species of a genus that were collected and studied, the more they appeared to grade insensibly into one another, with the result that taxonomic distinctions could not be made between them. If this were really so, systematic classification would be logically impossible. Using the expression of " species-barrier ", so happily coined by Professor Loren Eiseley,[3] it could be said that Lamarck did not discover the solution to the problem of how to penetrate it, but that he abolished it. As Sir Ronald Fisher has pointed out,[4] this criticism must not be applied to the solution found by Darwin of how the species-barrier could be penetrated, because Darwin was careful to recognize that species are well-defined even if their limiting characters are changeable.

Lamarck's explanation of the cause of transformism is contained in his four laws[5]:— 1. Life, by its own forces, tends continually to increase the volume of every body possessing it and to extend the dimensions of its parts, up to the limits which it sets itself. 2. The production of a new organ in an animal body results from the emergence of a new need which continues to make itself felt, and a new movement which this need evokes and maintains. 3. The development of organs and their power of action stand in constant relation to their use. 4. Everything that has been acquired, traced, or changed in the organization of individuals in the course of their life is preserved by generation and transmitted to the new individuals that descend from those which have experienced those changes.

The tendency to perfection[6] resulting from Lamarck's first Law necessitated an explanation of the persistence on earth of forms like infusoria which remain " imperfect ", and this he provided by supposing that spontaneous generation[7] had taken place continuously, and that the more " imperfect " an organism is, the more recently its stock was generated.

The " movements " from which the production of new organs is supposed to follow,

[1] The term " transformism " is preferred by many French-speaking authors (e.g. Alphonse de Candolle, *Darwin*, 2nd edition, Genève 1882, p. 35) because the successive changes are not always in the direction of increased development but may result in simplification. cf. also Jean Rostand. *L'état présent du transformisme*, Paris 1931, p. 13.

[2] Charles Lyell. *Principles of Geology*, London 1832. vol. 2, p. 11 which contains the first use in English of the term evolution in its present accepted sense.

[3] Eiseley. " Charles Darwin, Edward Blyth, and the theory of natural selection." *Proc. Amer. Phil. Soc.* vol. 103, 1959, p. 108.

[4] Sir Ronald Fisher. " Retrospect of the criticisms of the theory of natural selection ", *Evolution as a Process* edited by Julian Huxley, A. C. Hardy and E. B. Ford, London 1954, p. 88.

[5] Lamarck. *Histoire naturelle des animaux sans vertèbres*, Paris 1815, vol. 1, p. 181 : " 1ère loi. La vie, par ses propres forces, tend continuellement à accroître le volume de tout corps qui la possède, et à étendre les dimensions de ses parties, jusqu'à un terme qu'elle amène elle-même.

"2ième loi. La production d'un nouvel organe dans un corps animal, résulte d'un nouveau besoin survenu qui continue de se faire sentir, et d'un nouveau mouvement que ce besoin fait naître et entretient.

"3ième loi. Le développement des organes et leur force d'action sont constamment en raison de l'emploi de ces organes.

"4ième loi. Tout ce qui a été acquis, tracé ou changé, dans l'organisation des individus, pendant le cours de leur vie, est conservé par la génération, et transmis aux nouveaux individus qui proviennent de ceux qui ont éprouvé ces changemens."

[6] Lamarck. *Philosophie Zoologique*, vol. 1, p. 263.

[7] Lamarck. *Philosophie Zoologique*, vol. 1, p. 82 ; vol. 2, p. 78.

Lamarck contended are due to the *sentiment intérieur*,[1] or inner feeling possessed by " those animals which have a nervous system sufficiently developed to permit them to experience sensation. This feeling, although obscure, is very powerful for it is the source of the internal emotions experienced by those individuals that possess it, and therefore is the source of that curious force which places those individuals in a position to produce themselves the movements and actions which their needs demand ". Lamarck's attempts to define his *sentiment intérieur* were not felicitous. In one place he wrote[2] of " the emotions of the inner feeling which actuate animals and man himself, sometimes without any participation of the will, sometimes by an act of volition that gives rise to it." Elsewhere,[3] the inner feeling is made responsible for the good time with which a deaf and dumb girl was able to play the piano, " the whole of her person was actuated by measured movements of her inner feeling ".

It has been held that Lamarck's reputation has suffered from faulty translation of his works ; but to those who are competent to dispense with translation his works are not more acceptable, because his conclusions are contrary to the results of observation and experiment. When it is contended, as it has been, that the essence of Lamarckism is that when structures become necessary they appear, the matter ceases to belong to the realms of science. Animals strive for food, mates, and protection, and they scour for habitats and select them as Charles Elton[4] has stressed, which increases the possibilities of adaptation by multiplying the occasions for trial and error and exposing organisms of different genetic composition to different environments ; but this characteristic behaviour of mobile animals is not explained by ascribing an " inner feeling " to them ; nor is this an acceptable substitute for natural selection, mutation, and recombination of genes to account for evolution.

The similarity between Erasmus Darwin's " volition " and Lamarck's " inner feeling " as agents made responsible for evolution is remarkable, but there is no reason to suppose that the latter owed anything to the former ; still less to imagine that Darwin was not speaking the truth when he said of Lamarck's work that he " got not a fact or idea from it ".

Charles Lyell's work, without any doubt, exerted the most important influence on Darwin's thought. Curiously enough, this was not because of any facts which enabled Darwin to construct his theories of coral reefs or of evolution by natural selection ; on the contrary, in these subjects Darwin contradicted most of what Lyell had thought or written. It was the background of uniformitarianism in Lyell's *Principles of Geology* which provided Darwin with the general orientation of thought and method which enabled him to succeed where others, including Lyell himself,

[1] Lamarck. *Philosophie Zoologique*, vol. 2 p. 256 : le " *sentiment intérieur*, n'est point commun à tous les corps vivants, et ... ne l'est pas même à tous les animaux, ... est un sentiment ... dont sont doués les animaux qui ont un système nerveux assez développé pour leur donner la faculté de sentir."

[2] Lamarck. *op. cit.* vol 2, p. 259 : Les " émotions du sentiment intérieur, qui font agir les animaux et l'homme même, tantôt sans aucune participation de leur volonté, et tantôt par une volonté qui y donne lieu ... sentiment intérieur ... susceptible de s'émouvoir par des causes qui l'affectent ; or, ces causes sont toujours le besoin, soit d'assouvir la faim, soit de fuir les dangers, d'éviter la douleur, de rechercher le plaisir, ou ce qui est agréable à l'individu."

[3] Lamarck. *op. cit.* vol. 2, p. 262 : " toute sa personne etait mue par des mouvements mesurés de son sentiment intérieur."

[4] Charles Elton. *Animal Ecology and Evolution*, Oxford 1930, p. 51.

had failed to build and establish a coherent and scientifically satisfactory basis for biology.

As Professor Loren Eiseley[1] has so convincingly shown, it is an astonishing irony of history of science that Lyell did not discover Darwin's solution to the problem, for Lyell possessed all the ingredients which Darwin required to construct his theory. Already in 1832, the year in which the second volume of his *Principles of Geology* appeared, Lyell was familiar with the struggle for existence, ecological balance, the extinction of species, and even with the principle of natural selection by which extinction was brought about :[2] " A faint image of the certain doom of a species less fitted to struggle with some new condition in a region which it previously inhabited, and where it has to contend with a more vigorous species, is presented by the extirpation of savage tribes of man by the advancing colony of some civilized nation." But as Lyell in these early years refused to accept evolution, natural selection had no part to play in bringing it about in his scheme. Lyell recognized the succession of species and was well acquainted with the facts of geographical and geological distribution. The only thing which he rejected, as just stated, was evolution itself, and the curious reason for this has been admirably brought to light by Professor Eiseley.

Cuvier had broken the old notion of the scale of beings as a figurative single beanstalk, and had substituted for it a succession of stages of life, each terminated by a catastrophe. " Catastrophism " required that life started again after each revolution ; but as it was obvious that the forms of life showed progress in organization after each catastrophe, it was necessary to invoke a principle of " progressionism " on the part of the creative power. Imbued with the superior scientific value of uniformitarianism over catastrophism, Lyell repudiated the latter and, therefore, progressionism with it. The baby of evolution was thrown out with the bathwater of pseudo-geological magic, and Lyell missed one of the finest opportunities in the history of science. This was perhaps the greatest debt that Darwin owed to him.

The First Notebook contains a number of references to the names and works of other men, some of which may have been the start of ideas which subsequently played parts of great importance in the construction of Darwin's system. Among these is Cuvier whose views on the immutability of species Darwin of course challenged (pp. 53, 88, 89). But there is also a reference (p. 118) to some remarks by Cuvier's brother Frédéric on the production of domestic races of animals, in the course of which he wrote : " we could only produce domestic individuals and not races, without the concurrence of one of the most general laws of life, the transmission of the organic or intellectual modifications by generation. Here one of the most astonishing phenomena of nature manifests itself to us, the transmission of a *fortuitous* [our italics] modification into a durable form, of a fugitive want into a fundamental propensity, of an accidental habit into an instinct."

Professor Eiseley[3] has drawn attention to the extremely important question of what led Darwin to believe in the chance emergence of new characters. It is the

[1] Eiseley. *Darwin's century*, p. 102.
[2] Charles Lyell. *Principles of Geology*, vol. 2, London 1832, p. 175.
[3] Eiseley. *op. cit.* p. 202.

fundamental difference between the Darwinian view of fortuitous variation (which has been experimentally demonstrated by Sir Ronald Fisher as correct), and all other attempts to explain evolution as due to adaptively directed mutation. It is at the base of the argument about design. If variation were designed, as Darwin wrote[1] to Asa Gray, 26th November 1860, " you would have to believe that the tail of the Fantail was led to vary in the number and direction of its feathers in order to gratify the caprice of a few men "; and again[2] on 5th June 1861 : " It is not that designed variation makes, as it seems to me, my deity ' Natural Selection ' superfluous, but rather from studying, lately, domestic variation, and seeing what an enormous field of undesigned variability there is ready for natural selection to appropriate for any purpose useful to each creature." In the last pages of his book[3] *Variation of animals and plants under domestication*, Darwin drew up a fearsome list of consequences for those who believe in designed rather than in fortuitous variation, for they would be obliged to accept design as responsible for hosts of variations that are most injurious to the organisms concerned. Today, with modern knowledge of the properties of lethal genes, such arguments appear elementary, but in Darwin's day they were very topical, and it is at least probable that Frédéric Cuvier's remarks on " fortuitous modifications " started Darwin on this fundamentally important train of thought.

In the light of recent research on mutation of genes, the term " fortuitous " variation is preferable to the older term " random " variation, because although no correlation has ever been found between a mutagenic agent and the quality of adaptiveness in the character controlled by the resulting mutant gene, it is clear that chemical properties of mutagenic agents may induce some rather than other mutations. To this extent therefore mutations are fortuitous rather than random, since randomness implies equality of possibilities of mutation in any direction ; but equally there can be no question of biologically significant directedness in the mutations.

The geologist Leopold von Buch is not a source from which it is generally known that Darwin derived information or ideas for his special purposes, and yet in the Notebook of 1837 he is quoted twice for facts which were of supreme importance to Darwin. In the first (p. 156), von Buch related that on the island of Tristan d'Acunha, Du Petit Thouars found only 25 species of flowering plants of which some resembled the flora of the Cape and others that of South America. This played an important part in shaping Darwin's views on the colonization of islands and in framing the rhetorical question whether these species were created like this in order to deceive man (p. 218).

The second reference (p. 158) is even more important, for in it von Buch stated two fundamental propositions quite clearly :— that permanent varieties give rise to distinct species, and that geographical isolation of a region in which such a variety arises is the chief factor in its conversion into a new species by preventing intercrossing with the remainder of the parent population.

[1] *Life and Letters of Charles Darwin*, edited by Francis Darwin, vol. 2, 1887, p. 353.
[2] *Ibid.* vol. 2, p. 373.
[3] London 1868, vol. 2, p. 431.

That Darwin was indebted to Humboldt in a general way was known already from the *Autobiography*, but the Notebook shows (p. 142) that Humboldt's *Personal Narrative* contains a remark which reinforces that of von Buch : " The exclusion of all foreign mixture contributes to perpetuate varieties, or the aberrations from a common standard."

The part which isolation can play in the formation of species is mentioned in the *Origin of Species* (World's Classics p. 105), but in later life Darwin believed that it was not essential : a view contested by Moritz Wagner and Ernst Mayr.[1]

To Etienne Geoffroy-Saint-Hilaire it is possible that Darwin owed the germ of an idea of the relation between final and mediate causes. His name appears in the Notebook (p. 114) in connexion with the notion of the creator giving laws and leaving things to follow their consequences. This idea reappears in the *Sketch* of 1842 (p. 86), the *Essay* of 1844 (p. 254), and the *Origin of Species* (World Classics edition p. 559).

Mention must be made of the Hon. and Rev. William Herbert, the heterodox plant-breeder whose name figures in the Notebook (pp. 180, 191). He supplied Darwin with the information that in some genera the barrier of sterility between the species did not exist, and that there was no real difference between species and varieties.

Another man to whom Darwin was certainly indebted was William Paley, whose works on Natural Theology provided him with a catalogue of cases of adaptation and an argument which he used in reverse to show the efficacy of natural selection without design. His name does not appear in the extant portion of the Notebook, nor is there any reason why it should because neither adaptation nor the problem of design figure in it.

There was also John Stevens Henslow (mentioned on pp. 68 and 230), a devout believer in the fixity of species, to whom Darwin owed no particular information at all, but a great and loyal friendship, encouragement in his pursuits of natural history, the opportunity of embarking on the *Beagle*, and the suggestion that he should take with him (but not agree with) Lyell's *Principles of Geology*.

Edward Blyth was a man with whose works, as Professor Eiseley[2] has shown, Darwin who was his friend must have been familiar, but whose name and works do not appear in the extant portion of the First Notebook although they do in the Second. In a series of papers published between 1835 and 1837, Blyth touched on a number of subjects with which Darwin was concerned, including a remarkable description of the results of variation in species preyed upon by predators such as birds of prey. If the behaviour or colour of the variants departs from the typical specific character, either by failing in vigilance or in assuming a protective attitude or in matching its normal background, or in straying away from its normal background, such variants fall victim to the predator by the natural interplay of causes which remove " all that deviate from their normal or healthy condition, or which occur away from their proper and suitable locality ", and thereby " tend to limit the

[1] Ernst Mayr. " Isolation as an evolutionary factor ", *Proc. Amer. Phil. Soc.*, vol. 103, 1959, p. 221.
[2] Eiseley. " Charles Darwin, Edward Blyth and the Theory of Natural Selection ", *Proc. Amer. Phil. Soc.*, vol. 103, 1959, p. 94.

geographical range of species, and to maintain their pristine characters without blemish or decay to their remotest posterity." In other words, like Lyell before him (see above), Blyth who believed in special creation used the principle of natural selection to prove that species were immutable.

Bearing in mind that Darwin was after only one thing : how species became modified, it may be asked what Darwin's debt to Blyth was. So far as the construction of his theory is concerned, the answer is probably nothing at all. But Professor Eiseley also raises the question whether there were not items of information in Blyth's papers which Darwin built into his own body of knowledge, and bases it on the appearance in Darwin's notebooks and *Sketch* of expressions and statements which are also found in Blyth's papers. One such item is the word " osculant ";[1] others are mentions of Ancon sheep and of mutations such as polydactylous cats or rumpless fowls. Blyth's paper of 1835 and Darwin's First Notebook both contain mention of what Blyth called " the fact, equally well-known, of bullfinches . . . becoming wholly black when fed entirely on hempseed." Additional similar correspondences can probably be found, and although Darwin may have obtained some of them from other sources such as Lyell and Erasmus Darwin, and certainly found the expression " osculant " in the work of MacLeay, there is nothing improbable in his having copied some from Blyth. Indeed, Darwin's references to Blyth in the *Origin of Species, Variation in Animals and Plants under Domestication,* and the *Descent of Man,* are very numerous and generous on subjects other than how species become modified.

It forms no part of the intention of this study to defend Darwin from the imputation that he made unacknowledged use of Blyth's or any one else's work as regards the mechanism of natural selection. Darwin (and others) may have been wrong in thinking that he owed him or them nothing on this score.

Robert Edmund Grant surprised[2] Darwin as early as 1826 by speaking in high admiration of the work of Lamarck, and the anonymous paper[3] published in the *Edinburgh New Philosophical Journal* in that year when Darwin was in Edinburgh, was probably written by Grant. To this paper Darwin would not have felt himself any more indebted than to Lamarck's book, because it provided no facts that he

[1] Darwin used the word " inosculating " in his letter to Henslow dated 24 November 1832 (*Extracts from Letters addressed to Professor Henslow,* p.p. Cambridge 1835, p. 8). The source of the word is William Sharp MacLeay : *Horae entomologicae,* London 1819–21, p. 396 : " By an external order is meant one situated in the greater segment of a circle of affinity, when divided by a line joining its osculant points. There are ten such, viz. Orthoptera, Neuroptera, Homoptera, Hemiptera, Phalangidea, Scorpionidea? Amphipoda? Laemodipoda? Chilopoda and Thysanura. We may name the five orders, Vermes, Hymenoptera, Diptera, Acaridea, and Branchiopoda, internal, and the ten remaining inosculant, from their communicating with osculant groups." p. 37 " the nature of the genera that form the links of connexion. These genera I propose to call *osculantia,* from their occurring as it were at the point where the circles touch one another . . . " Murray *NED* : *Osculant* : — intermediate ; two groups united by some common characters and to an intermediate group which unites in itself the characters of two groups. MacLeay 1819, Kirby & Spence 1826 : *Entom.* 4, 382 : " They may form an osculant group, partly winged and partly apterous . . . "

Inosculate, to pass into ; to join ; to blend Kirby & Spence 1816 : Entom. 1, 332 : " hooks like those in the laminae of a feather inosculate into one another." Kirby. *Habits and Instincts of Animals,* II, 17, 168 : " The thigh inosculates with " the innominate.

[2] *Autobiography of Charles Darwin,* edited by Nora Barlow London 1958, p. 49.

[3] " Observations on the nature and importance of Geology ", *Edinburgh New Philosophical Journal,* vol. 1, 1826, p. 293.

could use, and the late Dr P. Helveg Jespersen has pointed out[1] that Grant shocked Darwin at the time by displaying scientific jealousy when he told Darwin that it was very unfair of him to work on the eggs of *Flustra*, material on which Grant was then engaged.

There are other cases in which Darwin simply forgot to mention his informants. The most striking case of this was his omission of the name of Wallace from the summary in the first edition of the *Origin of Species*.[2] In 1859 when writing[3] to Lyell about the succession of forms, Darwin forgot that he had himself published a paper on this subject in 1837. In 1860 when writing[4] to Baden Powell he excused himself for not having given a list of his predecessors who rejected special creation, saying that he had attempted no history of the subject ; yet later on the same day he remembered that he had a year or two previously drafted a Historical Sketch for his large work on evolution, in which Powell's name was mentioned with honour. All subsequent editions of the *Origin* contained the Historical Sketch. In 1880 when writing[5] to Samuel Butler about his introduction to Dr Krause' book on Erasmus Darwin, Darwin forgot that he had struck out a passage in proof which unintentionally altered the meaning of a footnote.

The only reason for mentioning these details is that they show, as Professor Eiseley has pointed out, that Darwin for all his eminence and genius was not different from other men ; and his Notebooks are like that of any other beginner casting around for facts with which to spin a hypothesis and by which to refute or establish it.

SUMMARY OF DARWIN'S CONCLUSIONS IN THE FIRST NOTEBOOK ON TRANSMUTATION

In order to provide a succinct account of the conclusions to which Darwin had arrived by February 1838, the following summary has been drawn up, leaving out all reference to subjects and questions on which he wanted further information or had not yet made up his mind. The page references are to the manuscript of the First Notebook.

" Definition of Species : one that remains at large with constant character . . . Species may be good ones and differ scarcely in any external character . . . Between species from moderately distant countries there is no test but generation whether good species " (pp. 212, 213).

Variation is observed between the progeny of parents reproducing by sexual methods. No variation is observed among the progeny of stocks reproducing by asexual methods such as budding, fission, or grafts. Therefore " generation ", which means sexual reproduction, is a mechanism whereby variation can be produced (p. 3).

Fully-developed organisms have difficulty in varying, but sexual reproduction

[1] P. H. Jespersen. " Charles Darwin and Dr. Grant ", *Lychnos* 1948–49, vol. 11, p. 159.
[2] *Life and Letters of Charles Darwin*, vol. 2, p. 264.
[3] *More Letters of Charles Darwin*, edited by Francis Darwin and A. C. Seward, London 1903, vol. 1, p. 133, to which attention was called by Eiseley : *Darwin's Century*, p. 163.
[4] " Some unpublished letters of Charles Darwin ", edited by Sir Gavin de Beer, *Notes and Records of the Royal Society of London*, vol. 14, 1959, p. 52.
[5] *Autobiography of Charles Darwin*, edited by Nora Barlow, London 1958, p. 182.

provides the means whereby new organisms can vary and become adapted to changed conditions, and conditions on earth have undoubtedly changed (p. 4).

With this tendency of organisms to produce varying offspring by sexual reproduction, why do species remain constant? Because interbreeding between variants in opposite directions quashes variation ; and if a pair of breeding organisms be isolated it is very doubtful if their offspring will remain constant (pp. 5, 6). Therefore the offspring of animals on separate islands should become different if they are kept isolated long enough (pp. 5, 6, 7). " As we thus believe species vary, in changing climate we ought to find representative species ". We do : e.g. Galapagos tortoises ; Falkland Islands fox ; English and Irish hare (p. 8). If new species result from isolation, their subsequent spread will be along rays from a centre (p. 155).

In islands near continents, recent arrivals would be similar to the organisms on the mainland ; earlier arrivals might have varied provided that the original types had not continued to arrive. Examples : Galapagos Islands ; Juan Fernandez (pp. 10, 11).

" Propagation " of species which means the origin of new species from other species, by descent, not by special creation, explains why on a continent there may be living species of the same type as extinct forms. Examples : Edentates in South America. " Parent of all armadilloes might be brother of Megatherium, uncle now dead ". (pp. 14, 54).

Origination of species by descent from a common ancestor explains why in particular continents animals may have the same type of structure although the " necessity " for such structure may not be apparent ; but it might have been " necessary " for their common ancestor, in which case "the result would be as it is". Examples : marsupials in Australia ; antelopes in South Africa (pp. 12, 14).

In the course of time, all animals may change, and the longer the time since regions were separated, the greater the difference between their animals (pp. 15, 16).

The cause of variation is unknown, except that change is not the result of volition of animals but of adaptation (pp. 17, 21).

If the number of species in an isolated region remains " equable ", and variation and multiplication have occurred, some species must have become extinct ; and extinction of species is no more extraordinary than death of individuals (pp. 21, 22, 36).

If a variety (e.g. Petise ostrich) is not well adapted for its environment, it will probably perish. If a variety is well adapted (e.g. Orpheus) it will multiply. Extinction is therefore a consequence of non-adaptation (p. 38).

Organisms represent an irregularly branched tree. Some branches are more branched than others, and these are the genera ; some twigs die and these are extinct species ; new twigs are formed and these are newly originated species (p. 21).

Why do some genera contain aberrant species ? " Is it an index of the point whence two favourable points of organization commenced branching ?" (p. 28).

If a population remains constant in numbers, say 2000, then 400 years ago perhaps 150 people were the progenitors of the 2000 alive today. This means that there was a selection of ancestors with long progeniture.

Unless the population increases greatly, it is very unlikely that any one man of

a family of 12 will have offspring living 10,000 years hence. If this is true, the larger the group of organisms, the greater will be the gaps between them and the wider their divergence (pp. 40, 42, 146).

In Marsupials the splitting into orders analogous to carnivores, rodents, etc. can be seen just beginning (p. 141).

There is no justification for denying that mammals and fish may have a common ancestor when such strange intermediate forms as the platypus exist (p. 97).

" I cannot for a moment doubt but what Cetacea and Phocea now replace Saurians of Secondary epoch ". This is the principle of the occupation of ecological niches (p. 206).

" My theory will make me deny the creation of any new quadrupeds since days of Didelphys in Stonesfield." (p. 219).

If species are specially created, were South American and African species created on Tristan d'Acunha merely because it lies between Africa and South America, or to deceive man, like fossils in old formations? What was the creative power that was to create species on the Galapagos islands doing before those islands emerged above the sea? (pp. 98, 194, 218).

" Absolute knowledge that species die and others replace them. Two hypotheses : fresh creations is mere assumption ; points gained if any facts are connected." (p. 104).

" The Grand question which every naturalist ought to have before him when dissecting a whale, or classifying a mite, a grampus or an insect is What are the Laws of Life? " (p. 229).

SUBJECTS TREATED IN THE FIRST NOTEBOOK

The chief subjects included in the extant portion of the Notebook are :— reproduction, variation, constancy of variation, causes of variation, heredity, prepotency in crosses, hybridization, breeding-barriers, isolation, geographical distribution, centres of origin of species, conditions of life, radiation, ecological niches, means of transport, taxonomy, instincts, morphology, parasitology, palaeontology, geology, extinction, divergence.

Only the briefest references are made to the struggle for existence, selection, and adaptation.

The chief subjects missing are artificial selection, domestic breeds, conditions of domestication, inadequacy of climatic or other environmental conditions to account for resemblance and differences between floras and faunas, principle of gradations, sterility, imperfection of the geological record, affinities and classification, embryonic resemblance, vestigial organs, inheritance of effects of use and disuse.

How far these may have been included in the missing pages is hard to determine. The chief impression left after comparing the First Notebook with the *Sketch* of 1842 is that the latter is imbued with a dynamic background of necessitation which the extant portion of the former lacks. It is here that the effect of reading Malthus's work in October 1838 may most probably be discerned. The principle of selection of better adapted variants is present in the First Notebook (p. 38), but it is presented statically without indication of its universal compelling force.

Why this should be so, in spite of the fact that the struggle for existence was well known to Darwin from the works of Erasmus Darwin, Lamarck, and Lyell, was probably because Malthus was the first to state the problem quantitatively, stressing the discrepancy between the arithmetical rate of increase of food supplies and the geometrical rate of potential increase of organisms. It is in this light that the words should be read which Darwin wrote[1] in 1876 : " In October 1838, that is, fifteen months after I had begun my systematic inquiry, I happened to read for amusement " Malthus on Population ", and being well prepared to appreciate the struggle for existence which every where goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances variations would tend to be preserved, and unfavourable ones to be destroyed. The result of this would be the formation of new species. Here then I had at last got a theory by which to work ". The clock had been provided with a mainspring.

There is another point on which the First Notebook throws light, for it contains a splendid discussion of the principle of branching and sub-branching of the evolutionary tree (pp. 21, 22), and this shows that Darwin had already grasped fully the principle of divergence. This emerges also from his query whether Geoffroy-Saint-Hilaire visualized evolution as having taken place in straight or in branching lines (p. 113). The question naturally arises how this is to be reconciled with Darwin's statement[2] written in 1876 referring to the *Essay* of 1844 : " But at that time I overlooked one problem of great importance. . . . This problem is the tendency in organic beings descended from the same stock to diverge in character as they become modified ".

In trying to explain this discrepancy, Sir Francis Darwin[3] was mistaken in thinking that descent with modification necessarily implies divergence ; evolution might take place along single lines without any divergence at all. The explanation emerges from a close attention to the *Origin of Species* [6th ed. World's Classics p. 112] where the problem is stated more forcibly : " How, then, does the lesser difference between varieties become augmented into the greater difference between species?" The problem is not only that of branching or splitting a species into two but of widening the split.[4]

What Darwin was referring to in 1876 was not the fact of divergence, for this was clearly stated in the First Notebook, but to a causal explanation of how it occurs and increases. This is also clear from the *Origin* [p. 113] :— " The more diversified the descendants from any one species become in structure, constitution and habits, by so much will they be better enabled to seize on many and widely diversified places in the polity of nature."

Darwin's other Notebooks on Transmutation of Species will be transcribed and printed in subsequent Numbers of this Bulletin.

[1] *Autobiography of Charles Darwin*, edited by Nora Barlow London 1958, p. 120.
[2] *Ibid.* p. 120.
[3] *Life and Letters of Charles Darwin*, vol. 2, p. 15.
[4] The date when Darwin hit on the solution of the problem of divergence (" I can remember the very spot on the road, whilst in my carriage, when to my joy the solution occurred to me," *Autob.* p. 120), may be placed in 1852 because of a letter from Darwin to George Bentham dated 19 June 1863 (*Life & Letters*, iii, p. 26) : " I believe it was fifteen years after I began before I saw the meaning and cause of the divergence of the descendants of any one pair." If the " beginning " was in 1837, the solution came in 1852.

CHARLES DARWIN'S FIRST NOTEBOOK ON TRANSMUTATION OF SPECIES 1837–1838

Inside cover

C. DARWIN

All useful pages cut out.
Dec. 7 /1856/.
(and again looked through
April 21, 1873).[1]

This Book was commenced about July 1837 ; p. 235 was written in January
1 1838, | perhaps ended in beginning of February.

ZOONOMIA

Two kinds of generation : the coeval kind — all individuals absolutely similar ; for instance, fruit trees, probably polypi, gemmiparous propagation, bisection of Planariae etc. etc.

The ordinary kind which is a longer process, the new individual passing through several stages (? typical or shortened repetition of what the original molecule has
2 done). — This appears | highest office in organisation (especially in lower animals, where mind and therefore relation to other life has not come into play) — see Zoonomia[2] arguments, fails in hybrids, where every thing else is perfect ; mother apparently only born to breed, — annuals rendered perennial etc. etc. — Yet eunuch, nor cut stallions, nor nurses are longer lived.

Why is life short, why such high object — generation. —

We *know* world subject to cycle of change, temperature and all circumstances,
3 which | influence living beings.

We see the young of living beings become permanently changed or subject to variety, according to circumstance, — seeds of plants sown in rich soil, many kinds are produced, though new individuals produced by buds are constant ; hence we see generation here seems a means to vary or adaptation. — Again we know, in course of
4 generation even mind and instinct becomes influenced. | Child of savage not civilized man. — Birds rendered wild generations acquire ideas ditto. V. Zoonomia. —

There may be unknown difficulty with *full grown* individual with fixed organisation thus being modified, — therefore generation to adapt and alter the race to *changing* world. —

On other hand, generation destroys the effect of accidental injuries, which if
5 animals lived for ever would be endless | (that is with our present system of body and universe. — Therefore final cause of life).

With this tendency to vary by generation, why are species all constant over whole country. Beautiful law of inter-marriages partaking of characters of both parents and then infinite in number.

[1] On this first page Darwin wrote a series of figures in running vertical order, and subsequently scored them out ; they were : 26, 30, 41, 46, 50, 54, 66, 67, 69, 76, 79, 91, 93, 107 Ireland, 113, 117.

[2] Erasmus Darwin. *Zoonomia ; or, the laws of organic life,* London 1794, vol. 1, p. 487 : " This paternal offspring of vegetables, I mean their buds and bulbs, is attended with a very curious circumstance : and that is, that they exactly resemble their parents, as is observable in grafting fruit-trees, and the propagating flower-roots ; whereas the seminal offspring of plants, being supplied with nutriment by the mother, is liable to perpetual variation."

6 In man it has been | said, there is instinct for opposites to like each other.

Aegyptian cats and dogs, ibis — same as formerly, but separate a pair and place them on fresh island, it is very doubtful whether they would remain constant; is it not said that marrying-in *deteriorates* a race, that is alters it from some end which is good for man. — |

7 Let a pair be introduced and increase slowly, from many enemies, so as often to intermarry — who will dare say what result.

According to this view animals on separate islands, ought to become different if kept long enough apart, with slightly differ[ent] circumstances. — Now Galapagos tortoises, mocking birds, Falkland fox, Chiloe fox. — English and Irish Hare. — |

8 As we thus believe species vary, in changing climate we ought to find representative species; this we do in South America closely approaching. — But as they inosculate, we must suppose the change is effected at once, — something like a variety produced 9 — every grade in that case [it] seems is not | produced? —

Species according to Lamarck[1] disappear as collection made perfect. — Truer even than in Lamarck's time. Gray's[2] remark, best known species (as some common land shells) most difficult to separate. [Difference in] Every character continues to vanish, — bones, instinct etc. etc. etc. |

10 Non-fertility of hybridity etc. etc.

If species (1) may be derived from form (2) etc., — then (remembering Lyell's[3] arguments of transportal) island near continents might have some species same 11 as nearest land, which were late arrivals, | others old ones (of which none of same kind had in interval arrived) might have grown altered. Hence the type would be of the continent, though species all different. —

2 cases as Galapagos and Juan Fernandez.

When continent of Pacific existed, might have been monsoons. When they ceased, 12 importation ceased and | changes commenced; — or intermediate land existed; — or they may represent some large country long separated. —

On this idea of propagation of species we can see why a form peculiar to continents, 13 — all bred in from one parent. Why Megathera several | species in S. America? why 2 [species] of ostriches in S. America. — This is answer to Decandolle[4] (his argument applies only to hybridity): genera being usually peculiar to same country, different genera — different countries. |

14 Propagation explains why modern animals — same type as extinct, which is law almost proved. — We can see why structure is common in certain countries when

[1] Jean-Baptiste de Lamarck. *Philosophie Zoologique*, Paris 1809, vol. 1, p. 75: "à mesure que nos collections s'enrichissent, nous voyons presque tous les vides se remplir et nos lignes de séparation s'effacer . . . plus nous rencontrons de preuves que tout est nuancé, que les différences remarquables s'évanouissent."

[2] John Edward Gray. Probably personal communication.

[3] Charles Lyell. *Principles of Geology*, vol. 2, London 1832, pp. 96–104.

[4] Augustin-Pyramus de Candolle. *Essai élémentaire de géographie botanique*, Strasbourg 1820, p. 60: "Les différences constantes des végétaux nés dans diverses régions ne semblent se rapporter ni à l'une ni à l'autre de ces classes [= produites par les élémens extérieurs + formées par l'hybridité] on ne peut les attribuer aux circonstances externes, . . . on ne peut les attribuer à l'hybridité. . . . [Les] espèces sont distribuées sur le globe en partie d'aprés des lois qu'on peut immédiatement déduire de la combinaison des lois connues de la physiologie et de la physique, en partie d'après les lois qui paroissent tenir à l'origine des choses et qui nous sont inconnues." [This question was discussed by Lyell, *Principles of Geology*, vol. 2, London 1832, p. 56.]

we can hardly believe necessary, but if it was necessary to one forefather, the result
15 would be as it is. — Hence antelopes at C. of Good Hope and | Marsupials at Australia. —

Will this apply to whole organic Kingdom when our planet first cooled. —

Countries longest separated — greatest differences, — if separated from immersage, possibly two distinct type[s], but each having its representatives — as in Australia

This presupposes time when no mammalia existed ; Australia ; Mamm[alia] were produced from propagation from different set as the rest of the world. — |

16 This view supposes that in course of ages, and therefore changes, every animal has tendency to change. —

This difficult to prove cats etc. from Egypt no answer, because time short and no great change has happened. —

17 I look at two Ostriches as strong argument of possibility of such | change ; as we see them in space, so might they in time. —

As I have before said, *isolate* species, especially with some change, probably vary quicker. —

18 Unknown causes of change. Volcanic island. — Electricity. | Each species changes. Does it progress.

Man gains ideas.

The simplest cannot help becoming more complicated ; and if we look to first origin, there must be progress.

If we suppose monads are constantly formed, would they not be pretty similar
19 over whole world under | similar climates and as far as world has been uniform at former epoch. How on this Ehrenberg?[1]

Every successive animal is branching upwards different types of organisation improving as Owen[2] says simplest coming in and most perfect and others occasionally
20 dying out ; for instance, secondary terebratula may | have propagated recent terebratula, but Megatherium nothing.

We may look at Megatherium, Armadillos and Sloths as all offsprings of some still older type. Some of the branches dying out. —

With this tendency to change (and to multiplication when isolated) requires
21 deaths of species to keep numbers | of forms equable. But is there any reason for supposing number of forms equable : This being due to subdivisions and amount of differences, so forms would be about equally numerous. —

Changes not result of will of animals, but law of adaptation as much as acid and alkali.

Organized beings represent a tree, *irregularly branched* ; some branches far more branched, — hence genera. — As many terminal buds dying, as new ones generated. |
22 There is nothing stranger in death of species, than individuals.

If we suppose monad definite existence, as we may suppose in this case, their creation being dependent on definite laws ; then those, which have changed most,
23 owing to the accident of positions must in each state of existence have shortest | life. Hence shortness of life of Mammalia. —

[1] Christian Gottfried Ehrenberg. *Die fossilen Infusorien und die lebendige Dammerde*, Berlin 1837.
[2] Richard Owen. Probably personal communication.

Would there not be a triple branching in the tree of life owing to three elements — air, land and water, and the endeavour of each typical class to extend his domain
24 into the other domains and subdivision[s] three more double arrangement. — | If each main stem of the tree is adapted for these three elements, there will be certainly points of affinity in each branch.

A species as soon as once formed by separation or change in part of country, repugnance to intermarriage — settles it. |

25 ? We need think that fish and penguins really pass into each other.—

The tree of life should perhaps be called the coral of life, base of branches dead, so that passages cannot be seen. — [fig. 1]

26 This again offers | no [(] only makes it excessively complicated [)] Contradiction to constant succession of genera in progress.

Fig. 1

Fig. 2

Is it thus fish can be traced right down to simple organization. — Birds — not. [fig. 2]

27 | We may fancy according to shortness of life of species that in perfection the bottom of branches deaden, — so that in mammalian tree it would only appear like circles, and insects amongst articulate, — but in lower classes perhaps a more linear arrangement. — |

28 ? How is it that there come aberrant species in each genus (with well characterised parts belonging to each) approaching another.

Petrels have divided themselves into many species, so have the awks [auks], there is particular circumstance, to which.

Is it an index of the point, whence two favourable points of organization commenced branching. — |

29 As all the species of some genera have died, have they all one determinate life dependent on genus, the genus upon another, whole class would die out therefore.

30 [*remainder of page excised*] | [*beginning of page exised*] In island neighbouring continent where some species have passed over, and where other species have " air " of

31 that place, will it be said those have been then created there : — | Are not all our

British shrews diff[erent] species from the continent. Look over Bell[1] and L. Jenyns.[2] Falkland rabbit may perhaps be instance of domesticated animals having effected, a change which the Fr[ench] naturalists thought was species. Study Lesson[3] — Voyage of Coquille. — |

32 Dr Smith[4] says he is certain that when white man and Hottentots or Negroes cross at C[ape] of Good Hope, the children cannot be made intermediate. The first children partake more of the mother, the later ones of the father ; is not this owing to each copulation producing its effect ; as when bitches ' puppies are less purely bred owing to having once born mongrels. He has thus seen the black blood come out from the grandfather (when the mother was nearly quite white) in the two first children. How is this in West Indies — Humboldt,[5] New Spain. — |

33 Dr Smith[6] always urges the distinct locality or metropolis of every species ; believes in repugnance in crossing of species in wild state. —

No doubt C.D.[7] wild men do not cross readily, distinctness of tribes in T.del Fuego. The existence of whiter tribes in centre of S. America shows this. — Is there a tendency in plants hybrids to go back? — If so man and plants together would establish law as above stated : no one can doubt that less trifling differences are blended |

34 by intermarriages, then the black and white is so far gone, that the species (for species they certainly are according to all common language) will keep to their type : in animals so far removed with instinct in lieu of reason there would probably be repugnance and art required to make marriage. — As Dr Smith[8] remarked man and wild animals in this respect are differently circumstanced. — |

35 ? Is the shortness of life of *species* in certain orders connected with gaps in the *series of connection*? if starting from same epoch certainly. The absolute end of certain forms from considering S. America (*independent of external causes*) does appear very probable : — Mem.: Horse, Llama, etc. etc.

If we grant similarity of animals in one country owing to springing from one branch, and the monucle has definite life, then all die at one period, which is not

∴ MONUCULE NOT DEFINITE LIFE. |

36 I think Case must be that one generation then should have as many living as now.

[1] Thomas Bell. *A History of British Quadrupeds*, London 1837. On p. xviii there is a notice pointing out that the *Sorex araneus* of British authors is not the *S. araneus* of the continent. Ellerman & Morrison-Scott (*Checklist of Palaearctic & Indian Mammals*, London 1951, p. 51) accord the status of a geographical race to the British *Sorex araneus castaneus* Jenyns 1838.

[2] Leonard Jenyns, afterwards Blomefield. *A Manual of British Vertebrate Animals*, London 1835, p. 17 : " incisors deep feruginous brown* * This circumstance together with one or two others, induces me to suspect that the *S. araneus* of the continental authors may be distinct from ours." This suspicion was verified by Jenyns in his paper " Further remarks on the British shrews ", *Ann. Nat. Hist.*, vol. 1, p. 417 ; especially p. 424.

[3] René-Primevère Lesson & Prosper Garnot. *Voyage autour du monde . . . sur . . . la Coquille, pendant . . .* 1822–1825. *Zoologie*, Paris 1826–30.

[4] Dr, later Sir Andrew Smith. Personal friend of Darwin who met him in South Africa in June 1836.

[5] Friedrich Heinrich Alexander von Humboldt. *Political essay on the Kingdom of New Spain*, transl. from the original French by John Black, New York 1811.

[6] Andrew Smith. *Report of the expedition for exploring Central Africa from the Cape of Good Hope, June 23 1834, under the superintendence of Dr. A. Smith*, Cape Town, 1836. Appendix, p. 39 : " most of the species we met with, appeared to have each a natural or chosen domicile, where an evident congregation of its members existed."

[7] Charles Darwin. *Journal of Researches*, (London 1839), p. 236 : " each [tribe] is surrounded by other hostile ones, speaking different dialects."

[8] Andrew Smith. Probably personal communication.

To do this and to have many species in same genus (as is), *requires* extinction. [fig. 3]

Thus between A and B immens[e] gap of relation, [between] C and B the finest gradation, [between] B and D rather greater distinction. Thus genera would be
37 formed, — bearing relation | to ancient types, — with several extinct forms, for if each species as ancient (1) is capable of making 13 recent forms. Twelve of the contemporaries must have left no offspring at all, so as to keep number of species constant. —

With respect to extinction we can easily see that variety of ostrich Petise may not be well adapted, and thus perish out, or on other hand like Orpheus being favour-
38 able, | many might be produced. This requires principle that the permanent varieties, produced by confined breeding and changing circumstances are continued and produce according to the adaptation of such circumstances, and therefore that

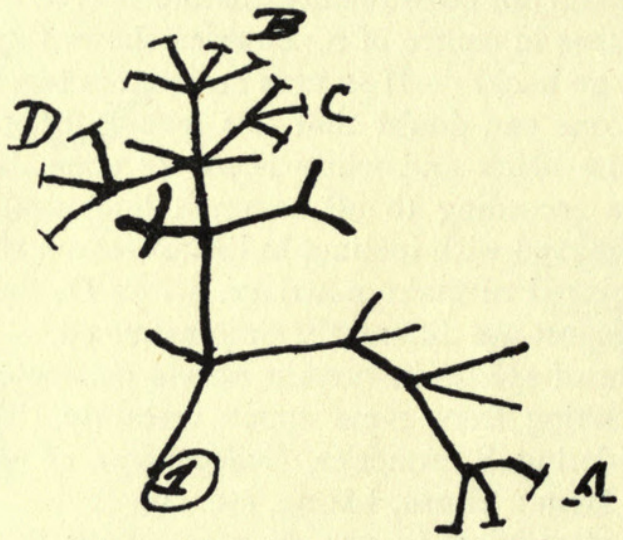

Fig. 3

death of species is a consequence (contrary to what would appear from America) |
39 of non-adaptation of circumstances. — Vide two pages back Diagram.

The largeness of present genera renders it probable that many contemporary [genera] would have left scarcely any type of their existence in the present world. — Or we may suppose only each species in each generation only breeds, *like* individuals in a country not rapidly increasing. — |

40 If we thus go very far back to look to the source of the Mammalian type of organization, it is extremely inprobable that any of the successors of his relations shall now exist. —

In same manner, if we take a man from any large family of 12 brothers and sisters
41 in a state which does not increase, | it will be chances against any one of them having progeny living ten thousand years hence ; because at present day many are relatives, so that by tracing back the fathers would be reduced to small percentage : — therefore the chances are excessively great against any two of the 12 having progeny after that distant period. — |

42 Hence if this is true that the *greater the groups* the *greater the gaps* (or *solutions* of *continuous structure*) between them. — for instance, there would be great gap
43 between birds and mammalia, still greater between | vertebrate and articulate, still greater between animals and plants. —

But yet besides affinities from three elements, from the infinite variations, and all coming from one stock and obeying one law, they may approach—some birds may approach animals and some of the vertebrate invertebrate. — Such or few on
44 each side will yet present some anomaly and bearing | stamp of some great main type, and the gradation will be sudden. —

Heaven know whether this agrees with Nature : *Cuidado!*

The above speculations are applicable to non-progressive development, which certainly is the case at least during subsequent ages. — |

45 The Creator has made tribes of animals, adapted preeminently for each element, but it seems law that such tribes, as far as compatible with such structure, are in minor degree adapted for other elements. Every part would probably be not complete, if birds were fitted solely for air and fishes for water. —

46 If my idea of origin of | Quinarian system[1] is true, it will not occur in plants which are in far larger proportion terrestrial, — if in any in the Cryptogamic flora. — but not atmospheric type hence probably only four, is not this Fries[2] rule, what subject has Mr Newman the (7) man[3] studied.

The condition of every animal is partly due to direct adaptation and partly to
47 hereditary taint ; hence the | resemblances and differences, for instance, of finches of Europe and America, etc. etc. etc.

The new system of Natural History will be to describe limits of form (and where possible the number of steps known).

48 Examine good collection of insects with this in view. — | Geogr. Journal. Vol. VI, P. 11, p. 89. — Lieut. Wellsted[4] obtained many sheep from Arabian count[ries]. " These were of two kinds : one white with a black face, and similar to those brought from Abyssinia, and others dark brown, with long clotted hair resembling that of goats ". |

49 Progressive development gives final cause for enormous periods anterior to man. Difficult for man to be unprejudiced about self, but considering power, extending range, reason and futurity, it does as yet appear cli. [cut off] |

50 In Mr Gould['s] Australian work[5] some most curious cases of close but certainly

[1] William Sharp MacLeay. Quinarian theory, see Introduction.

[2] Elias Magnus Fries. Fries's rule is given in John Lindley : " Some account of the Spherical and Numerical System of M. Elias Fries," *Phil. Mag. & Journ.*, vol. 68, Aug. 1826, p. 81 : " the founder of the system of quaternary arrangement . . . opinions are contained in the Introduction to a work published by M. Fries in 1825, under the title of *Systema Orbis Vegetabilis*."

p. 86 : " When the members of a bipartite section are again dichotomously divided upon analogous principles, four sections are created, of which the first and second, and the third and fourth, are in affinity ; but the first and third, and the second and fourth, are in analogy. But when this method of division becomes circuitous, a more direct path is undoubtedly to be discovered : hence other numbers are admitted, especially the quaternary (or double dichotomy), and also others in which dichotomy is understood." (Reference kindly supplied by W. T. Stearn).

[3] Edward Newman. *See* Introduction.

[4] Lieutenant R. Wellsted. " Observations on the Coast of Arabia between Rás Mohammed and Jiddah," *Journ. Roy. Geogr. Soc.*, vol. 6, 1836, p. 51, especially p. 89.

[5] John Gould. *The Birds of Australia and the adjacent Islands*, London 1837.

distinct species between Australia and Van Diemen's land, and Australia and New Zealand. Mr Gould says in subgenera they undoubtedly come from same countries. — In mundine genera |

51–52 *excised.*

53 | ... and whether extinction of great S. American quadrupeds part of some great system acting over whole world, the period of great quadrupeds declining as great reptiles must have once declined. —

Cuvier[1] (Read his theory of the Earth attentively) objects to propagation of species, by saying, why not have some intermediate forms been discovered between palaeo-

54 therium, megalonyx, mastodon and the species now living. — Now, according | to my view, in S. America parent of all armadilloes might be brother to Megatherium — uncle now dead. —

Bulletin Geologique, april 1837, p. 216. Deshayes[2] on change in shells from Salt and F[resh] Water on what is species. *Very good.* Has not Macculloch[3] written on same changes in Fish.

Mem. Rabbit of Falklands described by Q[uoy] and G[aimard][4] as new species. Cuvier examined it. |

55–56 *excised.*

57 ... something occurs with regards to other tribes in that same family. —

(NB. I see Waterhouse[5] thinks Quinary only three elements.) How far does Waterhouse's representatives agree with breeding in irregular trees and extinction of forms?? It is in simplest case saying every species in genus resembles each other (at least in one point, in truth in all excepting specific character) ; and in passing from species

58 to genera, each retains | some one character of all its family ; but why so? I can see no reason for these analogies ; from the principle of atavism, where real structure obliged to be altered, I can conceive colouring retained ; therefore probably in some Heteromera colouring of C[h]rysomela may be going back to common ancestor of C[h]rysom[ela] and Heterom[era], but I cannot understand the universality of such law. — |

[1] Georges Cuvier. *Essay on the theory of the earth,* with geological illustrations by Professor Jameson, Edinburgh & London 1817, p. 102 : " Why may not the presently existing races of land quadrupeds, ... be modifications of those ancient races which we find in a fossil state ; ... If the species have changed by degrees, we ought to find traces of these gradual modifications. Thus, between the palaeotheria and our present species, we should be able to discover some intermediate forms ; and yet no such discovery has ever been made."

[2] Gérard-Paul Deshayes. *Bull. Soc. Geol. France,* vol. 8, 1836 à 1837, Paris 1836 [1837], p. 216 : " Dans les espèces tertiaires de la Crimée, les modifications dans les caractères des dents de la charnière sont encore beaucoup plus nombreuses. On y observe une multitude de combinaisons dans la forme, la position, la présence ou l'absence, comme dans le plus ou moins de développement des dents cardinales et latérales, variations que M. Deshayes attribue à un changement de milieu ; il pense que d'abord marines, ces coquilles auront continué de vivre dans les eaux douces qui ont remplacé les eaux salées."

[3] John MacCulloch. " On the possibility of changing the residence of certain fishes from salt water to fresh ", *Quart. Journ. Sci.*, vol. 17, 1824, p. 209.

[4] Jean-René-Constantin Quoy & Joseph-Paul Gaimard. *Voyage Autour du Monde ... Zoologie,* Paris 1824, contains no description of the Falkland Islands rabbit. But Prosper Garnot : " Remarques sur la Zoologie des îles Malouines, faites pendant le Voyage autour du monde de la Corvette la Coquille," *Ann. Sci. Nat.*, vol. 7, p. 39, contains on p. 42 a description of a rabbit " que nous croyons pouvoir considérer comme une espèce nouvelle bien distincte, et que nous proposons de nommer lapin magellanique, (*Lepus magellanicus* Garnot)."

[5] George Robert Waterhouse. " Description of some new species of exotic insects," *Trans. Entom Soc. Lond.*, vol. 2, 1837, p. 188. On p. 190 [His views] " may go a great way to prove or disprove an exceedingly ingenious and favourite theory—I mean the circular and quinary system ; for it may happen that in the formation of this theory analogies may in some instances have been mistaken for affinities."

59 It would be curious to know in plants (or animals) whether *races* have tendency to keep to either parent (this is what French call *atavism*). Probably this is first step in dislike to union, offspring not well intermediate.

Lyell,[1] vol. III, p. 379. Mammalian type of organization same from one period to another, preeminently Pachidermata, less so in Miocene and so on. — |

60 As I have traced the great quadrupe[d]s to Siberia, we must look to type of organization : extinct species of that country — parents of American. — Now genera of these two countries ought to be similar. — |

61 ? Law : existence definite without change, superinduced, or new species. Therefore animals would perish if there was nothing in country to superinduce a change? |

62 Seeing animals[s] die out in S. America with no change, agrees with belief that Siberian animals lived in cold countries and therefore not killed by cold countries.

Seeing how horse and elephant reached S. America, — explain how zebras reached South Africa. —

63 It is a wonderful fact — Horse, Elephant and Mastodon dying out | about same time in such different quarters. — Will Mr Lyell[2] say that some circumstance killed it [them] over a tract from Spain to S. America? — (*Never*). They die, without they change, like golden Pippins ; it is a *generation* of *species* like generation of *individuals*. — |

64 Why does individual die? To perpetuate certain peculiarities (therefore adaptation), and to obliterate accidental varieties, and to accomodate itself to change (for, of course change even in varieties is accomodation). Now this argument applies to species. — If individual cannot propagate, he has no issue ; so with species. — |

65 I should expect that Bears and Foxes are same in N. America and Asia ; but many species closely allied, but different, because country separated since time of extinct quadrupeds ; — same argument applies to England. — Mem. Sh[r]ew mice |

66 Animals common to South and North America. — ? *Are there any*? |

67 Rhinoceros peculiar to Java and another to Sumatra. — Mem. Parrots peculiar, according to Swainson,[3] to certain islets in East India archipelago. —

Dr Smith[4] considers probable that northern species *replace* southern kinds.

Gnu reaches Orange river and says : so far will I go and no further. — |

68 Prof. Henslow[5] says that when race once established, so difficult to root out. — For instance ever so many seeds of white flower all would come up white, though planted in same soil with blue. Now this is same bearing with Dr Smith's fact of races of man ... |

69–70 *excised.*

71 Strong odour of negroes — a point of real repugnance. —

Waterhouse[6] says there is no TRUE *connection* between great groups. — |

[1] Charles Lyell. *Principles of Geology*, 5th edition, London 1837, vol. 3, p. 379.

[2] Charles Lyell. *Principles of Geology*, 5th edition, London 1837, vol. 3, p. 142 : " Successive extinction of species consistent with their limited geographical distribution " (cross-heading) . . . " They must die out ", to borrow an emphatical expression from Buffon ; " because Time fights against them."

[3] William Swainson. *A treatise on the geography and classification of animals*, Lardner's Cabinet Cyclopaedia, London 1835, p. 52 : " The suctorial cockatoos of Malacca, the elegant ring-necked parrakeets of the continent, and the crimson-coloured lories of the islands, are appropriated solely to these regions."

[4] Andrew Smith. Probably personal communication.

[5] John Stevens Henslow. Probably personal communication.

[6] George Robert Waterhouse. Probably personal communication.

72 Speculate on land being grouped towards centre near Equator at former periods and then splitting off. —

If *species* generate other *species*, their race is not utterly cut off : — like golden pippins, if produced by seed, go on, — otherwise all die. — The fossil horse generated
73 in S. Africa zebra — and continued, — perished in America. | All animals of same species are bound together just like buds of plants, which die at one time, though produced either sooner or later. — Prove animal[s] like plants : — trace gradation between associated and non-associated animals — and the story will be complete. — |
74 It is absurd to talk of one animal being higher than another — *We* consider those, where the { cerebral structure / intellectual faculties } most developed, as highest. — A bee doubtless would where the instincts were [most developed] |

75–76 *excised.*

77 There appears in Australia great abundance of species if few genera or families. — (long separated.) — Proteaceae and other forms (?) being common to Southern hemisphere. Does not look, as if S. Africa peopled from N. Africa. |

78 An originality is given (and power of adaptation is given by *true* generation), through means of every step of progressive increase of organization being imitated in the womb which has been passed through to form that species. — |

79 Mr Don[1] remarked to me, that he thought species became obscurer as knowledge increased, but genera stronger. Mr Waterhouse[2] says no real passage between good genera. — How remarkable spines, like on a porcupine or Echidna. —

Good to study Regne animal[3] for *Geography*. — |

80 The motion of the earth must be excessive up and down. — Elephants in Ceylon. — East India archipelago. — West Indies. — Opossum and Agouti same as on continent — 3 Paradoxusi[4] in common to Van Diemen's Land and Australia. England and Europe, Ireland — common animals. Ireland longer separate. Hare[s] of two countries different. — Ireland and Isle of Man possessed elk, not England. Did Ireland possess mastodons?? Negative facts tell for little. — From the consideration of these archipelagos ups and downs in full conformity with European formations, — for instance, tertiary deposits between East India islets. — |

81 Geographic distribution of Mammalia more valuable than any other, because less easily transported — then plants on coral islets. — Next to animals land birds. — And life shorter or change greater. — In the East Indian Archipelago it would be interesting to trace limits of large animals. — |

82 Owls : transport mice alive?

Species formed by subsidence. Java and Sumatra. Rhinoceros. Elevate and join keep distinct, two species made ; elevation and subsidence continually forming species. —

The male animal, affecting *all* the progeny of female, insures often mixing of individuals. |

[1] George Don. Probably personal communication.
[2] George Robert Waterhouse. Probably personal communication.
[3] Georges Cuvier. *Le Règne animal*, Paris 1829.
[4] i.e., platypus (*Ornithorhynchus paradoxus*).

83 South Africa — proof of subsidence and recent elevation : pray ask Dr Smith[1] to state that most clearly. —

Fox[2] tells me, that beyond all doubt seeds of Ribstone Pippins produce Ribstone Pippins, and Golden Pippins — goldens ; hence *sub-varieties* and hence possibility of reproducing any variety, although many of the seeds will go back. Get instances of a *variety* of fruit tree or plant run wild in foreign country. Here we have avitism the ordinary event and succession the extraordinary. |

84 When one sees nipple on man's breast, one does not say some use, but sex not having been determined ; — so with useless wings under elytra of beetles, born from beetles with wings and modified, — if simple creation, surely would have [been] born without them. — |

85 In some of the lower orders a perfect gradation can be found from forms marking good genera by steps so insensible that each is not more change than we know *varieties* can produce.—Therefore all genera MAY have had intermediate steps. Quote *in detail* some good instance.

86 But it is other question whether there | have existed *all* those intermediate steps, especially in those classes, where species not numerous. (NB. In those classes with few species greatest jumps — strongest marked genera ? Reptiles?). For instance,
87 there never may have been grade between pig and tapir, yet from some | common progenitor. — Now if the intermediate links had produced infinite species, probably the series would have been more perfect, because in each there is possibility of such organization. (Spines in Echidna and Hedgehog.) —

88 As we have one Marsupial animal in Stonesfield slate, the father of all | mammalia in ages long gone past and still more so known with fishes and reptiles. —

In mere eocene rocks we can only expect some steps. — I may ask whether the
89 series is not more perfect by the discovery of fossil Mammalia than before, | and that is all that can be expected. This answers Cuvier.[3] —

Perhaps the father of Mammalia as heterodox as Ornithorhynchus. If this last animal bred — might not new classes be brought into play. — |

90 The father being climatized — climatizes the child? — Whether every animal produces in course of ages ten thousand varieties (influenced itself perhaps by circumstances) and those alone preserved which are well adapted? This would account for each tribe acting as in vacuum to each other. |

91 p. 306. — Chamisso[4] on Kamtchatka quadrupeds. Kotzebues[5] first Voyage. Entomological Magazine, paper[6] on Geographical range. Copied with list. Richardson's[7] Fauna Borealis.

[1] Andrew Smith. " 1836 June 1–15 . . . with Dr A. Smith who has lately returned from his most interesting expedition to beyond the Tropic, I took some long geological rumbles." *Charles Darwin's Diary of the Voyage of the Beagle*, edited by Nora Barlow, Cambridge 1934, p. 409.

[2] William Darwin Fox. Probably personal communication.

[3] Georges Cuvier. *Essay on the Theory of the Earth*, Edinburgh and London 1817, p. 102.

[4] Adelbert von Chamisso. In *A Voyage of Discovery into the South Sea and Beering's Straits, etc.* by Otto von Kotzebue, (Remarks and Opinions of the Naturalist of the Expedition Chamisso) vol. 3, London 1821, p. 306.

[5] Otto von Kotzebue. *A Voyage of Discovery into the South Sea and Beering's Straits etc.*, London 1821.

[6] " Delta ". "Thoughts on the Geographical Distribution of Insects ", *Entomol. Mag.*, London 1835, vol. 2, pp. 44, 280.

[7] Sir John Richardson. *Fauna Boreali-Americana* ; or *the zoology of the northern parts of British America*, London, 1829–1837.

It is important the possibility of some islands not having large quadrupeds. — |

92 Humboldt[1] has written on the geography of plants : Essai sur la Geographie des Plantes. I vol. in 4°.

I have abstracted Mr Swainson's[2] tract at beginning of Volume on geographical distribution of animals. |

93 Geograph. Journal,[3] vol. I, p. 17–21, says from Swan river long south coast, all the remarkable Australian genera collected together. —

Man has no *hereditary prejudices* or wishes to conquer or breed together. — Man has no limits to desire, in proportion instinct more, reason less, so will aversion be. |

94 L'Institut,[4] 1837, No. 246, a section of fossil " singe ", it cannot be made to approach the Colobus, which in South Africa appear to represent the semnopitheque of India. — Tooth of Sapajou, — NB. Sapajou is S. American form : therefore it is

95 like case of great edentate (has been doubted?) | and opossum, found in Europe, now confined to southern hemisphere. — If these facts were established it would go to show a *centrum* for Mammalia. — I really think a very strong case might be made out of world before Zoological divisions.

Man : species doubtful when known only by bones.

Mem. Silurian fossils :? how are South American shells? |

96 Do not plants, which have male and female organs together, yet receive influence from other plants — Does not Lyell[5] give some argument about varieties being difficult to keep on account of pollen from other plants because this may be applied to show all plants do receive intermixture. — But how with hermaphrodite shells!!!? |

97 We have not the slightest right to say, there never was common progenitor to mammalia and fish, when there now exist such strange forms as ornithorhync[h]us. —

The type of organization constant in the shells. — |

98 The question if creative power acted at Galapagos, it so acted that birds with plumage and tone of idea purely American, North and South, — so permanent a breath cannot reside in space before island existed. — Such an influence must exist in such spots. We know birds do arrive and seeds. (And geographical division are arbitrary and not permanent. This might be made very strong if we believe

[1] Friedrich Heinrich Alexander von Humboldt. *Essai sur la géographie des plantes*, Paris 1805. [= Vol. 2 Part V of Humboldt, F. H. A. von, & Bonpland, A. J. A.:— *Voyage aux régions équinoxiales du Nouveau Continent, fait en* 1799–1804, Paris 1805–1837].

[2] William Swainson. *A Treatise on the Geography and Classification of Animals. Lardner's Cabinet Cyclopaedia*, London 1835, chapter I.

[3] Robert Brown. " General view of the botany of the vicinity of Swan River," *Journ. Roy. Geogr. Soc.*, vol. 1, p. 18 ; " this portion of the shores of New Holland, extending from Swan River on the West coast to Middle Island . . . on the south coast, may be said to contain the greatest proportion of those genera which form the chief peculiarities of New Holland Vegetation."

[4] William Martin. *L'Institut*, Paris vol. 6, 1838, No. 246, p. 300. [This paper was not published until 13th September 1838. It refers to a paper read before the Zoological Society of London on 11th July 1837 : " Mr. Martin then laid before the meeting the following observations on the Proboscis Monkey, or ' Guenon à long nez ' " *Proc. Zool. Soc. Lond.*, Part V, 1837, p. 70. There is no number 246 of the *Institut* in 1837. Darwin's reference therefore must be incorrect. The paper referred to here contains no reference to fossil monkeys. There are several references to fossil monkeys in *L'Institut* in 1837, but none on page 246, and none refers to *Colobus*.]

[5] Charles Lyell. *Principles of Geology*, London 1832, vol. 2, p. 33 : varieties of cultivated plants cannot originate nor be maintained without the intervention of man, because " it is only by strong manures that these varieties have been obtained, and in poorer soils they instantly degenerate." But even if the manure supply were kept up by herds of wild animals the varieties could not be maintained because of cross-pollination.

the Creator creates by any laws, which I think is shown by the very facts of the geological character of these islands.) |

99 The same remarks applicable to fossil animals same type, — armadillos like every created [edentate]. — Passage for vertebrae in neck — same cause ; such beautiful adaptation, yet other animals live so well. — This kind of propagation gives hiding-place for many unintelligible structures — it might have been of use in progenitor, or it may be of use, — like mammae on men's breast. — |

100 How does it come wandering birds such [as] sandpipers not new at Galapagos. — Did the creative force know these species could arrive — did it only create those kinds not so likely to wander — did it create two species closely allied to Mus[cicapa] coronata, but not coronata. — We know that domestic animals vary in countries without any assignable reason. |

101 Astronomers might formerly have said that God ordered each planet to move in its particular destiny. In same manner God orders each animal created with certain form in certain country, but how much more simple and sublime power let attraction act according to certain law, such are inevitable consequences — let animal be created,
102 then by the fixed laws of generation, such will be their successors. | Let the powers of transportal be such, and so will be the forms of one country to another. — Let geological changes go at such a rate, so will be the number and distribution of the species!! |

103 It may be argued representative species chiefly found where barriers or what are barriers by interruption of communication, or when country changes. Will it [be] said that volcanic soil at Galapagos under equator, that external conditions would produce species so close as Patagonian and Galapagos Orpheus. — Put this strong so many thousand miles distant. — |

104 Absolute knowledge that species die and others replace them. — Two hypotheses : fresh creations is mere assumption, it explains nothing further ; points gained if any facts are connected.[1] —

No doubt in birds ; mundine genera are birds, (bats, foxes, Mus) that are apt to
105 wander and of easy transportal. — Waders and | waterfowl — scrutinize genera and draw up tables. — Instincts may confine certain birds which have wide power of flight ; but are there any genera, mundine, which cannot transport easily. It would have been wonderful if the two Rhea had existed in different continents. — In plants I believe not. — |

106 It is a very great puzzle why Marsupials and Edentata should only have left offsprings in or near South Hemisphere. Were they produced in several places and died off in some? Why did not fossil horse breed in S. America. It will not do to say period unfavourable to *large* quadrupeds, horse not large. — |

107–108 *excised.*

109 . . . but not vice versa. (Could plants live without carbonic acid gas. Yet unquestionably animals most dependent on vegetables of the two great kingdoms. |

110 Principes de Zool. Philosoph.[2] : — I deduce from extreme difficulty of hypothesis

[1] This is an early appearance of the argument frequently used by Darwin to the effect that the value of a hypothesis increases with the number of facts which it explains.

[2] Etienne Geoffroy-Saint-Hilaire. *Principes de Philosophie Zoologique*, Paris 1830, pp. 54 ff. (hypothesis that Cephalopod molluscs provided a link between invertebrates and vertebrates).

of connecting mollusca and vertebrata, that there must be very great gaps. — Yet some analogy. The existence of plants and their passage to animals appears greatest argument against theory of analogies. |

111 [Saint-Hilaire] states there is but one animal,[1] one set of organ[s] ; the others [he] assumes CREATED with endless differences : — does not say propagated, but must have concluded so — Evidently or hints considers generation as a short process by which one animal passes from worm to man highest or typical of changes which can be traced in *same* organ in *different* animals in scale. — In monsters also organs |

112 of lower animals appear. — Yet nothing about propagation — I see nothing like grandfather of Mammalia and birds — &c.

p. 32, reference to M[ilne] Edwards'[2] law of crustacea with respect to mouth, those beautiful passages from one to other organ. — Cuvier[3] on opposite side ; 1st vol of Fish.

p. 59. Cuvier[4] has said each animal made for itself does not agree with old and modern types being constant. Cuvier's[5] theory of *Conditions* of existence is thought to account [for] resemblances and ∴ quinary system, on three elements. p. 66. |

113 With unknown limits, every tribe appears fitted for as many situations as possible ; conditions will not explain states, for instance, take birds, animals, reptiles, fish. — (Perhaps consideration of range of capabilities past and present might tell something.)

p. 111. G. St. Hilaire Insects and Molluscs allowed to be wide hiatus : states in one the sanguineous system, in other nervous developed.[6] (Owen's idea). States these class[es] approach on the confines? Balanida? I cannot understand whether S.H. thinks development in quite straight line or branching. — |

114 S.H. What does the expression mean used by Cuvier,[7] that all animals (though

[1] Etienne Geoffroy-Saint-Hilaire. *Principes de Philosophie Zoologique*, Paris 1830, p. 22 : " il n'est plus d'animaux divers. Un seul fait les domine, c'est comme un seul être qui apparaît." *Ibid.* p. 214 : " Il n'y a donc pas plusieurs animaux, à proprement parler, mais un seul animal, dont les organes varient dans la forme, l'usage et le volume, mais dont les materiaux restent toujours les mêmes, au milieu de ces surprenantes métamorphoses."

[2] Henri Milne-Edwards. " Sur l'organisation de la bouche chez les crustacés suceurs (1830) *Ann. Sci. Nat.*, vol. 28, 1833, p. 78 : transformation of normal mouth with mandibles and maxillae into sucking tube, elongated, but " la composition organique décrite est toujours restée analogique. Les mêmes élémens constituans sont retrouvés dans l'un et l'autre cas ; c'est une tendance remarquable à l'uniformité de composition."

[3] Georges Cuvier. Darwin made this note from E. Geoffroy-Saint-Hilaire's *Principes de Philosophie Zoologique*, Paris 1830, p. 57, where Cuvier is quoted as saying " Tout nouvellement encore, dans le premier volume de mon *Histoire des Poissons*, j'ai exprimé mon sentiment à ce sujet, sans doute avec le ton modéré que les sciences réclament, et avec la politesse qui appartient à tout homme bien élevé."

[4] Georges Cuvier. Darwin made this note from Geoffroy-Saint-Hilaire ; *Principes de Philosophie Zoologique*, Paris 1830, p. 59 where Cuvier's earlier article on " Nature ", in Levraut's *Dictionnaire des sciences naturelles* is quoted :— " Ces vues d'*unité* sont renouvelées d'une vieille erreur née au sein du panthéisme, étant principalement enfantée par une idée de causalité, par la supposition inadmissible que *tous les êtres sont crées en vue les uns des autres* ; cependant chaque être est fait pour soi."

[5] This reference appears to be to Etienne Geoffroy-Saint-Hilaire, *Principes de Philosophie Zoologique* p. 66 on which there is a footnote by St Hilaire (referring to Conditions) on Cuvier's argument about resemblance.

[6] Etienne Geoffroy-Saint-Hilaire. *Principes de Philosophie Zoologique*, Paris 1830, p. 111 : " Le système sanguin est en excès et au contraire le système nerveux est frappé d'atrophie chez les mollusques ; c'est l'inverse chez les insectes." Loi de compensation.

[7] Georges Cuvier. Darwin appears to be quoting from E. Geoffroy-Saint-Hilaire *Principes de Philosophie Zoologique*, Paris 1830, p. 56 where Cuvier is quoted as saying : " j'ai toujours soutenu que le plan, qui jusqu'à un certain point est commun aux vertébrés, ne se continue pas chez les mollusques." Cf. also *Le règne animal*, Paris 1829, vol. 1 p. 48 : " on trouvera qu'il existe quatre formes principales, quatre plans généraux, si l'on peut s'exprimer ainsi, d'après lesquels tous les animaux, semblent avoir été modelés."

some may be) have not been created on the same plan. ("Second resumé" well worth studying). H.[1] says grand idea God giving laws and on them leaving all to follow consequences. —

I cannot make out his ideas about propagation. His work Philosophie anatomique (2d vol. about monsters[2] worth reading.) |

115 NB. Well to insist upon large mammalia not being found on all islands (if act of fresh creation, why not produced on New Zealand ; if generated, an answer can be given). —

It is a point of great interest to prove animals not adapted to each country. —

116 Provision for transportal otherwise not so numerous : quoted from Lyell[3]; | assuming truth of quadrupeds being created on small spots of land of the same type with the great continents, we get a means of Knowing of movements. —

How can we understand, excepting by propagation, that out of the thousand of

117 new insects all belong to same | types already established. Why out of the thousands of forms should they all be classified. Propagation explains this. —

Ancient Flora thought to [be] more uniform than existing.[4] — Ed. n. Philos. J., p. 191, No. 5, [vol. 3] Apr. 1827. |

118 F. Cuvier[5] says : " But we could only produce domestic individuals and not races, without the occurrence of one of the most general laws of life — the transmission of a fortuitous modification into a durable form, of a fugitive want into a fundamental propensity, of an accidental habit into an instinct ". Ed. n. Phi. J., p. 297, No. 8, Jan.–Apr. 1828. — I take higher grounds and say life is short for this object and others, viz. not too much change. |

119 In number 6 ? of Ed. n. Phil. Journ. Paper by Crawford[6] on Mission to Ava, account of HAIRY (because ancestors hairy) man with one hairy child, and of *albino* DISEASE being banished, and given to Portuguese priest. — In first settling a country, people very apt to be split up into many isolated races! Are there any instances of peculiar people banished by rest? — ∴ Most monstrous form has tendency to propagate as well as diseases. |

[1] Etienne Geoffroy-Saint-Hilaire, *Principes de Philosophie Zoologique*, Paris 1830, p. 219: " La puissance créatrice, par des combinaisons aussi simples a produit l'ordre actuel de l'univers, quand elle eut attribué à chaque chose sa qualité propre et son degré d'action, et qu'elle eut réglé que tant d'élémens, ainsi sortis de ses mains, seraient éternellement abandonnés au jeu, ou mieux, à toutes les conséquences de leurs attractions réciproques." This concept appears in the *Sketch* of 1842, (p. 86), *Essay* of 1844 (p. 253), and the *Origin* (World's Classics Edition p. 559).

[2] Etienne Geoffroy-Saint-Hilaire. *Philosophie anatomique. Des Monstruosités humaines*, Paris 1822. In referring to " 2nd vol.", Darwin was regarding the work *Philosophie anatomique*, Paris 1818 as vol. 1.

[3] Charles Lyell. *Principles of Geology*, vol. 2, London 1832, chapters VI and IX, 5th edition, London 1837, chapters VIII and IX.

[4] Anonymous. " Scientific intelligence. 9. On the distribution of living and fossil plants." *Edin. New. Phil. Journ.* vol. 3, April–June 1827, p. 190. On p. 191 : " the same genera and species [of fossil plants] are found in the most remote regions where the plants now in existence are entirely different."

[5] Frédéric Cuvier (1773–1838, brother of Baron Georges Cuvier). " Essay on the domestication of mammiferous animals . . . " *Edin. new. Phil. Journ.*, vol. 4, April 1828, p. 297.

[6] John Crawfurd. " Account of Mr. Crawfurd's Mission to Ava." *Edin. new. Phil. Journ.*, vol. 3, July–September 1827, p. 359. On p. 368 : " a man covered from head to foot with hair . . . The hair on the face of this singular being, the ears included, is shaggy, and about eight inches long . . . has two daughters . . . the youngest is covered with hair like her father . . . Albinos occur, now and then . . . We saw two examples : one of these, a young man of twenty . . . They were ashamed of him, and considered him little better than a European, they made him over to the Portuguese clergy man."

120 In intermarriages: smallest differences blended, rather stronger tendency to imitate one of the parents; repugnance generally to marriage before domestication, afterwards none or little with fertile offspring; marriage never probably excepting from strict domestication, offspring not fertile or at least most rarely and perhaps never female. — No offspring: physical impossibility to marriage. — |

121 ? Whether those genera which unite very different structure as *petrel* and *alk* do not show the possibility of common branching off?

Accra,[1] Coast of Africa. Clay slate, strike SSW and NNE, and 30°–80° C°. — Ed. Phil. n. J., p. 410, 1828 |

122 It is daily happening, that naturalist[s] describe animals as species, for instance — Australian dog or Falkland rabbit. — There is only two ways of proving to them it is not; one when they can proved descendant, which of course most rare, or when placed together they will breed. — But what a character is this? — |

123–128 *excised.*

129 The relation of analogy of MacLeay[2] etc. appears to me the same as the irregularities in the degradation of structure of Lamarck,[3] which he says depends on external influences. — For instance he says wings of bat are from external influence. — |

130 Hence name of analogy, the structures in the two animals bearing relation to a third body, or common end of structure.

A Race of domestic animals made from influences in one country is permanent in another. — Good argument for species not being so closely adapted. |

131 Near the Caspian province of Ghilan wooded district, cattle with humps[4] as in India. Geograph. J. — Vol. III, P. 1, p. 17, (Lat. about 37°). Vol. IV, P. 1, Geograph. Journal. Voyage up the Massaroony by W. Hillhouse.[5] — Demerara. In note Demerara 10–12 feet beneath surface forest trees fallen, kind well known, carbonized; clay, fifty feet, then forest 120 ft., micaceous rocks; subsidence appears indicated. — p. 36. — |

132 Geograph. Journ., Vol. IV, P. II, p. 160. Melville Island: "the buffaloes, introduced from Timor, herded separate from the English cattle, nor could we get them to associate together".[6] |

[1] Thomas Park. In "Scientific intelligence: Mr. Thomas Park's journey into the interior of Africa," *Edin. new Phil. Journ.*, vol. 4, March–April 1828, p. 410.

[2] William Sharp MacLeay. *Horae Entomologicae*, London 1819–1821. The "relations of analogy" are conceived as "existing between corresponding points of the two contiguous circles which pass through a perfect change of form" (p. 391) e.g. the Decapoda in the Crustacean circle have "relations of analogy" with the Araneidea of the Arachnid circle, while the latter's Acaridea have "relations of analogy" with the Diptera of the Haustellata circle.

[3] Jean-Baptiste de Lamarck. *Philosophie Zoologique*, Paris 1809, vol. 1, p. 153: degradation is the result of less progress in the perfection and composition of the organization, and must be distinguished from the effects of environment and contracted habits. E.g., seals owe their imperfect limbs to the water in which they live, as do whales; but seals are less degraded than whales because their organization is less degraded in its essential parts.

[4] Colonel William Monteith. "Journal of a tour through Azerdbijan and the shores of the Caspian," *Journ. Roy. Geogr. Soc.*, vol. 3, 1834, p. 1. On p. 17: "Their features more resemble Indians, and the cattle are small, having also the hump peculiar to that country."

[5] William Hillhouse. "Journal of a voyage up the Massaroony in 1831." *Journ. Roy. Geogr. Soc.*, vol. 4, 1834, p. 25.

[6] Major Campbell. "Geographical memoir of Melville Island, and Port Essington on the Coburg Peninsula Northern Australia . . ." *Journ. Roy. Geogr. Soc.*, vol. 4, 1834, p. 129 (160).

133 There is long rigmarole articles by S. Hilaire[1] on wonder of finding monkey in France — of genus peculiar to East Indian isles. — Compares it to fossil Didelphis (S. American genus) in plaster of Paris. — Now this is exception to *law of type*, like horse in S. America or like living Edentata in Africa etc. etc. — Now if suppose
134 world more perfectly continental, we might have | wanderers (as Peccari in N. America) ; then if it is doomed that only one species of family has offspring the *chance* is that these wanderers would not, but where original forms most numerous,
135 there would be wanderers. — Some however might have offspring, and then | (v. L'Institut,[2] p. 245 [recte 243], 1837) we should have anomalies, as Cape anteater. — This supposes world divided into Zoological provinces, united — and now divided again. — Weakest part of theory death of species without apparent physical cause. —

Mem.: Mastodon all over S. America. Hilaire[3] does not seem (?) to consider the monkey as a wanderer, but as produced by climate? — |

136 M. Baer[4] (thinks) the Auroch was found in Germany and thinks even now in central and eastern Asia beyond the Ganges and perhaps even in India — p. 261, L'Institut, 1837.

Mem.: F[ox] Darwin[5] cross breed boars were wilder than parents, which is same as Indian Cattle. ∴ Tameness not hereditary? Having been gained in short time. |

137 Milvulus forficatus is a great flycatcher doing the service of a swallow.

I think we may conclude from Australia and S. America, that only some mundine cause has destroyed animals over the whole world. — For instance, gradual reduction of temperature from geographical or central heat. — But the shells. |

138 Mr Yarrell[6] says that old *races* when mingled with newer, hybrid variety partakes chiefly of the former. Eyton's[7] paper on Hybrids, Loudon's Magazine. Gould[8] on Motacilla Loudon's Mag., September or October 1837 species peculiar to Continent and England. |

[1] Etienne Geoffroy-Saint-Hilaire. " Singe fossile de Sansan ", *L'Institut*, 5, 1837, p. 242 : " Ce n'est point un singe généralement parlant que M. Lartet a découvert dans notre Europe, mais précisément l'analogue de l'une de ces formes qu'on ne rencontre que dans cette région décidément à part, où la spécialité d'essences animales propres aux Indes Orientales et soumises à l'influence d'un milieu ambiant d'une sorte déterminée."

[2] Darlu. *L'Institut*, Paris 5, 1837, 218, p. 245. This paper deals with fossil mammals in deposits of gypsum near Meaux and contains no reference to the wanderings of mammals, nor to their anomalous distribution. Darwin's reference must therefore be incorrect, and should read p. 243 : cf. next footnote.

[3] Etienne Geoffroy-Saint-Hilaire. *L'Institut*, vol. 5, 1837, p. 243 : " n'allez pas conclure qu'en recourant à l'accumulation hypothétique des siècles, vous finiriez par construire une route géographique bien servie par la nature des diverses températures, immédiatement à ce propices, afin que les espèces, Sarigue et Gibbon, aujourd'hui vivantes en leur contrée respective, aient fourni des voyageurs vers un point voisin de leur antipode et soient venus ainsi déposer en France les débris, juste sujet de notre admiration, que nous avons cités dans cet écrit ; non, il n'en est point ainsi. Je m'en tiens pour dénégation, quant à ce sujet, aux principes et aux données philosophiques de mes mémoires sur les milieux ambians . . . "

[4] N. Baer. " Aurochs du Caucase " *L'Institut*, Paris, 5, 1837, 218, p. 260.

[5] William Darwin Fox. Probably personal communication.

[6] William Yarrell. Probably personal communication.

[7] Thomas Campbell Eyton. " Some remarks upon the theory of hybridity ", *Mag. Nat. Hist.* N.S., vol. 1, 1837, p. 357.

[8] John Gould. " Observations on some species of the genus Motacilla of Linnaeus." *Mag. Nat. Hist.*, vol. 1, September 1837, p. 459. Distinction between *Motacilla flava* Ray of Britain and *M. neglecta* of France and Holland. The pied wagtail of Britain, Norway and Sweden, has its place taken in France by *M. alba* L. *M. lugubris* Pallas is restricted to eastern Europe.

139 Westwood[1] has written paper on affinity and analogy in Linnaean Transactions.

Mr Wynne[2] distinctly says that the mixture between Chinese and English Breed decidedly exceedingly prolific, and hybrid about half way. Eyton[3] says Hybrid about half aways [way], and results the same. Indian cattle and common produced
140 very fine | hybrid offspring, much larger, than the dom[estic] from those imported by L[ord] Powis. Hybrid dogs offspring seldom intermediate between parents. — How easily does Wolf and Dog cross? Mr Yarrel[4] thinks oldest variety impresses the offspring most forcibly. Esquimaux dog and pointer.

Game-fowls have courage independently of individual force. |

141 Mr Wynne[5] has crossed Duck and Widgeon, and offspring either amongst themselves or with parent birds.

W. [Darwin] Fox[6] knew of case of male widgeon winged and turned on pool; first season bred readily with common ducks.

Kirby[7] all through Bridgewater errs greatly in thinking every animal born to consume this or that thing. — There is some much higher generalization in view.

In Marsupial division do we not see — splitting in orders carnivora, rodents etc. JUST COMMENCING. |

142 Kirby[8] says (not definite information) west of Rocky Mountains asiatic types discernible. — Bridgewater Treatise, p. 85. Parasites of negroes different from European.[9] — Horse and ox have different parasites in different climates. —

Humb[oldt],[10] Vol. V, P. II, p. 565. Consult. Says types most subject to vary where intermixture precluded. — |

143 Kirby[11] Bridgewater Treatise. There are some good accounts of passages of legs

[1] John Obadiah Westwood. " On Diopsis, a Genus of Dipterous insects ", *Trans. Linn. Soc. Lond.* vol. 17, 1837, p. 283. On p. 285 : " as these instances* involve in some degree the doctrine that every affinity is connected with, and must be tested by, a corresponding analogy . . . " (* footnote : lateral prolongation of the head into ocular peduncles).

[2] Wynne. Untraced.

[3] Thomas Campbell Eyton. " Some Remarks upon the Theory of Hybridity ", *Mag. Nat. Hist.*, N.S., London 1837, vol. 1, p. 357.

[4] William Yarrell. Probably personal communication.

[5] Wynne. Untraced.

[6] William Darwin Fox. Probably personal communication.

[7] William Kirby. *On the power, wisdom, and goodness of God, as manifested in the creation of animals and in their history, habits, and instincts*, (The Bridgwater Treatises) London 1835, vol. 1, p. 141 : " There is another function which is devolved upon animals with respect to the vegetable kingdom : to keep the members of it within due limits " vol. 2, p. 496 : " the vegetable tenants of the ocean require to be kept within due limits, . . . amongst other creatures to whom this province is assigned, are some Crustacea.' vol. 2, p. 514 : " The general functions of this Order [Carnivora] are to check the tendency to increase not only in their own Class, the Mammalians, but in most of the other Classes of Animals ."

[8] William Kirby, *op. cit.* vol. 1, p. 52 : " On the Rocky Mountains, and in the country westward of that range, Asiatic types are discoverable, both in the vegetable and animal kingdoms."

[9] William Kirby. *op. cit.* vol. 1, p. 85 : " Little stress will be laid on the parasite of the negroes (*Pediculus Nigritarum*), being specifically distinct from that which infests the whites, when we reflect that the horse and the ox have different parasites and assailants in different climates."

[10] Friedrich Heinrich Alexander von Humboldt. *Personal Narrative of Travels to the Equinoctial Regions of the New Continent, during the years* 1799–1804, translated by Helen Maria Williams, London 1821, vol. V, p. 565 : " The exclusion of all foreign mixture contributes to perpetuate varieties, or the aberrations from a common standard."

[11] William Kirby. *op. cit.* vol. 2, p. 75 : " in this Order of the Myriapods we see the first tendency towards employing what in Hexapods wear the form and perform the functions of legs as auxiliaries of the *mouth*."

into mouthpieces of Crustacea. Vol. II, p. 75. A Fish which emigrates over land,[1] a silurus, p. 123. A climbing fish,[2] p. 122. A terrestrial annelidous animal,[3] p. 347, Vol. I. — compare with my planariae.[4] Leaches out of water. |

144 Does the odd Petrel of T. del F. take form of awk because there is no awk in Southern Hemisphere? Does this rule apply? |

145 A Treatise on Form of Animals by Mr Cline :[5] " The character of both parents are observed in their offspring, but that of the male more frequently predominates ". p. 20 ditto : " If hornless ram be put to horned ewe almost all the lambs will be hornless ". Does this apply to when same animal breeds often with same male.

p. 23 " It is wrong to enlarge a native breed of animals, for in proportion to their increase of size they become worse in form, less handy, and more liable to disease ". |

146 If population of place be constant, say 2000, and at present day every ten living souls on average are related to the (200dth year) degree, then 200 years ago there were 200 people living who now have successors. Then the chance of 200 people, being related within 200 years backward, might be calculated and this number eliminated ; say 150 people four hundred years since were progenitors of present people, and so on backwards to one progenitor, who might have continued breeding from eternity backwards. — |

147 If population was increasing between each lustrum, the number related at the first start must be greater, and this number would vary at each lustrum and the calculation of chance of the relationship of the progenitors would have different formula for each lustrum. We may conclude that there will be a period, though long distant, when of the present men (of all races) not more than a few will have 148 successors. At present day in looking at two fine families one will | [have] successors for centuries, the other will become extinct. —

Who can analyse causes, dislike to marriage ; hereditary disease, effects of contagions and accidents ; yet some causes are evident as, for instance, one man killing another. — So is it with *varying* races of man : then races may be overlooked mere variations consequent on climate etc. — the whole races act towards each other and are acted on, just like the two families no doubt a different set of causes must act in the two cases. —

[1] William Kirby. *op. cit.* vol. 1, p. 122 : " Another migrating fish was found by thousands in the ponds and all the fresh waters of Carolina, by Bosc ; and as these pools are subject to be dry in summer, the Creator has furnished this fish, as well as one of the flying ones (*Exocoetus*), by means of a membrane which closes its mouth, with the faculty of living out of water, and of travelling by leaps, to discover other pools."

[2] William Kirby. *op. cit.* vol. 1, p. 123 : " Another fish (*Perca scandens*), found by Daldorff, in Tranquebar, not only creeps upon the shore, but even climbs the Fan palm in pursuit of certain Crustaceans which form its food."

[3] William Kirby. *op. cit.* vol. 1, p. 347 : " My late indefatigable and talented friend, the Rev. L. Guilding once found a *land* species, in an ancient wood in the Island of St. Vincent's, which from its soft body he regarded as a Molluscan, but from its figure, and annulose structure, its jointed antennae, and seemingly jointed legs crowned with bristles, it (*Peripatus juliformis*) certainly belongs, as Mr. Gray has remarked, to the present class [Annelida]."

[4] Charles Darwin. *Journal of Researches*, London 1839, p. 30 : " The terrestrial Planariae, of which I have found no less than eight species, occur from within the tropic to lat. 47° south, and are common to South America, New Zealand, Van Diemen's Land, and Mauritius."

[5] Henry Cline. *On the form of animals*, London 1805. *Observations on the Breeding and Form of Domestic animals*, London 1829.

May this not be extended to all animals, first consider species of cats etc. etc. Exclude mothers and then try this as simile. |

149 In a decreasing population at any one moment fewer closely related, ∴ (few species of genera) ultimately few genera (for otherwise the relationship would converge sooner), and lastly perhaps some one single one.— Will not this account for the odd genera with few species which stand between great groups, which we are bound to consider the increasing ones. —

NB. As illustration are there many anomalous lizards living, or of the tribes fish extinct, or of Pachydermata, or of coniferous trees, or in certain shell cephalopoda. — Read Buckland.[1] |

150 L'Institut, 1837, p. 319. Brongniart[2] — no dicotyledonous plants and few monocot [yledonous] in coal formation? p. 320. States cryptogam[ic] Flora formerly common to New Holland?! p. 320. Says Coniferous structure intermediate between vascular or Cryptogam (original Flora) and Dicotyledones, which nearly first appear (p. 321) at Tertiary epochs. p. 330. Fossil Infusoria found of unknown forms, a circumstance undiscovered by Ehrenbergh.[3] — |

151–154 *excised.*

155 . . . Indian cow with hump and common ; — between Esquimaux and European dog? Yet man has had no interest in perpetuating these particular varieties.

If species made by isolation, then their distribution (after physical changes) would be on rays — from certain spots. — Agrees with old Linnaean[4] doctrine and Lyell's[5] to certain extent. |

156 Von Buch[6] — Canary Islands : French Edit. — Flora of Islands very poor (p. 145) : 25 plants [Tristan da Cunha]. 36 St. Helena without ferns. — Analogous to nearest continent ; poorness in exact proportion to distance (?) and similarity of type (?) (Mem.: Juan Fernandez[7]). From study of Flora of islands : " ou bien encore on pourrait au plus en conclure quels sont les genres qui, sous ce climat, se divisent le plus aisément en espèces distinctes et permanentes ", p. 145. In Humboldt[8] great

[1] William Buckland. *Geology and Mineralogy considered with reference to Natural Theology*, London 1836.

[2] A. Brongniart. " Végétaux fossiles ", *L'Institut*, Paris 5, 1837, 220, p. 318.

[3] Christian Gottfried Ehrenberg. *L'Institut*, Paris 5, 1837, p. 330 : " Paléontologie : infusoires fossiles du tripoli d'Oran. M. Ehrenberg communique l'extrait d'une lettre de M. Agassiz de Neuchâtel sur le tripoli d'Oran qu'il a reconnu être formé de corps organisés microscopiques et silicifiés."

[4] Carolus Linnaeus. " Oratio de telluris habitabilis incremento ", reprinted in *Amoenitates Academicae*, vol. 2, contains a hypothesis of diffusion of plants and animals from the Island of Paradise. It is probable that Darwin's source was the English translation by F. J. Brand : *Select dissertations from the Amoenitates Academicae*, London 1781. (Information kindly supplied by W. T. Stearn ; cf. his " Botanical Exploration to the time of Linnaeus ", *Proc. Linn. Soc. Lond.*, 169 Session 1956–7, London 1958, especially pages 193 and 194).

[5] Charles Lyell. *Principles of Geology*, vol. 2, London 1832, p. 126.

[6] Leopold von Buch. *Description physique des Iles Canaries*, par Léopold de Buch traduite de l'Allemand par C. Boulanger, Paris 1836, p. 144 : " Le célèbre naturaliste français Du Petit-Thouars ne trouve, sur l'Ile de Tristan d'Acunha . . . pas plus de 25 différentes espèces de plantes phanérogames, dont les unes rappellent la végétation du Cap, les autres celle de l'Amérique, à peu prés également distante, et leur nombre à Sainte- Hélène, d'après le Catalogue de Risburgh, ne monte pas à plus de 36 espèces."

[7] Charles Lyell. *Principles of Geology*, vol. 2, London 1832, p. 154 has a reference to the introduction of goats into Juan Fernandez.

[8] Friedrich Heinrich Alexander von Humboldt. *De Distributione geographica plantarum secundum coeli temperiem et altitudinem montium, prolegomena*, Lutetiae Parisiorum, 1817, p. 39 : " si, in singula zona, *specierum* numerum cum numero *generum* confers, cui illae adscribuntur, tum versus polum, tum versus cacumina montium, longe plura genera invenies, quam locis planis et calidioribus. Sic alit Gallia inter 3645 species phanerogamas 683 genera, cum in Laponia 487 Phanerogamae ad 212 genera referuntur ; unde rationes fiunt 5, 7 : 1 et 2, 3 : 1."

157 work | De distribut. plantarum relation of genera to species in France is 1 : 5·7, in Laponia 1 : 2·3. Mem.: Lyell[1] on shells. —

	genera
In North Africa	1 : 4·2
Iles Canaries	1 : 1·46
St. Helena	1 : 1·15

Calculate my Keeling case ; Juan Fernandez ; Galapagos. — Radack Islands. —
158 ∴ Islands and Arctic are in same relation. We find | species few in proportion to difficulty of transport. For instance, the temperate parts of Teneriffe : the proportion of genera 1 : 1. I can understand in one small island species would not be manufactured. Does it not present analogy to what takes place from time? Von Buch[2] distinctly states that permanent varieties become species, p. 147–150, — not being crossed with others. — Compare it to languages. But how do plants cross? ——— Admirable discussion. |

159–160 *excised.*

161 Mr Owen[3] suggested to me, that the production of monsters (which Hunter[4] says owe their origin to very early stage) and which follow certain laws according to species, present an analogy to production of species. —

Animals have no notion of beauty, — therefore instinctive feelings against other species for sexual ends, whereas man has such instincts very little. |

162 In Zoǫlog. Proceedings, June 1837, by Eyton[5] account of three kinds of pigs. Difference in skeletons : VERY GOOD.

Apteryx, a good instance probably of rudimentary bones. — As Waterhouse[6] remarked mere length of bill does not indicate affinity because similar habits produce similar structure. — Mem.: Ornithorhync[h]us.

Would not *relationship* express a real affinity and affinity whales and fish? — |

163 Progeny of Manks-cats without tails : some long and some short, therefore like dogs.

[1] Charles Lyell. *Principles of Geology*, vol. 3, London 1833. Appendix I. M. Deshayes's Table of Shells, gives the number of species in each genus of selected living and Tertiary shells, in various localities.

[2] Leopold von Buch. *op. cit.* p. 148 : " Un lieu se trouve-t-il isolé par des obstacles naturels, par des chaînes de montagnes qui établissent une séparation plus effective que des espaces considérables de mer interposés, on peut toujours s'attendre à y trouver des espèces de plantes entièrement nouvelles, et ne croissant pas dans les autres parties de l'île. Un hasard favorable a peut-être porté, par un enchainement particulier de circonstances, des semences pardessus les montagnes. Abandonnée à elle-même, la variété qui résulte des nouvelles conditions auxquelles elle est soumise, y formera, avec le cours du temps, une espèce distincte, qui s'èloigne d'autant plus de sa forme primitive, qu'elle reste plus longtems dans cette région isolée, exempte d'autres influences."

[3] Richard Owen. Probably personal communication.

[4] John Hunter. *Observations on certain parts of the Animal Oeconomy*, London 1837, with notes by Richard Owen. P. 26 [":] I should imagine, " he writes, " that monsters were formed monsters from their very first formation, for this reason, that all supernumerary parts are joined to their similar parts, as a head to a head &c. &c."

[5] Thomas Campbell Eyton. " Notice of some Osteological Peculiarities in different skeletons of the Genus *Sus* ", *Proc. Zool. Soc. Lond.*, 1837, pt. V, p. 23.

[6] George Robert Waterhouse. Probably personal communication.

Ogleby[1] says : Wolves at Hudson bay breed with dogs, — the bitches never being killed by them, whilst they eat up the dogs. —

L'Institut. Curious paper by M. Serres[2] on Molluscous animals representing foetuses of Vertebrata etc. 1837, p. 370. Owen[3] says nonsense. |

164 The distribut[ion] of big animals in East Indian Archipelago, very good in connection with Von Buch Volcanic chart and my idea of double line of intersection. —

At India House collection of Birds from Java. — At Leyden series from several islands. — Bear peculiar to Sumatra and not found on Java. — Monkey peculiar to latter, not to former. — Dr Horsfield.[4] |

165–166 *excised.*

167 ? Consult Dr. Smith[5] History of S. African cattle.

Phillips Geology,[6] p. 81, in Lardners Encyclop. Proportion between fossils and recent shells, between herbivorous and zoophagous mollusca according to periods. —

NB. Was Europe desert (like S. Africa) after Coal Period? |

168 ? In those divisions of mollusca, where species now least in number (as cephalopods), in last tertiary epoch most genera dead? — Examine into this in Phillips.[7] — According to this formerly there would have been many genera of monotrematous animals. — p. 82. There are many tables in Phillips of numerous genera in fossil and recent state well worth consideration. — |

169 Tabulate Mammalia on this principle.

Man in *savage* state may be called species, in *domesticated* races. — If all men were dead, then monkeys make men. — Man makes angels. — |

170 Those species which have long remained are those — ? Lyell[8]? — which have wide range and therefore cross and keep similar. But this is difficulty : this immutability of some species.

In Phillips,[9] p. 90, it seems the most organized fishes lived far back, first approaching to reptiles at Silurian age. — |

171 How long back have insects been known? As Gould[10] remarked to me the " beauty of species is their exactness ", but do not known varieties do the same, may you not breed ten thousand greyhounds and will they not be greyhounds? — Yarrell's[11]

[1] William Ogilby? The reference has not been traced, but John Wandesford Ogilby was Assistant Secretary to the Hudson's Bay Company from 1777 to 1780. At the London Office of the Company, Beaver House, there is a MS by Andrew Graham who was on the staff from 1750–1775 : " Observations on Hudson's Bay ", in which the following passage occurs : " a she-wolf copulated with a husky dog . . . "

[2] Antoine-Etienne-Renaud-Augustin Serres. " Anatomie des mollusques ", *L'Institut*, Paris 5, 1837, 221, p. 370.

[3] Richard Owen. Probably personal communication.

[4] Thomas Horsfield. *Zoological researches in Java and the neighbouring islands*, London 1824. *Semnopithecus pyrrhus* = *Presbytis cristatus*, Java. *Ursus malayanus* = *Helarctos m.*, Sumatra.

[5] Andrew Smith. Cf. *Variation of Animals and Plants under Domestication*, vol. 1, p. 88 : " Sir Andrew Smith several years ago remarked to me that the cattle possessed by the different tribes of Caffres, though living near each other under the same latitude and in the same kind of country, yet differed, and he expressed much surprise at the fact."

[6] John Phillips. *Treatise on Geology. Lardner's Cabinet Cyclopaedia*, London 1837.

[7] John Phillips. *A Treatise on Geology. Lardner's Cabinet Cyclopaedia*, London 1837, p. 83 : " Most of the fossil cephalopoda belong to extinct genera."

[8] Charles Lyell. No reference to this subject in Lyell's published works has been traced.

[9] John Phillips. *A Treatise on Geology. Lardner's Cabinet Cyclopaedia*, London 1837, p. 90. Fishes with placoid and ganoid scales are shown dating back to the Silurian.

[10] John Gould. Probably personal communication.

[11] William Yarrell. Probably personal communication.

remark about old varieties affecting the cross must [be] well worthy of observation.— |
172 I think it is certain strata could not now accumulate without seal-bones and cetaceans, — both found in every sea from Equatorial to extreme poles. —

Oh, Wealden, — Wealden. —[1]

Do the N. American Tertiary deposits present analogies to shells of living seas? |
173–174 *excised.*
175 A breed of Blood-Hounds from Aston Hall close to Birmingham, and supposed to be descended from a breed known to be there since the time of Charles, — and now in the possession of Mr Howard Galton have one of the vertebra, about 2/3 from
176 base of tail, enlarged here [?] | very considerably, so that any person would say the tail was broken and this came so often that it was difficult to obtain a litter without this defect. Very curious case. — W. D. Fox.[2]

When dogs are bred into each other, the females loose [lose] desire, and it is required to give the cantharides. |
177–178 *excised.*
179 Bull. Soc. Geolog., 1834, p. 217. Java Fossils : 10 out of twenty have analogues in the Indian sea. — Deshayes.[3]

Mr M'Clay[4] is inclined to think that offspring of Negro and white will return to native stock (the cross often whiter than white parent) ; the mulattos themselves
180 explain it by intermarriage with people either a little nearer black | or white as it may happen. — Dr Smith[5] says he is sure of the case at Cape. — M'Clay argues from it Black and White species. — For, says he, seeds of hybrid lillies etc. etc. (V[ide] Herbert[6] on hybrids) thus act. — Now the point will be to find whether know[n] varieties in plants do so, — as in cacti etc. etc., — as in dogs ; investigate
181 case of pidgeons, fowls, rabbits, | cats etc. etc. — When black and white men cross, some offspring black, others white, which is more closely allied to case of cross of dogs. — See Paper in Philosophic Transactions on a quagga and mare, crossing by Lord Moreton [Morton],[7] where mare was influenced in this cross to after births like aphides. — Case of boy with foetus developed in breast, — looking as if many ova
182 impreg- | nated at once. — Dr Smith[8] considers the Caffers (like Englishmen) men of many countenances, as hybrid race. Is not this contradiction to his view of races

[1] Darwin's exclamation probably refers to the problem presented by the apparently estuarine nature of the Wealden deposits and the embedding of freshwater species in them. (Cf. Lyell, *Principles of Geology*, vol. 1, London 1830, p. 134 ; vol. 2, London 1832, p. 275 ; vol. 3, London 1833, p. 325). Information kindly supplied by Mr. S. C. A. Holmes of the Geological Survey.

[2] William Darwin Fox. Probably personal communication. (Cf. *Variation in Animals and Plants*, 1868, vol. 2, p. 121.)

[3] Gérard Paul Deshayes. *Bull. Soc. Geol. France*, vol. 4, Paris [1834], p. 217 : " M. Deshayes fait connaître à la Société que M. Hardie lui ayant fait voir les fossiles qu'il a recueillis dans l'Inde, à l'île de Java, dans un terrain tertiaire très moderne, il a reconnu que, parmi les vingt espèces environ qui lui ont été communiquées, dix sont rigoureusement déterminables, et ont certainement leurs analogues dans les mers de l'Inde."

[4] William Sharp MacLeay. Probably personal communications.

[5] Andrew Smith. Probably personal communication.

[6] William Herbert. *Amaryllidaceae : preceded by an attempt to arrange the Monocotyledonous orders, and followed by a Treatise on cross-bred vegetables and Supplement.* London 1837.

[7] George, Earl of Morton. " A singular fact of natural history. Peculiarities of the progeny of an Arab horse from a mare that had previously bred with a Quagga." *Phil. Trans. Roy. Soc.*, 1821, p. 20.

[8] Andrew Smith. Probably personal communication.

not mingling? — In Fox's[1] case of Blood Hounds — a little mingling would probably have been good, namely such as Blood Hounds from other parts of England. |

183 Mr Bell[2] of Oxford Street had a very fine blood hound bitch which would never take the dog. But at last a rough-haired shepherd dog lined her and produced a very large litter — never afterwards went in heat. This is good instance of same fact in Mr Galton's case. — It explain[s] the loss and experience (must probably have occurred to every one) of rare breeds of dogs from owners great care of them. Fox says when two dogs of opposite breeds are crossed, sometimes offspring quite inter-

184 mediate | sometimes take strongly after either parent, about as often one way as other. — He has known case of good pointer and rough water spaniel produce litter like both parents, and Mr Bell has half blood-hound and greyhound. —

When two dogs have lined bitch directly one after the other, puppies differ, and [are] like both parents. — Fox told me of case of mare covered by blood horse and carthorse two folds [foals ?] . . . |

185–190 *excised.*

191 Mr Herbert's[3] papers are in the Horticultural Transactions and a distinct work on Hybridity under title of Amaryllidae and Narcissus. Mr Donn [Don] considers Mr H[erbert] rather wild.

Mr Donn[4] [Don] remarks to me that give him a species from Ireland, England, Scotland and other localities, and each one will have a peculiar constant aspect. That is varieties, though of trifling order are formed by nature. |

192 Carmichael,[5] Tristan D'Acunha, a list of its Flora is given. Mr Don[6] remarked to me, that some good African and some good S. American forms (and on average some of these forms would have some peculiarity). — Now when we hear that the whole island is volcanic, surmounted by crater and studded with others, we see a beginning to island. Graham Island. — We know many seeds might be transported

193 some blown — floating trees. | — Thrushes (Turdus Jagonensis?) and bunting[s] (Emberiza Brasiliensis?) and coots (Fulica chloropus) might bring in stomach etc. etc. (Mem.: discover what kinds of seed these plants). (Mem.: Fact stated by Mr Don[7] in island[s]. Teneriffe, St. Helena, J. Fernandez, Galapagos. Many trees [and] compositae, because seeds first arrived and hence formed trees ; Ferns ditto), and would creator *make* plants when this volcanic point appeared in the great ocean,

194 have made | plants of American and African form, merely because intermediate

[1] William Darwin Fox. Probably personal communication.

[2] J. Bell, " of Oxford Street ". Bell, Thomas : *A History of British Quadrupeds*, London 1837, p. 209 : " The race [of blood-hounds] has been gradually diminishing, and is now very rarely to be met with in its purity. Amongst the very few instances of its present existence, I may mention a fine breed in the possession of Mr. J. Bell, of Oxford Street, who retains them in great purity." Darwin's information was no doubt transmitted personally by Mr. J. Bell.

[3] William Herbert. " Instructions for the treatment of the Amaryllis longifolia, with some observations on the production of hybrid plants." *Trans. Hort. Soc.*, vol. 3, 1820, pp. 187–196 : and " On the production of hybrid vegetables, with the result of many experiments made in the investigation of that subject ", *Trans. Hort. Soc.*, vol. 4, 1822, p. 15.

[4] George Don (junior). Probably personal communication.

[5] Captain Dugald Carmichael. "Some account of the Island of Tristan da Cunha and of its natural productions ", *Trans. Linn. Soc. Lond.*, 12, Part II, 1818, p. 483.

[6] George Don (junior). Probably personal communication.

[7] George Don. Presumably personal communication or perusal of Don's manuscript Journal in Royal Horticultural Society of London (cf. A. W. Exell : *Catalogue of the Vascular plants of S. Tomé*, London B.M. (N.H.), 1944, p. 8.

position. — We cannot consider it as adaptation because volcanic islands whilst African sandstone and granite (that is genera near Cape), see if there are any species same as T. del Fuego and C. of Good Hope, show *possibility* of transport. If some cannot be explained more philosophical to state we do not know how transported. |
195 (Glaciers might have acted at Tristan D'Acunha. — Carmichael,[1] Linn. Transacts., Vol. XII. —)

The alpine plants of the Alps must be new formations because snow formerly descended lower, therefore species of lower genera altered, or northern plants.

Mem. The antarctic flora must formerly have been separated by short space from mountains low down, therefore plants common ; take an example from T. del Fuego. |
196 Ellis[2] (?) says Tahitian kings would hardly produce from incestuous intercourse, — a parallel fact to Blood Hounds.

Before attraction of gravity discovered it might have been said it was as great a difficulty to account for movement of all [planets] by one law,[3] as to account for each separate one ; so to say that all mammalia were born from one stock, and since distributed by such means as we can recognize, may be thought to explain nothing, — it being as easy to produce for the creator two quadrupeds at S. America — jaguar and Tiger. |

197–202 *excised.*

203 When species cross and hybrid breed, their offspring show tendency to return to one parent ; this is only character, and yet we find this same tendency (only less strongly marked) between what are called varieties. NB. One mother bringing forth young having very different characters is attempt at returning to parent stock. I think we may look at it so — ?? It holds good even with trifling differences of expression — one child like father, another like mother. |

204 Has Lowe[4] written any other paper besides one in Latin, one on Madeira — any general observation. Difference of species between land shells of Porto Santo and Madeira. I believe very curious.

My idea of propagation almost infers, what we call improvement. All mammalia from one stock, and now that one stock cannot be supposed to be most perfect
205 (according to our ideas of perfection), but intermediate | in character. The same reasoning will allow of decrease in character (which perhaps is case with fish, as some of the most perfect kinds the shark. Lived in remotest epochs). — ? Lizards of secondary period in same predicament. It is another question whether whole scale of Zoology may not be perfecting by change of Mammalia for Reptiles which can
206 only be adaptation to changing world. — I cannot for a | moment doubt but what cetacea and Phocea now replace Saurians of Secondary epoch : it is impossible to suppose such an accumulation at present day and not include Mammalian remains. The Father of all insects gives same argument as father of Mammalia, but here

[1] Captain Dugald Carmichael. *See* above p. 64.

[2] William Ellis. *Polynesian researches, during a residence of nearly eight years in the Society and Sandwich Islands*, London 1831.

[3] This is the first appearance of the argument used by Darwin in the *Sketch* of 1842, p. 84 ; and the *Essay* of 1844, p. 250.

[4] Richard Thomas Lowe. " Primitiae Faunae et Florae Maderae et Portus-Sancti ; sive Species quaedam novae vel hactenus minus rite cognitae animalium et plantarum in his insulis degentium breviter descriptae ", [1830] *Trans. Camb. Phil. Soc.*, vol. 4, 1833, p. 1.

improvement in system of articulation. ? Whether type of each order may not be supposed that form, which wandered least from ancestral form. If so are present
207 typical | species most near in form to ancient ; in shells alone can this comparison be instituted. —

People often talk of the wonderful event of intellectual man appearing. The appearance of insects with other senses is more wonderful. — Its [the insect's] mind more different probably and introduction of man nothing compared to the first thinking
208 being — although hard to draw line, | not so great as between perfect insects and forms low hard to tell whether articulate or intestinal, or even a mite. — A bee compared with cheese mite — with its wonderful instincts. The difference is that there is wide gap between man and next animals in mind more than in structure.

If the skeleton of a negro had been found, what would anatomists have said? — ? Where is Pentland's[1] account of ... |

209–210 *excised.*

211 A. B. C. D. (A) crossing with (B), and (B) being crossed with (C) prevents offspring of A becoming a good species, well adapted to locality. But it is instead a stunted and diseased form of plant, adapted to A. B. C. D. Destroy plants B. C. D. and A will soon form good species!

The increased fertility of slightly different species and intermediate character of offsprings accounts for *uniformity* of species and we must confess, that we cannot
212 tell, what is the amount | of difference which improves and checks it. — It does not bear any precise relation to structure. Mem.: Eyton's[2] hogs and dogs.

The passage in last page explains that between species from moderately distant countries there is no test but generation (but experience according to each group) whether good species, and hence the importance naturalists attach to geographical ranges of species. |

213 Definition of species : one that remains at large with constant characters, together with other beings of very near structure. — Hence species may be good ones and differ scarcely in any external character. For instance, two wrens, found to haunt two islands — one with one kind of herbage and one with other — might change organization of stomach and hence remain distinct. |

214 When country changes rapidly, we should expect most species. —

The difference [between] intellect of man and animals not so great as between living thing without thought (plants) and living thing with thought (animal).

∴ My theory very distinct from Lamarck's.[3]

Without *two* species will generate common kind, which is not probable, then
215 monkeys will never produce man, but | both monkeys and man may produce other species. Man already has produced marked varieties and may someday produce something else, but not probable owing to mixture of races. — When all mixed

[1] Joseph Barclay Pentland. Probably " Decription of fossil remains of some animals from the northeast border of Bengal ", *Proc. Geol. Soc.*, vol. 1, 1834, p. 76.

[2] Thomas Campbell Eyton. " Some Remarks upon the Theory of Hybridity ", *The Magazine of Natural History*, N.S., vol. 1, London 1837, p. 357.

[3] Darwin's point appears to be that Lamarck placed a great distinction between the higher animals which possessed a " sentiment intérieur ", and the lower animals which do not. (*Philosophie Zoologique*, Paris 1809, vol. 2, p. 256).

physical changes (? intellectual [faculty] being acquired alters case) other species or angels produced. |

216 Has the Creator since the Cambrian formation gone on creating animals with same general structure. — Miserable limited view. —

With respect to how species are [formed], Lamarck's[1] "willing" doctrine absurd (as equally are arguments against it[2] — namely how did otter live before being made 217 otter — why to be sure there were a thousand intermediate | forms. — Opponent will say : show them me. I will answer yes, if you will show me every step between bull Dog and greyhound). I should say the changes were effects of external causes, of which we are ignorant, as why millet seed turns a Bullfinch black, or iodine on glands of throat, or colour of plumage altered during passage of birds (where is this statement? — I remember L. Jenyns[3] talking of it), or how to make Indian cow with hump or pig's foot with cloven hoof. |

218 Ask Entomologists whether they know of any case of *introduced* plant, which an insect has become attached to, that insect not being called omniphitophagous.

But it will be said there are latent insects [instincts], — as crows against man with gun, and Bustards etc. etc.!!!

An American and African form of plant being found in Tristan D'Acunha, may be said to deceive man, as likely as fossils in old rocks for same purpose! |

219 Can the wishing of the Parent produce any character in offspring? Does the mind produce any change in offspring? If so, adaptation of species by *generation* explained?

NB. Look over Bell[4] on Quadrupeds for some facts about dogs etc. etc. — NB. Animals very remote — ass and horse — produce offspring exactly intermediate. — Reference to Pig and Dogs.

My theory will make me deny the creation of any new quadruped since days of Didelphis in Stonesfield ∴ all lands united (Falkland Fox, ice). Mauritius — what a difficulty, when elevated, subsidence near is only hope. — New Zealand, compare to Van Diemen's land, glorious fact of *absence* of quadrupeds. — East India Archipelago, very good on opposite tendency. — |

220 Study Ellis and Williams [William Ellis][5] Zoology of South Sea islands — any animals [mammals]? I believe — none. — Canary islands? Madeira? Tristan D'Acunha? Iceland?

The connection between Mauritius and Madagascar very good. — Fernando Po and Coast of Africa equally good. — Small islands off New Guinea — same fact, see Coquille's Voyage. — Galapagos mouse (?) — brought by canoes. — Ceylon and India. — Van Diemen's Land — Australia. — England and Europe. — It will be well worth while to study profoundly the origin and history of every terrestrial mammalia, especially moderately large ones. — |

[1] Jean Baptiste de Lamarck. *See* Introduction.

[2] Darwin means that arguments against the formation of species are absurd. The argument about the evolution of the otter through intermediate forms is developed in the *Essay* of 1844, p. 152.

[3] Leonard Jenyns, afterwards Blomefield. Probably personal communication.

[4] Thomas Bell. *A History of British Quadrupeds*, London 1837 ; pp. 194 to 251 are devoted to the breeds of dogs.

[5] William Ellis. *Polynesian researches, during a residence of nearly eight years in the Society and Sandwich Islands*, London 1831.

221 In the Flora of Tierra del Fuego, like that of North Europe, many genera and few species.

The number of genera on islands and on Arctic shores evidently due to the chance of some ones of the different orders being able to survive or [to] chance having transported then to new station. — When the new island splits and grows larger, species are formed of those genera, and hence by same chance few representative species. This must happen and then enquire [enquiry] will explain representative system.

Of these we see example in English and Irish Hare. — Galapagos shrews and when
222 big continent, many species belonging to its own genera. | Therefore if in small tract we have many species, we may insure mass continental or many large islands. — Hence this must have been condition of Paris basin land. — How is this with Fernando Po, with plants of St. Helena and Tristan D'Acunha? — resolves itself into question of proportion of species to genus.

If on one island several species of same genus — subsided land. — Mauritius? Although the horse has perished from S. America, the jaguar has been left and Fox
223 and bear. — If I had not discovered | channel of communication by which great Edentata might have roamed to Europe and Pachydermata from Europe to America, how strange would presence of jaguar [have] been in S. America. —

West coast of Africa and East of America ought to present great contrast in forms ; India intermediate ; see how that is. — ? Are shell-boring Mollusca like Carnivorous mammalia in their wide range and in their duration of species. (? Are carnivorous mamm[alia] in Paris basin altered ? perhaps more like present carnivora than Pachydermata.) |

224 If my theory true, we get 1st a *horizontal* history of earth within recent times, and many curious points of speculation ; for having ascertained means of transport, we should then know whether former lands intervened. — 2[d]) By character of any two ancient fauna, we may form some idea of connection of those two countries. Hence India, Mexico and Europe — one great sea. (Coral reefs ∴ shallow water at Melville island). 3[d]) We know that structure of every organ in A.B.C., three species of one genus can pass into each other by steps we see ; but this cannot be predicated
225 of structures in two genera. Although D.E.F. follow close to | A.B.C., we cannot be sure that structure (C) could pass into (D). — We may foretell species, limits of good species being known. It explains the blending of two genera. — It explains typical structure. — Every species is due to adaptation hereditary structure ; Latter far chief element. ∴ Little service habits in classification or rather the fact they are *not* far the most serviceable. We may speculate on durability of succession from what we have seen in old world and in current changes which may happen. —

It leads you to believe the world older than *geologists* think ; it agrees with exces-
226 sive inequality of numbers of species in divisions, — look at articulata!!? | It leads to [knowledge of] nature of physical change between one group of animals and a successive one. — It leads to knowledge what kinds of structure may pass into each other ; now on this view no one need look for intermediate structure, say in brain, between lowest mammal and reptile (or between extremities of any great divisions) ; thus a knowledge of possible changes is discovered, for speculating on future. |

227 ∴ Fish never become a man. — Does not require fresh creation. — If continent had sprung up round Galapagos on Pacific side, the Oolite order of things might have early been formed. —

With belief of transmutation and geographical grouping we are led to endeavour to discover *causes* of changes, — the manner of adaptation (wish of parents??), instinct and structure becomes full of speculation and line of observation. — View of generation being condensation, test of highest organization intelligible. — May
228 look to first germ, | led to comprehend true affinities. My theory would give zest to recent and fossil Comparative Anatomy ; it would lead to study of instincts, heredity and mind heredity, whole [of] metaphysics. — It would lead to closest examination of hybridity, — to what circumstances favour crossing and what prevent it ; and generation, causes of change in order to know what we have come from and to what we tend, this and direct examination of direct passages of structure in species might lead to laws of change, which would then be [the] main object of study,
229 to guide our speculations | with respect to past and future.

The grand question which every naturalist ought to have before him when dissecting a whale, or classifying a mite, a grampus or an insect is What are the Laws of Life?

When we have near genera far back as well as at present time, we might expect confusion of species. — Important. For instance, take Voluta and Conus (??), which now near together, were not both genera formerly abundant.

Seed of Ribston Pippin tree producing crab [apple] is the offspring of a male and female animal of one variety going back? Whether this going back may not be owing to cross from other trees???? |

230 Do the seeds of Ribston Pippin and Golden Pippin produce real crabs, and in each case similar or mere mongrels?

It really would be worth trying to isolate some plants under glass bells and see what offspring would come from these. Ask Henslow[1] for some plant, whose seeds go back again, not a monstrous plant, but any marked variety. — Strawberry produced by seeds?? — Universality of generation strongly shown by hybridity of ferns. — Hybridity showing connexion of two plants. |

231 Animals whom we have made our slaves we do not like to consider our equals. — Do not slave-holders wish to make the black have other mind? — Animals with affection, imitation, fear of death, pain, sorrow for the dead — respect.

We have no more reason to expect the father of mankind, than Macrauchenia, yet it may be found. — We must not compare chance of embedment in man in present state with what he is as former species. His arts would not then have taken him over whole world. — |

232 The soul by consent of all is superadded, animals not got it, not look forward. If we choose to let conjecture run wild, then animals — our fellow brethren in pain, disease, death, suffering and famine, our slaves in the most laborious works, our companions in our amusements, — they may partake from our origin in one common ancestor, we may be all netted together. —

Hermaphrodite animals couple : argument for true molluscs coupling. — |

233–234 *excised.*

[1] John Stevens Henslow.

235 Geograph. Journal, Vol. V, P. I, p. 67. Dr Coulter[1] on decrease of population in California [by the] cessation of female offspring : applicable to any animal.

Athenaeum, p. 154, 1838. Hybrid Ferns.[2]

It may be argued against theory of changes that if so, in approaching desert country or ascending mountain you ought to have a gradation of species, now this
236 notoriously is | not the case. You have stunted species, but not such as would make species (except perhaps in some plants, and then a chain of steps as found in some mountains). — How is this explained by law of small differences producing more fertile offspring. — I[ly] All variation of animal is either effect or adaptation, ∴ Animal best fitted to that country where change has taken place. Nature. . . . |

237–238 *excised.*

239 Any change suddenly acquired is with difficulty permanently transmitted. A plant will admit of a certain quantity of change at once, but afterwards will not alter. This need not apply to very slow changes without crossing. — Now a gradual change can only be traced geologically (and then monument imperfect) or horizontally, and then cross breeding presents perfect change. |

240 It is scarcely possible to get evidence of two races of plants run wild. — (For we know that such can take place without impregnating each other). For if they are different, then they will be called species, and these producing fertile hybrids will not destroy that evidence, as so many plants produce hybrids, or else whole fabric will be overturned. — Hence extreme difficulty, argument in circle. — Falkland Island case good one of animals not soon being subjected to change in Americas.
241 Perhaps merely gone back previous | to fresh change. —

Get a good many examples of animals and plants very close (take European birds Mr Gould's[3] case of willow wren and other varying in wild state to show that we do not know what amount of difference prevents breeding, or as others would express it amount of varying in wild state. —

When breaking up the primeval continent, — Indian Rhinoceros, Java and Sumatra ones all different. — Join Sumatra and Java together by elevations now in Pro-
242 gress, and you will have two | Tapirs existing in East Indian seas. Marsupial animals all show greater connexion in Quadrupeds, but *plants do not follow* by any means. — Ostriches. — Hippo[po]tamus only african. — American and African forms mingle in India and East Indian islands. — Monkeys different not travellers??

Royle's[4] case of Himalayan plants. ? Migrating birds. He told me some story of crane from Holland!!! In stomach or in feathers — seeds. — |

243 Two inhabitants of the tropics (whether one fossil or not) are related by real relationship, as well as effect of similar temperature. — Now those of temperate

[1] Thomas Coulter. " Notes on Upper California ", *Journ. Roy. Geogr. Soc.*, vol. 5, 1835, p. 59. On p. 67 : " It is a very extraordinary fact that their [the Indians'] decrease is greatly hastened by the failure of female offspring, — or the much greater number of deathe amongst the females in early youth than in the males."

[2] Martin Martens. " On hybridity in ferns ", (Paper read before Botanical Society on 16th February 1838). *The Athenaeum*, 1838, p. 154.

[3] John Gould. *The Birds of Europe*, London 1837, vol. 2, (pages unnumbered). P. 131 : " A little variation frequently occurs in the size of each of the birds ".

[4] John Forbes Royle. *Illustrations of the Botany and other Branches of the Natural History of the Himalayan Mountains*, London 1834–1835.

regions and tropics are only related by one connection — viz. descent. — Hence far greater discordance in latter. Hence change in form. — This probably explains crag and miocene. — The descendants left in cooling climate might change twice over, whereas those which migrate a little to the southward would merely be specifically different if so. — Now this is difficult to explain by creation or we must suppose a
244 multitude of small creations. — | Will Dromedaries and Camels breed? — As man has not had time to form good species, so cannot the domesticated animals with him ! —

Modern origin shown by only one species far more than by non-embedment of remains — ? agrees with non-blending of languages ? —

Till man acquired reason, he would be [a] limited animal in range, and hence probability of starting from one point. — |

245 In the crag we see the process of change of those forms, which have succeeded in becoming habituated to colder climate, whilst others died out or moved towards equator, or some species might then have been wanderers. —

There ought to be fewer species in proportion to genera, than in present seas. All the species which survives any change may undergo indefinite change (making in their history an eocene, miocene and pliocene epoch), whilst others may die out or move southward.

246 ∴ Species must be compared | to neighbouring sea. — For change of species does not measure time but physical changes (We assume like weather on long average tolerably uniform). — Comparing fossils with whole world, would be like in a palaeontologic table in comparison of temperature of two countries, finding a very hot day in one, oh we will take a day from the equator to add to the mean of the other. |

247 If the world had cooled by secular refrigeration in chief part instead of change from insular to extreme climate, Iceland and North of Europe would have possessed a most peculiar Flora. — As European forms have travelled towards Equator, so would the plants from extreme north, which according to all analogy would have been very unlike southern European ones, — " a variation played on secular refrigeration ". |

248 Experimentise on land shells in salt water and lizards ditto. — Ask Eyton[1] to procure me some. Get Hope[2] to give me an account of parasitic animals of beast varying in different climates.

Those will not object to my theory, those the philosophers who soar above the pride of the savage, they perceive the superiority of man over animals, without such resorts. |

249–250 *excised.*

251 Duméril[3] great work on Reptiles. M. D says some reptiles same from Mauritius and Madagascar and C. of Good Hope. — His book probably worth studying. —

Wingless birds [of] S[outh] continents. Ostriches. Dodo. Apteryx. Penguin. —

[1] Thomas Campbell Eyton.
[2] Frederick William Hope.
[3] André-Marie-Constant Duméril. *Erpétologie générale ou Histoire complète des Reptiles.* Paris 1836, p. 278 : " Parmis ces cinq dernières espèces Africaines [de Platydactyles], une a pour patrie commune le Cap de Bonne Espèrance, Madagascar et Maurice."

Logger-headed Duck. — Large proportion of Water and small of land — or few quadrupeds. —

Study production of great Fresh Water lakes of North America. |

252 If Parasites different, whilst man and his domesticated quadrupeds are not so, greater facilities of change in the articulata, than in Vertebrata. But how does this agree with longevity of species in Molluscs!!!

When we talk of higher orders, we should always say intellectually higher. — But who with the face of the earth covered with the most beautiful savannahs and forests dare to say that intellectuality is only aim in this world. |

253–260 *excised.*

261 Of genera in all classes are not a few only cosmopolitan, and in genera peculiar to any one country do not species generally affect different stations ; This would be strong argument for propagation of species. — Again is there not similarity even in quite distinct countries in same hemisphere more than in other. |

262 Are there any cases where domesticated animals separated and long interbred having great tendency to vary? Is not man thus circumstanced? Varieties of dogs in different countries a case in point. — All cases like Irish and English Hare bear upon this. — |

263 Why do Van Diemen's land people require so many imported animals? —

At what point of tree of life can orders like birds and animals [mammals] separate etc. etc.

Work out Quinary system according to three elements. |

264 How is Fauna of Van Diemen's land and Australia? |

265–271 *blank.*

272 Falconer's[1] remarks on influence of climates, situations etc. etc. 242 Hook.

Smellie,[2] Philos. of Zoolog. 842

Poor Tract Lyell.

White[3] regular gradat. in man 1024.

Fleming's[4] Philosophy of Zoolog.

Royle[5] on Himalaya Plants. — |

273 Would it not be possible to work through all genera and see how many confined to certain countries. So on with families. — Ask Royle[6] about Indian cattle with humps. — |

274 ? To be solved if horses sent to India and long bred in and no new ones introduced, would not change be superinduced. — Why is every one so anxious to cross animals from different quarters to prevent them taking peculiar character. Indian Bull? — |

275 Do species of any genus, as American or Indian genus inhabit different kind of localities? — if so, change.

[1] Hugh Falconer. "On the Aptitude of the Himalayan Range for the Culture of the Tea Plant", *J. Asiatic Society of Bengal*, Calcutta 1834, vol. 3, p. 178.

[2] William Smellie. *The Philosophy of Natural History*, Edinburgh & London 1790, 1799.

[3] Charles White. *An account of the regular gradation in Man, and in different animals and vegetables*, London, 1799.

[4] John Fleming. *The Philosophy of Zoology*, Edinburgh & London 1822.

[5] John Forbes Royle. *Illustrations of the Botany and other Branches of the Natural History of the Himalayan Mountains*, London 1834–1835.

[6] John Forbes Royle. Cf. *Illustrations of the Botany and other Branches of the Natural History of the Himalayan Mountains*, London 1839, p. lxxiv.

THE GRAND QUESTION : Are there races of plants run wild or nearly so, which do not intermix, — any cultivated plants produced by seed. — Lychnis. — Flox. — |

276 Read Swainson.[1] |

277 *blank.*

278 In production of varieties is it not per saltum —

Islands bordering continents — same type. Collect cases. — African islands. — How in Juan Fernandez ? Humming-Birds.

Types of former dogs. Character of Miocene Mammalia of Europe. |

279 Mem. Mr Bell's[2] case of *Sub-Himalayan* land emys decidedly an Indian form of Tortoise. — On other hand, freshwater tortoise from Germany[3] (where Mr Murchison's[4] fox was found) decidedly next species to some South American kinds. — |

280 Are the closest allied species always from distant countries, as Decandolle[5] says? (no, he only says — sometimes). We might expect disseminated species to say a little, but such should not be general circumstance. — In insects, in England, surely it is not — intermediate genera we might expect. — |

281 Lindley[6] Introduction.

Dict. Science Naturelle.[7]

Géographie Botanique. De Candolle.[8] Geol. Soc.

Horae Entomologicae.[9]

Linn. Soc.

Geoffr. St. Hilaire Philosophy of Zoology.[10] Waterhouse.

[1] William Swainson. *A Treatise on the Geography and Classification of Animals. Lardner's Cabinet Cyclopaedia*, London 1835.

[2] Thomas Bell. *Proc. Zool. Soc. Lond.*, Part II, 1834, p. 17. " Specimens and drawings were exhibited of a *freshwater Tortoise*, forming part of the collection of Mr. Bell, by whom it was described as a type of a new genus, for which he proposed the name of *Cyclemys*." " Mr. Bell regards the *Tortoise* which he has thus characterized as supplying a link in the connecting series of the *land* with the *freshwater* families which has hitherto been wanting. . . . "

[3] Thomas Bell. " Zoological observations on a new Fossil Species of Chelydra, from Oeningen." [1832], *Trans. Geol. Soc.*, vol. 4, 1835, p. 379.

[4] Roderick Impey Murchison. " On the fossil fox of Oeningen, with an account of the lacustrine deposit in which it was found," *Proc. Geol. Soc.* 1826–1833, vol. 1, p. 167 ; *Trans. Geol. Soc.*, vol. 3, 1835, p. 277.

[5] Augustin-Pyramus de Candolle. *Essai élémentaire de géographie botanique*, Strasbourg, 1820.

[6] John Lindley. *An Introduction to the Natural System of Botany*, London 1830.

[7] *Dictionnaire des sciences naturelles, dans lequel on traite méthodiquement des différens Etres de la nature*, edited by F. Cuvier with a prospectus by Georges Cuvier, Paris & Strasbourg 1816–1830.

[8] Augustin-Pyramus de Candolle. *Essai élémentaire de geographie botanique*, Strasbourg 1820.

[9] William Sharp MacLeay. *Horae Entomologicae*, London 1819–1821.

[10] Etienne Geoffroy-Saint-Hilaire. *Principes de philosophie zoologique*, Paris 1830.