

DARWIN'S NOTEBOOKS ON  
TRANSMUTATION OF SPECIES  
PART IV. FOURTH NOTEBOOK  
(OCTOBER 1838—10 JULY 1839)

Edited with an Introduction and Notes

BY

SIR GAVIN DE BEER

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# DARWIN'S NOTEBOOKS ON TRANSMUTATION OF SPECIES

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PART IV. FOURTH NOTEBOOK. (OCTOBER 1838 TO 10TH JULY 1839)

## INTRODUCTION

DARWIN'S Fourth Notebook on Transmutation of Species was written after he had read Malthus's<sup>1</sup> *Essay on the principle of population* on 3rd October, 1838. The first two pages subsequently cut out by him and now lost, were doubtless devoted to Malthus's work, as is the third page. Considering the importance of the influence which Malthus's book was thought (even by Darwin himself in later life) to have exerted on Darwin's work and ideas, it is significant that he devoted so little space to Malthus in the Notebook which he wrote immediately after reading his book. The reason, as explained in the Introduction to Darwin's Third Notebook on Transmutation of Species,<sup>2</sup> is that Darwin had already and independently thought out the principle of selection of favourable variations and seen the possibility that the transmutation of species might be explained by its means. What Malthus gave Darwin was evidence of the rigorousness of selection and of the inevitability of widespread mortality.

To this concept, Darwin introduced the notion of extinction as the extreme case of depopulation (IV 3), and the notion of variation; and he showed that he was well aware that this would lead to results very different from those which Malthus thought that he had achieved. This fact emerges clearly from the only other passage in the Fourth Notebook where Darwin refers to Malthus and is concerned to show that he does not subscribe to Malthus's assumption that the variation possible in cultivated plants and domestic animals is strictly limited. "It may be said that wild animals will vary according to my Malthusian views, within certain limits, but beyond them not, — argue against this" (IV 136). The term "Malthusian views" does not mean acceptance of Malthus's economic and political system, but solely adherence to the view that mortality ensues from reproduction outstripping food-supply. The parallel between the effects of artificial selection in producing new breeds of cultivated plants and domesticated animals, and of natural selection in producing new species is clearly formulated: "It is a beautiful part of my theory,

<sup>1</sup> Darwin used the 6th edition, London 1806.

<sup>2</sup> *Bull. Brit. Mus. (Nat. Hist.) Historical Series*, vol. 2, part 4, 1960.

that domesticated races of organics are made by precisely same means as species — but latter far more perfectly and infinitely slower " (IV 71).

A soliloquy on the mechanism of natural selection takes the following form: " it is difficult to believe in the dreadful but quiet war of organic beings going on in the peaceful woods and smiling fields " (IV 114). The fact that natural selection applies to man is adduced as additional evidence that man is of similar nature to animals. " When two races of men meet, they act precisely like two species of animals, — they fight, eat each other, bring diseases to each other &c., but then comes the most deadly struggle, namely which have the best fitted organisation, or instincts (i.e. intellect in man) to gain the day " (IV 63). It is not difficult in this passage to recognize experiences which Darwin underwent during the voyage of the *Beagle*.

With regard to the evolution of man and the question whether his ancestors were bimanous or quadruped, Darwin had already seen the importance of embryonic development and vestigial organs in determining affinity and therefore descent. " There being no fossils, the only way, that I can see to discover whether the parent of man was quadruped or bimanous, is to see, what parts of structure abortive." (IV 66). That was written during the first half of December 1838, and on 6th January, 1839 comes the solution: "The rudiment of a *tail* shows man was originally quadruped " (IV 89).

Morals are the result of evolution from " social instincts, which as I hope to show is probably the foundation of all that is most beautiful in the moral sentiments of the animated beings " (IV 49).

The notion of fortuitous as distinct from designed variation is clearly expressed: " my principle being the destruction of all the less hardy ones & the preservation of accidental hardy seedlings " (IV 111). That survival is not fortuitous but is undesignated emerges from the following passage: " seeing the beautiful seed of a Bull Rush I thought, surely no ' fortuitous ' growth could have produced these innumerable seeds, yet if a seed were produced with infinitesimal advantage it would have better chance of being propagated " (IV 137).

The " tendency to progression " postulated by Lamarck as an inherent quality of living organisms which would make natural selection unnecessary in those cases where it has resulted in improvement, quickly attracted Darwin's attention as a principle to be tested. " See if any law can be made out, that varieties are generally additions, & not abortive: with reference to the non-necessity of the so-called progressive tendency law " (IV 70). Soon comes the answer, and it opens up the whole science of ecology: " The enormous number of animals in the world depends of their varied structure and complexity. — hence as the forms became complicated, they opened fresh means of adding to their complexity " (IV 95). Here Darwin shows that he has realized the part which organisms themselves play in the complex of factors which make up the environment of other organisms. He continues: " but yet there is no necessary tendency in the simple animals to become complicated although all perhaps will have done so from the new relations caused by the advancing complexity of others. — It may be said, why should there not be at any time as many species tending to dis-development, . . . my answer is because, if we begin



with the simplest forms & suppose them to have changed, their very changes tend to give rise to others" (IV 95). Darwin concludes: "I doubt not if the simplest animals could be destroyed, the more highly organized would soon be disorganized to fill their places" (IV 96). Improvement, where it takes place, is not the result of any innate tendency to progression, but to competition and adaptation. "Considering the Kingdom of nature as it now is, it would not be possible to simplify the organization of the different beings, . . . without reducing the number of living beings — but there is the strongest possible [tendency] to increase them, hence the degree of development is either stationary or more probably increases" (IV 97).

The ecological web of life is so closely netted that when transmutation of species results in the origin of a new one, a new problem is created. "When a species becomes rarer, as it progresses towards extermination, some of the species must increase in number where then is the gap for the new one to enter?" (IV 43). The solution to this problem is closely connected with the principle of divergence<sup>1</sup> which Darwin did not solve until 1852.

Darwin was alive to the problems of what are now known as ring-species. "Lyell tells me . . . that Hooded crow and Carrion crow have in Europe different ranges latter not going north of the Elbe, yet they meet in one wood in Anhalt & there every year produce hybrids" (IV 101, 102).

It is curious to find Darwin speaking of final causes regarding the existence of separate sexes, but the analysis developed in this and the following two pages of the consequences of their existence, and of what the result would be if there were only unisexual generation, is remarkably acute, particularly the realization of the advantages accruing from slow change in adaptation to the general conditions of the habitat instead of rapid changes in adaptation to local conditions (IV 48, 49, 50). Variation would be entirely unconnected in any groups of individuals and change would be unarchic. Furthermore, physical factors would act on individuals without restraint. The value of sexual reproduction is therefore that it canalizes variation into a small number of channels by making physical factors act not on single individuals but on interbreeding populations, and it slows down change with the result that changes can "bear relation to the whole changes of country, & not to the local changes" (IV 50).

Researches into the progress of ideas in the minds of those who solved the problem of evolution and natural selection are by no means complete, but it is already possible to see two curious patterns in the history of thought. The first relates to the manner in which arguments have simply been turned upside down as a result of progress of knowledge. The foremost example of this reversal of direction is the fate of Paley's arguments aimed at proving that the adaptations of plants and animals to their environment show evidence of purposive design.<sup>2</sup> First of all it must be remembered that Paley selected his evidence. There are not wanting cases of mal-adaptation. Every case of a parasite killing its host is a blunder of nature, reflecting no credit on

<sup>1</sup> In a letter which Darwin wrote to George Beatham on 10th June, 1861, *L&C and Letters*, vol. 3, p. 26, he said: "I believe that it was fifteen years after I began before I saw the meaning and course of the divergence of the descendants of any one pair." If 1837 was the date when he began, this works out at 1852.

<sup>2</sup> William Paley: *Natural Theology*, London 1826.

any designer, and the same is true of many structures and functions, such as the prostate and the proneness of man to hernia as a result of his upright carriage. However, as a result of Darwin's work, the same facts as were adduced by Paley as proof of beneficent design are now recognised as evidence of what natural selection can achieve without any design at all. Indeed, if there were a designer, he would have to be singularly malevolent to produce all the failures and suffering caused.

Another case of inversion is provided by Lyell's attempt to use the principle of uniformitarianism to show that evolution could not have occurred, because catastrophism involved progressionism and catastrophism must be rejected.<sup>1</sup> Again as a result of Darwin's work, it is now clear that application of the principle of uniformitarianism shows that evolution must have occurred, because organic progressionism is the only correct interpretation of the facts in spite of catastrophism being erroneous.

Thirdly, both Lyell and Blyth<sup>2</sup> used the principle of natural selection, implicit in the penalization of variants from the specific type, to prove that species remain constant; whereas Darwin and Wallace showed that this argument must be turned on its head to show that natural selection can make varieties depart indefinitely from the specific type. This last case is particularly instructive, because natural selection can in some cases bring about change and in other cases preserve stability, and T. H. Huxley<sup>3</sup> showed that natural selection was the only agency that could account for this facultative alternative. The reason for this is known, because Mendelian heredity is a mechanism which can according to circumstances produce diversity or stability. The former capacity is based on the power of mutation, crossing-over, segregation, and recombination of genes; the latter on the particulate nature of the non-contaminating genes and on chromosome linkage.

Finally, the most remarkable case of all of reversal concerns the conclusion which Malthus drew from his argument based on the check which limitation of food-supply was supposed to impose on human fecundity and population increase. Since Malthus did not consider the possibility of variation in the population, he concluded that the results of checks to increase resulted merely in keeping numbers down, the quality of the population remaining the same as before. And since he believed that the practice of cultivation of plants and breeding of domestic animals showed that they were limited and not indefinitely perfectible, he concluded that the struggle for existence was an obstacle to the improvement of man just because it kept numbers down. In other words, Malthus's principle of population meant quantitative natural elimination without selection. As Conway Zirkle<sup>4</sup> has pointed out, Malthus was prevented from anticipating Darwin by his opposition to the ideal of human perfectibility embodied in the works of Condorcet<sup>5</sup> and Godwin.<sup>6</sup> Darwin and Wallace, independently, introduced into the argument the variability of plants and animals of which

<sup>1</sup> Charles Lyell: *Principles of Geology*, vol. 2, London 1832. See Introduction to Darwin's *First Notebook on Transmutation of Species* (*Bull. Brit. Mus. (Nat. Hist.)*, Historical Series, vol. 2, 1950, p. 25.)

<sup>2</sup> Edward Blyth. See Introduction, *ibid.*, p. 36.

<sup>3</sup> T. H. Huxley: "Evolution in Biology", *Encyclopædia Britannica*, 9th Edition, vol. 8, p. 752.

<sup>4</sup> C. Zirkle: "Natural Selection before the Origin of Species", *Proc. Amer. Phil. Soc.*, vol. 84, 1942, p. 202.

<sup>5</sup> Antoine-Nicolas de Condorcet: *Sketch for a Historical Picture of the Progress of the Human mind*, London 1793.

<sup>6</sup> William Godwin: *Enquiry concerning political justice and its influence on virtue and happiness*, London 1796.

they were aware both in artificial conditions and in nature. Familiar with the results of artificial selection, Darwin had already seen that selection in nature would cause species to vary from the original type; and both he and Wallace, independently, saw that Malthus's principle of quantitative limitation working on natural populations must inevitably result in natural selection of the better adapted variants through a qualitative elimination, and they used the struggle for existence to explain the possibility of departure of varieties from the original type until they became new species; which was exactly the opposite of Malthus's conclusion.

The second pattern in the history of thought is the realization that knowledge at a given time may already be sufficient to suggest the correct solution of a problem, if only the scientist knows where to look. The best example of this phenomenon, that science is sometimes richer than is imagined, is provided by Darwin himself. None of the ingredients which he required, both to establish the fact of evolution and to show that natural selection provided the explanation of how species become modified, was unknown to Lyell who missed the great chance, partly by failing to test the imaginary link between catastrophism and progressionism, and partly because his mind was orientated away from transmutation of species for reasons of theological orthodoxy. How close Lyell came to the facts without recognizing them may be seen in the second volume of his *Principles of Geology* published in 1832. There, in Chapter XI he actually speculated on the extinction of old species and the appearance of new species and asks (p. 179) "is it possible that new species can be called into being from time to time, and yet that so astonishing a phenomenon can escape the observation of naturalists?" This problem was referred to in a remarkable letter dated 20 February 1836 from Sir John Herschel to Lyell, to which Darwin himself alluded in his Fourth Notebook (MS. page 59, below). The reference,<sup>1</sup> which I owe to Dr. Sydney Smith, is as follows: "Of course I allude to that mystery of mysteries, the replacement of extinct species by others. Many will doubtless think your speculations too bold, but it is as well to face the difficulty at once. For my own part, I cannot but think it an inadequate conception of the Creator, to assume it as granted that his combinations are exhausted upon any one of the theatres of their former exercise, though in all this, as in all his other works, we are led, by all analogy, to suppose that he operates through a series of intermediate causes, and that in consequence the origination of fresh species, could it ever come under our cognizance, would be found to be a natural in contradistinction to a miraculous process, although we perceive no indications of any process actually in progress which is likely to issue in such a result."

Another example is that of Sir Ronald Fisher's<sup>2</sup> demonstration that, far from being antagonistic and mutually exclusive, Darwinian selection and Mendelian genetics are complementary and indispensable to each other. Here, it was William Bateson who missed his great chance of effecting the synthesis by failing to recognize the fact that mutations may have infinitesimal and cumulative effects, and the possibility that selection might have played a part in controlling the effects of mutations. Al-

<sup>1</sup> Charles Babbage. *The IXth Bridgewater Treatise*. London 1837, p. 203. Darwin used the 2nd edition of this work which has not been consulted.

<sup>2</sup> R. A. Fisher: *The Genetical Theory of Natural Selection*, Oxford 1930.

though he had available to him all the basic ingredients out of which Fisher constructed his synthesis, Bateson was blinded by the clean-cut results of such Mendelian crosses as were known to him, appearing to have arisen ready-made without selection, and this prejudiced him against Darwinian selection. He was eventually driven to the untenable view that evolution had been stopped down at the start, and had occurred through the successive removal of inhibitory factors.<sup>1</sup>

The lesson to be derived from this is that even today there may be great syntheses waiting to be assembled from materials that are already to hand.

Darwin's Fourth Notebook on Transmutation of Species, also known as Notebook "E", is Darwin MS. 124 in the Cambridge University Library, to the authorities of which acknowledgement is warmly made for their unfailing assistance and courtesy.

As in the other Notebooks, a number of pages were cut out by Darwin in 1856, and seventy eight pages have thus been lost. Since the texts of Darwin's Notebooks on Transmutation of Species were sent to the press, some of the excised pages have been found in the British Museum (Natural History) and in the Cambridge University Library. These will be transcribed and published in a subsequent number of the Bulletin, together with Corrigenda and an Index of the names of persons referred to by Darwin.

#### *Editorial Note*

The general policy of this edition has been to present a text, which is already difficult enough in its contents, with the minimum of complication. It is not intended to be a facsimile edition.

The handwriting of the Notebooks is extremely difficult to decipher, because of letters indistinctly made, abbreviations and slurred endings to words, and ungrammatical construction of sentences. The use of capital and lower case letters is variable, as is the punctuation. The text is littered with dashes and with stops to which it would be misleading to attribute the value of periods in all cases. Many of them require the value of commas and are shown as such where the sense would otherwise be obscured. There are also several places where lines are drawn across the page, but no attempt has been made in this edition to reproduce them as rules. The use of different pens, inks, and of pencil here and there occurs frequently. In some cases the change appears to have no significance other than that he had temporarily run out of the instrument he had been using; in other cases it means that entries were made subsequently, often between the lines, and these are noted where they appear to be significant.

Where words that are essential for the sense of the text were inadvertently omitted by Darwin they have been added between square brackets. In some places Darwin inserted square brackets, apparently subsequently, to indicate special emphasis and perhaps to show passages which he wanted to copy out. They have been indicated where significant by footnotes, but square brackets are exclusively reserved for editorial intercalations by me.

Two kinds of erasure occur in the text. In the first, words were resolutely struck

<sup>1</sup> William Bateson: "Evolutionary Faith and modern doubts", *Science*, vol. 35, 10th January, 1910.

out by Darwin because they were wrong and not what he meant to write, or because he changed the construction of his sentence. Since such words seldom serve any purpose in elucidating the sense of the text but add to its existing complexity, Darwin's own verdict on them has been accepted and they have been omitted without indication, save in exceptional cases. In the second type of erasure sentences or whole pages have been lightly scored through, doubtless to indicate that they have been dealt with, and such erasures have been ignored.

I do not doubt that even allowing for the simple editorial style here adopted, many misreadings of the text have been made, to which corrections will be welcomed for the *Corrigenda* and *Addenda* which it is hoped to publish; but if any reader requires more information than this edition gives, he must be referred to the manuscripts in the Cambridge University Library.

### *Acknowledgments*

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Gavin de Beer

Inside front cover.

Finished July 10th 1839. —  
Selected Dec 15 1836 |

1-2 excised.

3 Epidemics<sup>1</sup> seem intimately related to famine, yet very inexplicable. —

ditto p. 529 " It accords with the most liberal spirit of philosophy to believe that no stone can fall, or plant rise, without the immediate agency of the deity.<sup>2</sup> But we know from experience ! that these operations of what we call nature, have been conducted almost ! invariably according to fixed laws : and since the world began, the causes of population & depopulation have been probably as constant as any of the laws of nature with which we are acquainted ". — This applies to one species — I would apply it not only to population & depopulation, but extermination & production of new forms. — this number & correlations |

4 Octob. 4<sup>th</sup>. [1838] It cannot be objected to my theory, that the amount of change within historical times has been small — because change in form is solely adaptation of whole of one race to some change of circumstances ; now we know how slowly & insensibly such changes are in progress — we feel interest in discovering a change of level of a few feet during the last two thousand years in Italy,<sup>3</sup> but what change would such a change produce in climate vegetation &c. — It is the circumstance of small physical changes & oscillations, not affecting organic forms, that the whole value of the geological chronology depends that most sublime discovery of the genius of man. |

5-14 excised.

15 sorts come up from it, lately saw a nonpareil sowed by Mr Tillet<sup>4</sup> so produce. — thinks it probable that great part of those varieties may be due to impregnation from other apple trees. — now seeds of crab produce crab, so that some effect from apple trees is produced. — Thinks probably experiment was never tried of separating apple tree entirely from all others & so my experiment of strawberry<sup>5</sup> not so absurd. —

16 Thinks that such variety as red cabbage | produced from passage from many varieties, & probably would take long before all the stain would be got out of it. — Now this is curiously different from primrose suddenly produce cowslip, one is tempted to think here some anomaly — I can fancy cowslip producing primrose return to old stock, but not primrose producing cowslip |

17 Uncle J.<sup>6</sup> says common belief that female plant impresses main features on offspring & male the lesser peculiarities, — brilliancy of inflorescence

Gardeners by chance sometimes graft pears on apples they will live, but not flourish — a medlar may be grafted on pear. Mountain-ash & white Thorn |

<sup>1</sup> Thomas Robert Malthus. *An Essay on the Principle of Population*, 5th edition, London 1806, vol. 1, especially book I, chapter 2 ; and book II, chapter 13.

<sup>2</sup> Thomas Robert Malthus. *Ibid.*, vol. 1, p. 519. Malthus wrote " divine power " instead of " the deity ".

<sup>3</sup> The reference is to the subsidence and re-emergence of Roman buildings at Pozzuoli described by Charles Lyell : *Principles of Geology*, London, vol. 1, 1830, pp. 449, 5.

<sup>4</sup> Mr. Tillet of Betley Hall, cattle breeder, cf. *Variation of Animals and Plants*, London 1858, vol. 2, p. 199.

<sup>5</sup> The reference to Darwin's experiments with strawberries has not been traced.

<sup>6</sup> John Hensleigh Allen of Gressley.

Species not being observed to change is very great difficulty in thick strata, can only be explained by several strata being merely leaf.<sup>1</sup> If one river did form sediment in one spot, for many epochs such changes would be observed. — |

- 18 G. W. Earl's Eastern Seas, p. 206 — shot a monkey, ceased their cries, "many of them descending to examine their defunct companion".<sup>2</sup> —

p. 229 Borneo — only animals he heard of pigs, small bears or badgers, deer, apes, baboons, monkey & an animal probably a tapir.<sup>3</sup> —

p. 233. dogs in Borneo brought probably by Chinese<sup>4</sup> "the breed<sup>5</sup> of the latter being the same as the fox-like animals which are met with near Canton".<sup>6</sup> "Here as in all Malay countries, I noticed a peculiarity"<sup>7</sup> |

- 19-22 excised.

- 23 Macleay<sup>8</sup> says it is nonsense to say take a tooth of any animal (as *Toxodon*) & say its relations, — if we know its congeners then we can. — Now on my theory this certainly can be accounted for, on any other it is the will of God. —

Octob. 16<sup>th</sup>. A very strong passage might be made — why seeing great variation in external form of varieties, do we suppose bones will not change in number (even species do not this), because it has been so pronounced ex cathedra. Let us look at facts, considering few domestic animals few that have not.<sup>9</sup> cows hornless (horses not) |

- 24 If they give up infertility in largest sense as test of species, — they must deny species which is absurd. — Their only escape is that rule applies to wild animals only, from which plain inference might be drawn that whole infertility of hybrid receive no explanation was consequent on mind or instinct now this is directly incorrect.

The case of my mice<sup>10</sup> is good, because it is an involuntary variation made by man, common to every individual & therefore effect of climate. — |

- 25-30 excised.

- 31 Did man spread over world as early as Elephants &c. — if in next 30 years none of his remains found in the Americas probably did not. —

Octob. 25<sup>th</sup>. I observed in Windsor Park — the Fallow Deer which were of a nearly

<sup>1</sup> Darwin's meaning is that many of the individual strata are as thin as a leaf of a book and contain no fossils. It is an adaptation of Lyell's analogy between Geological formations and a book with most of its leaves torn out and lost.

<sup>2</sup> George Windsor Earl. *The Eastern Seas or Voyages and Adventures in the Indian Archipelago in 1823-25-26*. London 1827, p. 206. The author uses the word "comrade" instead of "companion" as quoted by Darwin.

<sup>3</sup> George Windsor Earl. *Ibid.* p. 229.

<sup>4</sup> The words "brought probably by Chinese" were crossed out by Darwin in the MS.

<sup>5</sup> In the MS. the word "being" is inserted here.

<sup>6</sup> George Windsor Earl. *Ibid.* p. 233.

<sup>7</sup> George Windsor Earl. *Ibid.* p. 233: "Here, as in all Malay countries I noticed a peculiarity in the ears, which I never heard satisfactorily accounted for. The joints near the tip of the tail are generally crooked, as if they had been broken".

<sup>8</sup> William Sharp Macleay. Presumably personal communication. Darwin is contending that the relations of a form can be identified by similarities in the structure of parts and that this can be accounted for on the theory of descent by modification from common ancestors.

<sup>9</sup> The word "not" is repeated here in the MS. after the word "which" crossed out.

<sup>10</sup> "My mice": cf. G. H. Waterhouse. "Species of the *Canis* Mss. forming part of the collection presented to this Society by Charles Darwin, Esq." *Proc. Zool. Soc. Lond.*, vol. 3, 1837, p. 13.

uniform blackish brown yet retained a trace of horizontal mark on flanks; & tail & kind of semi-lunar mark<sup>1</sup> on each side darker, so that whole colour is changed. these best marked characters are partly retained, therefore colours vary in same manner as they would vary, if in wild state: thus mark on ear of cats be barred |

- 32 Ditto saw what was said to be hybrid between silver & gold fish.

Octob. 26<sup>th</sup>. If hereafter M[astodon] angustidens be found to be inhabitant of S. America & as it is embedded with almost recent shells. — shows that progression of change in Molluscs is somewhat similar in two hemispheres. — It might be worth investigating whether Megatherium & Mastodon are embedded in N. America. see my Journal<sup>2</sup> for references.

In such cases as at Galapagos where different islets have different forms it is either effects of having been long separated, or having never |

- 33-36 excised.

- 37 from its master. — dogs when strayed hang their tails. —

November 1<sup>st</sup> — Addenda to Journal.<sup>3</sup> I show erratic blocks transported far S. in Northern Hemisphere — likewise far North in Southern. — Great animals of same two great orders destroyed about same time in North & South America. — Whole world formerly possessed a climate compared to S. America at present days, which S. America now does to North America & Europe. — S. America favourable  
38 to Tropical productions. | The world formerly much more so, yet climate of same order as that of S. America. — (Explained by profound views of Lyell)<sup>4</sup>

Now Equatorial America from the low limits of blocks both North & South, has probably undergone a greater change, than any parts, (except Europe in which all Tropical forms have been obliterated) of the world, from the Equable kind of |  
39 climate to the extreme. — Therefore species which were fitted from such a preeminently equable climate might not have been able to have survived a change, (& become transmuted), although other parallel species in other continents might have survived this mundane change. — Therefore I argue from this that Africa & East Indian Archipelago formerly were not so very equable, or so tropical, & therefore present  
40 state of world is not so different, with | regard to their productions. — Hence it is, from the ancient preeminently equable & temperate climate of America, that the Mammalia of S. America are as different from the existing orders, as the Eocene of Paris! (Great Edentates at that period) Analyse this, — consider state of |

- 41-42 excised.

- 43 If species change, we see external conditions have great effect on them, & therefore extermination becomes part of same law. —

When we know what a great effect light has in colouring plants, — who can say what colours acting by a most delicate organ, on the whole system may produce?

<sup>1</sup> A small sketch here in MS.

<sup>2</sup> Charles Darwin. *Journal of Researches into the Geology and Natural History of the Various Countries visited by H.M.S. Beagle*, London 1845, p. 150.

<sup>3</sup> Charles Darwin. "Darwin's Journal", *Bull. Brit. Mus. (Nat. Hist.) Historical Series*, vol. 2, 1935 p. 8; against the date October 27, 1838 is the entry: "Preface and addenda on Theory of Erratic Blocks to Journal [of Researches]". cf. *Journal of Researches*, London 1845, p. 160.

<sup>4</sup> Charles Lyell. *Principles of Geology*, 5th edition, London 1837, vol. 1, p. 158.



When a species becomes rarer, as it progresses towards extermination, some of the species must increase in number where then is the gap, for the new one to enter? — |

- 44 The wonderful species of Galapagos must be owing to their islands having been purely results of elevation. — all modern & wholly volcanic — Azores might be prophesied to have this character. — Worth going there for. — Gales of wind would blend species.

- Buckland<sup>1</sup> *Reliquiae Diluvianae* p. 222. Bones of Horse, Bear & Deer at 16000 feet with snow on Himalaya — Humboldt bones | at 7800 in Andes<sup>2</sup> — parallel & curious facts. — The Himalaya case bears on the vast changes even in that quarter of the world. — Mem. elevation & subsidence of East Indian Archipelago now rising.

On a particular part of coast of Somersetshire the Cocks are all apt to be diseased & some of them asymmetrically. — It is easy to get 50 of same kind of monstrosities G. B. Sowerby.<sup>3</sup> — |

- 46 Looking over Lamarck<sup>4</sup> surprised to see how many Tropical genera come from New Holland. Sydney?

The dog being so much more intellectual than fox, wolf &c &c — is precisely analogous case to man exceeding monkeys. — |

- 47 Having proved mens & brutes bodies on one type : almost superfluous to consider minds. — as difference between mind of a dog & a porpoise was not thought overwhelming — yet I will not shirk difficulty — I have felt some difficulty in conceiving how inhabitant of Tierra del Fuego is to be connected with civilized man. — ask the Missionaries about Australian yet slow progress has done so. — Show a savage dog, & ask him how wolf was so changed. |

- 48 When discussing extinction of animals in Europe ; the forms themselves have been basis of argument of change. — now take greater area of water & snow-line descent. I do not wish to say only cause, but one great final cause, nothing probably exists for one cause. My theory gives great final cause of sexes in separate animals : for otherwise there would be as many species, as individuals, & though we may not trace out all the ill effects, — we see it is not the order in this perfect world, either |
- 49 at the present, or many anterior epochs. — but we can see if all species, there would not be social animals. hence not social instincts, which as I hope to show is probably the foundation of all that is most beautiful in the moral sentiments of the animated beings — &c, this<sup>5</sup> is stated too strongly, for there would be innumerable species & hence few only social there could not be one body of animals. life with certainly another

Whether he was or not He is [at] present a social animal. If man is one great object

<sup>1</sup> William Buckland. *Reliquiae Diluvianae or Observations on the Deposits Remains in Caves, Pinnacles, and other Geological Phenomena attesting the action of an Universal Deluge*. London 1823, p. 222 : " But in Central Asia the bones of horses and deer have been found at an elevation of 16,000 feet above the sea, in the Himalaya mountains . . . "

<sup>2</sup> William Buckland. *Ibid.* p. 222 : " we have in America the bones of the mastodon at an elevation of 7500 feet above the sea, in the Camp de Glacis, near Santa Fe de Bogota ; and another species of the same genus in the Cordillera, found by Humboldt, at the elevation of 7500 feet . . . "

<sup>3</sup> George Brettingham Sowerby. Possibly personal communication.

<sup>4</sup> Jean-Baptiste de Lamarck. *Graves of Shells*, translated by John George Children, n.p. 1845.

<sup>5</sup> The words from here to the end of the paragraph are inserted between lines, and the last four words are uncertain. Perhaps " purpose " was intended at the end.

for which the world was brought into present state, — a fact few will dispute, (although, that it was the sole object, I will dispute, when I hear from the geologist the history, from the astronomer that the moon probably is uninhabited) & if my theory be true then the formation of sexes rigidly necessary. — |

- 50 Without sexual crossing, there would be endless changes, & hence no feature would be deeply impressed on it, & hence there could not be improvement, & hence not in higher animals — it was absolutely necessary that Physical changes should act not on individuals, but on masses of individuals. — so that the changes should  
51 be slow & bear relation to the whole changes of country, & not to the local | changes — this could only be effected by sexes. all the above should follow after discussion of crossing of individuals with respect to representative species, when going North & South.

Thinking of effects of my theory, laws probably will be discovered of correlation of parts,<sup>1</sup> from the laws of variation of one part affecting another. —

- (I from looking at all facts as inducing towards law of transmutation, cannot  
52 see the deductions which are possible.) — Ascertainment of | closest species (& naming them) with relation to habits, ranges & external conditions of country, most important & will be done to all countries, — but naming mere single specimens in skins worse than useless. — I may say all this, having myself aided in such sins. Yet there is no cure (do not add name without reference to description), except describers having some high theoretical interest, — "the great end must be the law & causes of change". — A philosopher would as soon turn tailor as mere describer of species from its garments, without some end. — Respect good describers like Richardson.<sup>2</sup> |

- 53 The relations of numbers of species to genera &c &c can never be told without species being described. — but the permanent varieties in same country, must be distinguished from permanent varieties not in same country. —

- The traces of changes in forms of organs, will care little for species, except so far as wanting names to refer to, to those forms, when the termination of change occurs. — Those discovering the *formal* laws of the correlation of parts in individuals, will care little, whether the individual be species or variety, but to discover *physical*  
54 laws of such correlation, & changes of | individual organs, must know whether the individuals forms are permanent, all steps in the series, their relation to the external world, & every possible contingent circumstance. — The laws of variation of races, may be important in understanding laws of specific change. — When the laws of change are known — then primary forms may be speculated on, & laws of life, — the end of Natural History will be approximated to. —

Treating of the formal laws of correlation of parts & organs it may serve perfectly to |

55-56 excised.

<sup>1</sup> This reference to the correlation of parts shows that Darwin entertained it very early. As Professor S. Adler F.R.S., has suggested, it was probably because Darwin was over-impressed with the importance of this concept that he failed to think of the particulate nature of heredity.

<sup>2</sup> Sir John Richardson. Author of *Fauna Boreali-Americana; or the Zoology of the northern parts of British America*. London 1829-1837.

- 37 The Pipe-fish is instance of part of the hermaphrodite structure being retained in the male,<sup>1</sup> — far more than marsupial bones, & even more than mammae, which have given milk. — is secretion from Pidgeon stomach true milk. — Species are innumerable variations<sup>2</sup>

Every structure is capable of innumerable variations, as long as each shall be perfectly adapted to circumstances of times, & from persisting owing to their slow formation these variations tend to accumulate on any structure. |

- 38 L'Institut<sup>3</sup> 1838, p. 384. List of fossil Mamun : from Poland &c. —

Three principles will account for all

- (1) Grandchildren like grandfathers
- (2) Tendency to small change especially with physical change
- (3) Great fertility in proportion to support of parents |

- 39 December 2<sup>d</sup> Lyell<sup>4</sup> letter Mr Beck<sup>5</sup> considers the characteristics of the Tropical Forms in shells are numerous species, numerous individuals, & species of large size. — consider this (Cetacea) with reference to my theory.

Babbage<sup>6</sup> 2nd Edit. p. 326 — Herschel<sup>7</sup> calls the appearance of new species the mystery of mysteries, <sup>8</sup> & has grand passage upon the problem. ! Hurrah — "intermediate causes" |

- 60 The Sexual system of the Cirrhipedes is the more remarkable from their alliance to Articulata, which are all truly bisexual.

Buckland's<sup>9</sup> Reliqu : Diluv. says Africa only place where Elephant, Rhinoceros, Hippot., Hyæna & are found together. — Read this Work. —

Decb. 4<sup>th</sup> Why has the organisation of fishes & Mollusca (& plants ???) been so little progressive (& insects. — Stonesfield<sup>10</sup> ???) ! Agassiz<sup>11</sup> makes it wonderfully changed since Cretaceous period, whether progressive I know not. Have Mammalia ?? my theory certainly requires progression, otherwise |

61-62 excised.

<sup>1</sup> The male pipe-fish carries the developing eggs in a ventral pouch.

<sup>2</sup> The words "species are innumerable variations" are crossed out in the MS.

<sup>3</sup> Carl Eduard von Eichwald. "Sur des Osmements fossiles de Mammifères trouvés en Pologne", L'Institut, 1838, vol. 6, p. 384.

<sup>4</sup> Charles Lyell, *Principles of Geology*, 5th edition, London 1837, vol. 1, p. 38.

<sup>5</sup> Heinrich Henrichsen Beck.

<sup>6</sup> Charles Babbage, *The Ninth Bridgewater Treatise. A Fragment*, London 1837. On p. 326 of the 1st edition is an Appendix "On the age of strata as inferred from the rings of trees embedded in them", the 2nd edition of this work has not been consulted.

<sup>7</sup> See Introduction, p. 137 above.

<sup>8</sup> Here is the origin of the expression on the first page of the Introduction of the *Origin of Species*.

<sup>9</sup> William Buckland, *Reliquiæ Diluvianæ : or, Observations on the Organic Remains contained in Caves, Fossils, and Diluvial Gravel, and other Geological Phenomena affecting the action of an Universal Deluge*, London 1824, p. 179 : " . . . another interesting branch of inquiry connected with it is, whether any fossil remains of elephant, rhinoceros, hippopotamus, and hyæna exist in the diluvium of tropical climates; and if they do, whether they agree with the recent species of these genera, or with those existing species, whose remains are dispersed so largely over the temperate and frigid zones of the northern hemisphere." On p. 21 Buckland refers to the modern hyæna living in Africa, and the elephant, rhinoceros, and hippopotamus were well known to be African. The statement that Africa is the only continent in which they all lived has not been traced.

<sup>10</sup> The reference is to Mesozoic Mammals discovered in the Stonesfield Slate, published by William John Woodruff, *Zool. Journ.*, vol. 3, 1828, p. 408.

<sup>11</sup> Louis Agassiz, *Recherches sur les Poissons Fossiles*, Neuchâtel, 1833, tome 1, p. xxvii : "Les espèces de la crâe appartiennent pour plus des deux tiers à des genres qui ont entièrement disparu." From "Agassiz" to "I know not" inserted between lines.

- 63 Are the feet of water-dogs at all more webbed than those of other dogs. — if nature had had the picking she would make such a variety far more easily than man, — though man's *practised* judgment even without time can do much. — (yet one cross, & the permanence of his breed is destroyed).

- When two races of men meet, they act precisely like two species of animals. — they fight, eat each other, bring diseases to each other &c., but then comes the most  
64 deadly struggle, namely which have | the best fitted organization, or instincts (i.e. intellect in man) to gain the day. — In man chiefly intellect, in animals chiefly organization, though Cont. of Africa & West Indies shows organization in Black Race there gives the preponderance, intellect in Australia to the white. — The peculiar skulls of the men on the plains of Bolivia — study (?) fossil — & in Van Diemen's land — they have been exterminated on *principles* strictly applicable  
65 to the | universe — The range of man is not unlike that of animals transported by floating ice. — I agree with Mr Lyell,<sup>1</sup> man is not an *intruder* — : the geological history of man is as perfect as the Elephant if some genus holding same relation as Mastodon to man were to be discovered.

Man acts & is acted on by the organic and inorganic agents of this earth like every other animal. |

- 66 Would anyone raise an argument against my theory, should no fossil very distinct species of the Ornithorhynchus be found; yet until man became cosmopolite, he would probably be confined in locality like Ornithorhynchus: since being cosmopolite, we do find his remains. — Lima — caves. — There being no fossils, the only way, that I can see to discover whether the parent of man was quadruped or bimanous,  
67 is to see, what | parts of structure abortive. — Remember my fathers<sup>2</sup> remark about the Bladder. —

The numbers of fatal diseases in mankind, the more valuable domesticated animals no doubt is owing to the tearing up of every hereditary tendency towards fatal diseases, & such constitutions only being cleared off by fatal diseases. — |

- 68 The value of a group does not depend on the number of the species: therefore man & monkeys have equal chance that progenitor was bimanous or quadrumanous. — What a chance it has been, (with what attendant organization, Hand & throat)  
69 that has made a man. — \*any monkey probably might, with | such chances be made intellectual, but almost certainly not made into man. — It is one thing to prove that a thing has been so, & another to show how it came to be so. — I speak only of the former proposition. — as in races of Dogs, so in species & in man.

December 16<sup>th</sup>. The end of each volume of Whewell's<sup>3</sup> Induction History contains many most valuable references |

- 70 See if any law can be made out, that varieties are generally additions, & not abortive: with reference to the non-necessity of the so-called progressive tendency law. —

In animals analogy leads one to suppose that seminal fluid fluid (& not dry as in plants) therefore, great difficulty in crossing & this most important obstacle to my

<sup>1</sup> Charles Lyell. *Principles of Geology*, 5th edition, London 1837, vol. 3, pp. 68, 138.

<sup>2</sup> Robert Waring Darwin. The nature of the remark is unknown.

<sup>3</sup> A square bracket is opened here; it is not closed.

<sup>4</sup> William Whewell. *History of Inductive Sciences*, London 1837.

*theory*<sup>2</sup> without the hermaphrodites mutually couple. — now how is it in Planaria,  
 71 they couple (lowest terrestrial animals), — in shells? — | insects? — all ??? — Worms?  
 Barnacles, aquatic Crustaceans, & true hermaphrodites<sup>3</sup> *It may be said that true  
 hermaphroditism is a consequence of non-locomotion* — (contradicted by Plants) & as  
 there are no fixed land animals, so there are [no] true hermaphrodites. — I suspect  
 this rather effect of liquid semen, therefore animal life commenced in water!

It is a beautiful part of my theory, that domesticated races of organics are made  
 by precisely same means as species — but latter far more perfectly & infinitely  
 slower. — No domesticated animal is perfectly adapted to external conditions. —  
 72 & not others. — Term *variety* may be used to *gradation of change* | which gradation  
 shows it to be the effect of a gradation in difference in external conditions. — as  
 in plant up a mountain — In races the differences depend upon inheritance & in  
*species* are only ancient & perfectly adapted races

L'Institut<sup>4</sup> 1838, p. 394. Rhinoceros tichorhinus in Paris basin. — its relation to  
 African Species good observations<sup>5</sup> larger than any living |

73-74 excised.

75 A Greyhound might be made almost without any relation to running hares as  
 in Italian Greyhound<sup>6</sup> — not so species every part of newly acquired structure is  
 fully practical & perfected. Hence difference between *race* & *variety*?

Man picks the male, instead of allowing strength to get the day.

The fertility of Indian & Common Oxen, which one must think deserve the name  
 of species, may be owing to the little fixity of organization, in the two races, owing  
 to the domestication of both. — Now in the ass — there is little tendency to vary &  
 hence offspring are hybrids. — |

76 Mr G. B. Sowerby<sup>7</sup> showed me many land shells of the common species from one  
 locality all left whorled. — He kept two to see if they would breed.

It is difficult to think of *Plato & Socrates*, when discussing the Immortality of the  
 Soul as the linear descendant of mammiferous animal, which would find its place in  
 the *Systema Naturae*. |

77 Looking at simple generation as being the action of two organs in one body. — or  
 in two bodies, we can as well understand the necessity of a relation between the  
 fluids of the two as in the grafting of trees. Mr. Knight<sup>8</sup> makes this analogy between  
 grafting & sexual union. — "The similarity of child to parent appears to follow same

<sup>1</sup> The words in italics enclosed between square brackets.

<sup>2</sup> From "Barnacles" to "hermaphrodites" enclosed between square brackets.

<sup>3</sup> "M. Valenciennes écrit qu'en faisant des fouilles sur la Place de la Gaieté pour les fondations des  
 nouveaux Bâtimens de l'Hôtel de Ville, on a trouvé à 17 pieds au-dessous du sol, un humérus droit de  
 Rhinocéros de l'espèce nommée par Cuvier *Rhinoceros tichorhinus*." L'Institut, 1838, tome 4, p. 394.

<sup>4</sup> The words "good observations" were crossed out in the MS.

<sup>5</sup> "as in Italian greyhound" inserted in pencil.

<sup>6</sup> George Brettingham Sowerby. This was a century before the experiments were performed by A. E.  
 Reycott, C. Dyer, S. L. Garstang, and F. M. Turner: "The inheritance of Sinistrality in Limnaea  
 peregra", Phil. Trans. Roy. Soc. B, vol. 209, 1930, p. 31.

<sup>7</sup> Thomas Andrew Knight. "Introductory Remarks relative to the objects which the Horticultural  
 Society have in view", Trans. Hort. Soc., vol. 1, 1820, (read 4 April 1803). On p. 4: "to use the phrase  
 of Lord Bacon, the graft in all cases overrules the stock, from which it receives aliment, but no motion."

<sup>8</sup> A square bracket is opened here; it is not closed.

law in two of the same variety, as in two varieties, & this we might expect, as the difference between man & woman is indeed (independent of sexual differences) 78 a variety. The offspring of true hermaphrodite would of course be like either, that is both parents, for they are one. —

The laws, therefore, of likenesses of fathers to children of mankind no doubt are applicable to likenesses, when species & races are crossed. — Now these laws are, that child may be either like father or mother, independently of its sex, or half way between, or somehow different from either; or like progenitors. — in some families all the children like mother & in some like father What is cause of this. — |

79 (Lord Morton's "law holds with different species, & individuals of same species. — ) some races of man D'Orbigny<sup>3</sup> affect the common progeny more than others. — does this more refer to length of time that the resemblance is permanent, or the similarity at first births. — It is the latter only that one refers to in speaking of resemblances of children to their parents. —

Lord Morton's law<sup>4</sup> cannot hold with fishes, & there are male fishes & reptiles & those which have their eggs impregnated externally; nor can it be a necessary concomitant with moths which can be impregnated externally. |

80 My view of every animal being Hermaphrodite — probably will receive illustration from domestication of Monoecious plants & abortion of others. —

? in herm-hermaphrodite insects is it not easier to understand <sup>perfect</sup> development of one sex on one side, then the addition of other organs, in which case the hermaphroditism would not be perfect. in Ox the amount of double sexual development is spread over |

81-82 excised.

83 is utterly untold, — what is added to the composition of the atom to make it alive, & how the laws of generation were impressed on it. —

Seeing that all vertebrates Müller's<sup>5</sup> Physiolog. p. 24 can be traced to a germ, endowed with the vital principle, which gives rise to the sexual organs, different in each species, — & knowing from analogy, that all these big animals are descended from some one single stock, one is led to suspect that the birth of the species & individual

84 in their present forms, are closely related — By birth the | "successive modifications of structure being added to the germ, at a time (as even in childhood) when the organization is pliable, such modifications become as much fixed, as if added to old individuals during thousands of centuries, — each of us then is as old as the oldest animal," have passed through as many changes as has every species. — |

<sup>1</sup> Lord Morton. "A communication of a singular fact in Natural History". Phil. Trans. Roy. Soc. vol. 111, 1811, p. 207. Lord Morton's "law" is the supposed transmission through the dam to the progeny of characters of another sire which the dam does not possess.

<sup>2</sup> Alcide Desmoulins d'Orbigny. "L'homme américain (de l'Amérique méridionale), considéré sous ses rapports physiologiques et moraux". Comptes rendus Acad. Sci., Paris, tome 7, 1838, p. 308.

<sup>3</sup> Lord Morton's "law" could not be expected to hold in cases where the young undergo development externally to the mother as free and independent larvae.

<sup>4</sup> Johannes Müller. *Elements of Physiology*, translated from the German by William Baly, London 1839, vol. 1, p. 24: — "organic beings do not subsist merely by virtue of accidental combination of elements; but, on the contrary, by the vital force inherent in them . . . The germ is "potentially" the whole animal." This reference is enclosed between square brackets.

<sup>5</sup> The word "the" is repeated here.

<sup>6</sup> The words "is as old as the oldest animal" were crossed out by Darwin in MS. This is an early attempt by Darwin to express anatomy in terms of embryology.

85-88 *excised*.

89 Jan. 6<sup>th</sup> [1839] The rudiment of a tail shows man was originally *quadruped*.  
Hairy — could move his ears

The head being six metamorphosed vertebra,<sup>1</sup> the parents of all vertebrate animals must have been like some molluscous bisexual animal with a vertebra only & no head—

Handwriting is determined by most complicated circumstances, as shown by difficulty in forging, yet handwriting said to be hereditary, shows well what minute details of structure of [race are] hereditary |

90 *Athenaeum*<sup>2</sup> 1839, p. 36. — a crustaceous animal is mentioned which inhabits the Pinna of Rio Janeiro (like some Mediterranean species). — might these fertile other shells, as insects do flowers. — Mem. Spallanzani's<sup>3</sup> experiments showing how little of the spermatic fluid fertilized spawn of frogs. —

*Annals of Natural History*<sup>4</sup> (p. 225, 1838) account of metamorphosis in the young of *Syngnathus*, curious as showing generality of law even in fish: ditto p. 236 on Hybridity in ferns.<sup>5</sup> — ditto p. 250 — speaking of the terrestrial mollusca of Morocco, Mr Forbes<sup>6</sup> says the Fauna (near Oran) approach in character to Canary Isl<sup>7</sup>. — i.e. Canary Isl<sup>8</sup> approaches more to neighbouring coast of Africa, than to other parts of that |

91-94 *excised*.

95 The enormous number of animals in the world depends of their varied structure & complexity. — hence as the forms became complicated, they opened *fresh* means of adding to their complexity. — but yet there is no necessary tendency in the simple animals to become complicated although all perhaps will have done so from the new relations caused by the advancing complexity of others. — It may be said, why should there not be at any time as many species tending to dis-development (some probably always have done so, as the simplest fish), my answer is because, if we begin with the simplest forms & suppose them to have changed, their very changes  
96 tend to | give rise to others. — Why then has there been a retrograde movement in Cephalopods & fish & reptiles? — supposing such be the case, it proves the law of

<sup>1</sup> When Darwin wrote, the accepted view was that of Goethe and Owen that the vertebrate skull was composed of a number of fused vertebrae. This view of transcendental anatomy, to which Richard Owen also subscribed, was destroyed by T. H. Huxley in 1858 (G. R. de Beer, *The Development of the Vertebrate Skull*, Oxford 1937).

<sup>2</sup> *Athenaeum*, 1839, 12th January, p. 36. Miscellaneous. New Crustacea. "A surgeon of the French navy, M. Mirre, just arrived at Brest, among several new and interesting objects of natural history, has brought a new *Madurea*, which he found at Rio de Janeiro in the Pinna shells. The existence of this Crustacean in the case of the New World is a curious fact in the geography of zoology, for since the time of Aristotle, it has only been found in the Mediterranean."

<sup>3</sup> Lazzaro Spallanzani. *An Essay on Animal Reproduction*, London 1789. "Of the existence of the tadpoles in eggs before fecundation". On page 46: "... could not the eggs of frogs be fecundated artificially, by sprinkling them before fecundation, with the liquor extracted from the spermatic vessels of the male?"

<sup>4</sup> R. F. Price. "Metamorphosis observed in *Syngnathus larbalestrieri*". *Ann. Nat. Hist.*, vol. 2, 1838, p. 225: "... the young of this beautiful species at their development from the egg have the entire tail covered with a skin-like membrane and possess pectoral fins. These at a subsequent unknown period are thrown off in a way similar to that of the larvae of frogs rejecting their tails."

<sup>5</sup> M. Martens. "Hybridity in Ferns". *Ann. Nat. Hist.*, vol. 2, 1838, p. 236: M. Martens observed in the Botanical Garden of Leuven, a fern which he regarded as a hybrid between *Gymnocarpium calceolatum* and *G. dryopteris* L.

<sup>6</sup> Edward Forbes. "On the Land and Freshwater Mollusca of Algiers and Bougie", *Ann. Nat. Hist.*, 1838, vol. 2, p. 250: "Oran (near Morocco), where the Fauna of Barbary assumes a different aspect, approximating to that of the Canaries on the one hand, and to that of Spain on the other."

development in partial [*recte* ? particular] classes is far from true. — I doubt not if the simplest animals could be destroyed, the more highly organized would soon be disorganized to fill their places. —

The geologico-geographical changes must tend sometimes to augment & sometimes to simplify structures. Without enormous complexity, it is impossible to cover whole surface of world with life. — for otherwise a frost if killing the vegetables in one quarter of the world would kill all, — & the one herbivorous & its one carnivorous devourer; it is [quite clear that a large part of the complexity of structure is adaptation, though perhaps difference between jaguar & tiger may not be so. — Considering the Kingdom of nature as it now is, it would not be possible to simplify the organisation of the different beings, (all fishes to the state of the *Ammocoetus*, Crustacea to —? &c) without reducing the number of living beings — but there is the strongest possible [tendency?] to increase them, hence the degree of development is either stationary or more probably increases. — ]

98 Jan. 29<sup>th</sup>. Uncle John<sup>1</sup> says he feels sure, that the reason people send for their seeds to London is that people in the southern Counties have whole fields, some for cauliflower &c. — Uncle John believes one single turnip in a garden is sufficient to spoil a bed of Cauliflowers. — (How curious it would be to make enquiries of some of the great seed-growers — ). —

Feb. 24<sup>th</sup>. Monoceros, which Sowerby<sup>2</sup> says is an American form, has several 99 species in my | fossils —<sup>3</sup> If cases of one variety in upper part of bed & another in lower is very rare, the conclusion will be that our greatest formations have been deposited in a period (say 20,000 years) which is sufficient only to have most slightly modified organic forms. — We know not rate of deposition has been equal even in one bed, much less in alternating strata of sand & limestone &c. &c. — ]

100 L'Institut 1838,<sup>4</sup> p. 290 — admirable paper on geographical distribution of Crustacea. — (I forget whether I have already referred to it — also on spermiatic animalcules in Musci frondosi, et hepatici, — in Chara, in Marchantia & Hypnum. —

Prof : Don<sup>5</sup> would have known the Composites of Galapagos were South American. — several cases of species peculiar to separate islets. —

March 5<sup>th</sup>. Lyell<sup>6</sup> says fossil shells from North America, Scotland, Uddévalle many species same. & northern forms — & the American ones & European — agree 101 very much | closer, than the present ones, which according to Beck<sup>7</sup> are different. — Subsidence of Greenland — case of splitting of two regions — are there any cases of union of two regions in modern times. — this would depend on negative evidence of fossil remains, & therefore not to be trusted. — Lyell tells me, on authority of Beck that Hooded crow & Carrion crow have in Europe different ranges — latter not going |

<sup>1</sup> John Hensleigh Allen of Cressley (1769-1843).

<sup>2</sup> George Brettingham Sowerby. *The Zoology of Captain Boscawen's Voyages*, London 1820, p. 161: "*Monoceros crassilabrum* Lam.: recent at Valparaiso, &c. *Monoceros crassilabrum* var.: recent at Valparaiso &c.". This note is not by Sowerby, but is included in the Section immediately following his "Observations by the Editor".

<sup>3</sup> A square bracket is opened here: it is not closed.

<sup>4</sup> Henri Milne Edwards. "Géographie Zoologique. M. Milne Edwards lit l'extrait d'un mémoire sur la distribution géographique des Crustacés", *L'Institut*, tome 6, 1838, p. 290.

<sup>5</sup> George Don (jun.) had collected plants in S. America.

<sup>6</sup> Charles Lyell. Presumably personal communication.

<sup>7</sup> Heinrich Heinrichsen Beck. Personal communication to Lyell.



102 north of the Elbe, — yet they meet in one wood in Anhalt & there every year produce hybrids — now this is independent good case, but very odd since these crows are mixed in England — for I presume Carrion Crow is found in Edinburgh. — Why does Fleming<sup>1</sup> consider them varieties & what says Jenyns<sup>2</sup> to it? — In argument of origin of Wolf, difference of mind is most relied on, |

103-104 *existed*.

105 forms. — on southern flanks of Alps, many peculiar plants on single mountains, though these are connected with other mountains laterally. —

Owen.<sup>3</sup> Fossil Mammalia p. 53 talks of *Tapirus* American form found in Eocene beds of Paris.

Lyell<sup>4</sup> has remarked species never reappear when once extinct. Lyell's argument about Isl<sup>5</sup>. neighbours, formed in the Tertiary epoch like Sicily,<sup>6</sup> not having species, if true, important on my view. — |

106 March 9<sup>th</sup> Is there any relation between the fact that different species produce abundantly infertile hybrids, & the fact that old varieties do not so much affect first race, as it does indelibly the many subsequent ones.

My views,<sup>7</sup> V. p. 103 would lead me to think that a variety of one species would cross easier with 2nd species, than two perfect species; but facts of grouse, & pheasant, & hooded crow goes against this, & wild hybrid plants. |

107 If many wild animals were crossed, there would probably be perfect series, from physical impossibility to unite to perfect prolificness — (a series might be obtained)<sup>8</sup> but the intervention of domesticated i.e. new varieties destroys the appearance of this series & makes me think that one large body of varieties are fertile & make mongrel, & other great series quite otherwise & make no true hybrids — but this is false, give instance of series from wild animals & plants<sup>9</sup> |

108 Mr. Mark<sup>10</sup> has some nephews who are astonishingly like to some distant cousins, the nearest blood being a *great great* grandfather. — Little Miss Hibbert case of kindness coming out more than in mother or indeed grandmother: what is in S.S. parentage? —

<sup>1</sup> John Fleming. *A History of British Animals*, Edinburgh 1828, p. 87: "Corvus corone ... is this species different from the Hooded Crow?"

<sup>2</sup> Leonard Jenyns. *A Manual of British Vertebrate Animals* Cambridge 1835. On pp. 145 and 146 *Corvus* covers the Carrion Crow and *C. corone*, the Hooded Crow are listed as separate species.

<sup>3</sup> Richard Owen. *The Zoology of the Voyage of the Beagle*, Part I, Fossil Mammalia, London 1845, p. 53: "It is well known how overlooked and unlikely was the announcement of the existence of an extinct quadruped entombed in the Paris Basin, whose closest affinities were to a genus, (*Tapirus*) at that time, regarded as exclusively South American."

<sup>4</sup> Charles Lyell. It seems that Darwin must have obtained verbally from Lyell the view expressed subsequently in his *Elements of Geology*, 2nd edition, London 1843, vol. 1, p. 200: "It appears, that from the remotest periods there has been ever a coming in of new organic forms, and an extinction of those which pre-existed on the earth: some species have endured for longer, others for a shorter time; while none have ever re-appeared after once dying out."

<sup>5</sup> Charles Lyell. *Principles of Geology*, 3rd edition, London 1837, vol. 3, p. 444: "We have seen that a large portion of Sicily has been converted from sea to land since the Mediterranean was peopled with the living species of Cetacea and scorpiphytes. The newly emerged surface, therefore, must, during this modern geological epoch, have been inhabited for the first time by the terrestrial plants and animals which now abound in Sicily." The words "formed" to "Sicily" are in pencil.

<sup>6</sup> The reference is to MS. page 103 of this Notebook, which Darwin edited.

<sup>7</sup> The words "a series might be obtained" were crossed out by Darwin.

<sup>8</sup> The words "give" to "plants" enclosed between square brackets.

<sup>9</sup> Mr. Mark. Dr. Robert Darwin's coachman at Shrewsbury.

Wonderful as is the possession of voice by Man we should remember, that even birds can imitate the sounds surprisingly well. —

In early stages of transmutations, the relations of animals & plants to each other would rapidly increase, & hence number of forms, once formed, would remain stationary, hence all present types are ancient | according to my views of all plants, being occasionally dioecious; & really dioecious plants being effect of abortion of one sex. — Linnean class Dioecia & Monoecia ought to be preeminently artificial. —

Would not subsidence of Greenland render climate less extreme (& so account for descent (rare ascent) of snow line there & then & there only: as stated by Capt. Graah<sup>1</sup> & break up N. American Conchology from European, & the climate being now less extreme than before, arctic forms would retreat: effect on snow of arctic climate in far north regions? Arctic forms have travelled S. |

From the analogy of the animal kingdom I should suppose, — that the pollen of crab would possibly (no, for pollen of any kind would fertilize it)<sup>2</sup> fertilize an apple somewhat more readily than other apples, he probably would more indelibly stain offspring — it would not reach one apple sooner than that of another apple. only effect produced would be different. — same way one variety of dog does not prefer other, but produces greater effect on offspring — |

Mr. Herbert<sup>3</sup> says p. 347 Amaryllidaceae Plants do not become acclimatized by crossing, or by accidental production of seedling with hardier constitution. — Now Sir J. Banks<sup>4</sup> says Zizania in 16 generations did become acclimatized, & says Laurels have not been so (which is case adduced by Herbert)<sup>5</sup> because not reared by seedlings. Now my principle does not apply to any plant reared artificially, & only very partially to the Zizania in Sir J. ponds — my principle being the destruction of all the less hardy ones & the | preservation of accidental hardy seedlings: (which are confessed to by Herbert)<sup>6</sup> to sift out the weaker ones: there ought to be no weeding or encouragement, but a vigorous battle between strong & weak.

<sup>1</sup> Captain Graah: in Charles Lyell's *Principles of Geology*, 5th edition, London 1837, vol. 2, p. 300: "The observations alluded to were made by Captain Graah during a survey of Greenland in 1823-24; and afterwards in 1828-29."

<sup>2</sup> The words in this bracket inserted subsequently.

<sup>3</sup> William Herbert. *Amaryllidaceae*, London 1837, p. 347: "it does not appear that in reality any plant becomes acclimated under our observation, except by crossing with a hardier variety, or by the accidental alteration of constitution in some particular seedling." It will be noticed that Darwin's note on this passage is inaccurate by substituting "or" for "except".

<sup>4</sup> Sir Joseph Banks. "Some hints respecting the proper mode of lowering tender plants to our climate," (read December 3rd, 1804), *Trans. Hort. Soc.*, vol. 2, 1811, p. 21. On p. 21: "In the year 1791, some seeds of Zizania aquatica were procured from Canada, and sown in a pond at Spring Grove, near Hounslow; it grew, and produced strong plants, which ripened their seeds: these seeds vegetated in the succeeding spring, but the plants they produced were weak, slender, not half so tall as those of the first generation, and grew in the shallowest water only; the seeds of these plants produced others next year, sensibly stronger than their parents of the second year. In this manner the plants proceeded, springing up every year from the seeds of the preceding one, every year becoming stronger and larger, and rising from deeper parts of the pond, till the last year, 1804, when several of the plants were six feet in height. . . . Here we have an experiment which proves, that an annual plant, scarce able to endure the unusual summer of England, has become in fourteen generations, as strong and as vigorous as our indigenous plants are, and as perfect in all its parts as in its native climate."

<sup>5</sup> William Herbert. *op. cit.* p. 347: "although we are told that Laurels were at first kept in hothouses in this country, it was not that they were less capable of supporting our seasons than at present, but that the cultivators had not made full trial of their powers of endurance."

<sup>6</sup> William Herbert. *op. cit.* p. 347: see above.

March 11<sup>th</sup>. Yarell's<sup>1</sup> law must be partly true, as enunciated by him to me, for otherwise breeders who only care for first generations, as in horses, would not care so much about breed. — what can however be more striking, about indelibility, than the number of good race-horses which *Eclipse*<sup>2</sup> has begotten. Walker<sup>3</sup> attributes this to effect of male sex on locomotive system.

I am bound to insist honestly that the sudden change from Primrose to cowslip is great difficulty (I should doubt if wild species ever found like short-tailed cat or dog has been without recurrent tendency in external conditions) sudden loosing [losing] of horns. — I do not believe this nature's plan. —

Whether we can or not trace history of first appearance of varieties of domesticated animals, yet as we know how many plants have been produced (look at the Dahlias we may infer it in animals) — Azara<sup>4</sup> gives account of production of hornless cattle, & others? — |

March 12<sup>th</sup>. It is difficult to believe in the dreadful but quiet war of organic beings going on [in] the peaceful woods & smiling fields. — we must recollect the multitude of plants introduced into our gardens (opportunities of escape for foreign buds & insects) which are propagated with very little care, — & which might spread themselves as well as our wild plants, we see how full nature, how finely each holds its place. — When we hear from authors (Ramond<sup>5</sup> Hort. Transact. vol. 1, p. 17 Append) that in the Pyrenees that the |

113-116 excised.

Poet Cowper<sup>6</sup> describes his tame Hares attacking a sick one like Chillingham bulls are described. — His three have had very different dispositions: this is important as showing small variations in offspring of wild animals — grateful & intelligent. —

The theory that all animals have sprung from few stocks, does not bear the least on ancient generic forms. — the animals in Eocene period could not have been direct parents of any of ours, — even if extinction is denied. — it will not account for all species even if it will for all (?recks some). — |

Varieties are made in two ways — local varieties when whole mass of species are subjected to same influence, & this would take place from changing country: but greyhound race-horse & poulter Pidgeon have not been thus produced, but by

<sup>1</sup> William Yarell who believed that in a cross the oldest variety had the greatest influence on the characters of the mongrel offspring. cf. Darwin's Second Notebook on Transmutation of Species, MS. pp. 1 and 121.

<sup>2</sup> Alexander Walker. *Intermarriage*, London 1838, "by regulating the relative youth, vigour and voluntary power of sire and dam, either may be made to give to progeny the voluntary and locomotive systems, and the other the sensitive and vital systems; though, if they be well conformed, it is preferable that the sire should give the former and the dam the latter, as being the systems in which naturally they respectively excel."

<sup>3</sup> Félix d'Azara. *Essai sur l'histoire naturelle des quadrupèdes de la province du Paraguay*. Paris ix (1801), tome 2, p. 171: "Dans le district des Corrientes, naquit en 1770 un Taureau dépourvu de tous cornes. Il a propagé sa race dans ce pays-ci, et il faut observer à cet égard que les petits d'un Taureau sans cornes en sont privés, quoique la mère ait des cornes, et que les petits d'un père à cornes en ont aussi, quoique la mère en soit privée."

<sup>4</sup> Louis-Elisabeth Ramond de Carbonnières. "On the vegetation of high mountains", translated by Richard Anthony Salisbury (read and April, 1814). *Trans. Nat. Soc.*, vol. 1, 1812, Appendix p. 12. The passage in question on p. 17 reads: "Thus in the Swiss Alps, and Pyrenees, trees cease to grow at about 4200 or 5200 metres of actual elevation, as they do about the 50th degree of north latitude."

<sup>5</sup> William Cowper. "Unnoticed properties of that little animal the hare". *Continuator's Magazine*, vol. 34, part 1, 1784, p. 412. On p. 413: "Like many other wild animals, they persecute one of their own species that is sick." Their names were "Puss", "Tiney", and "Bun".

training, & crossing & keeping breed pure — & so in plants *effectually* the offspring are picked & not allowed to cross. — Has nature any process analogous — if so she can produce great ends — But how — even if placed on 1st<sup>2</sup>. if &c &c — make the difficulty apparent by cross-questioning<sup>3</sup> — Here give my theory. — excellently true theory |

119-126 excised.

127 be thus put, shall we give up whole system of transmut. or believe that time has been much greater, & that systems are only leaves of whole schemes. —

The fact of tumbling pigeons. — flying high all together & then tumbling far more wonderful than hereditary swifling horses.

Whether the body of parent be altered, that in the *Nisus formativus* (what does Muller<sup>4</sup> call it) succeeds in altering form of body, or whether it merely has tendency (as effects of cultivation or successive generations of plants) to do so, the effects are equally handed to offspring. — |

128 Whewell's<sup>5</sup> anniversary address 1839. p. 9 talks about fossil Infusoria becoming extinct not so soon as other forms. — p. 35 speaking about the controversy on Didelphys says<sup>6</sup> "If we cannot reason from the analogies of the existing to the events of the past world, we have no foundation for our Science"<sup>7</sup> — but experience has shown we can & that analogy is sure guide & my theory explains why it is sure guide. — |

129-132 excised.

133 the stigma retains its power. —

R. Brown<sup>8</sup> found the masses of pollen of *Asclepias* placed on *Orchis* (so very different) that the granules exerted their tubes; now Mr. Herbert<sup>9</sup> has shown that stigma swells, when pollen even most remote is put to it. —

April 6<sup>th</sup> "Dr Edwards<sup>10</sup> on the Influence of Physical agents" translated by Dr

<sup>2</sup> These seven words inserted between lines.

<sup>3</sup> Johannes Müller. *Elements of Physiology*, translated from the German by William Baly, London 1839, 2nd edition, on p. 393: " . . . both organs and nerves are produced by the same power, the same formatives, which remain undivided in the germ."

<sup>4</sup> William Whewell. "Address to the Geological Society, delivered at the Anniversary, on the 14th of February, 1839", *Proc. Geol. Soc. Lond.*, vol. 3, 1839, p. 62. On p. 49: "Of about eighty species of fossil Infusoria, which have been discovered in various strata, almost the half are species which still exist in the waters: and thus these forms of life, so long overlooked as invisible specks of brute matter, have a constancy and durability through the revolutions of the earth's surface which is denied to animals of a more conspicuous size and organization." The page references given by Darwin must refer to the pagination of a reprint.

<sup>5</sup> William Whewell. *Ibid.* vol. 3, p. 89.

<sup>6</sup> While most of the credit for impressing Darwin with the principle of uniformity is rightly given to Lyell, this statement of Whewell's view should not be overlooked.

<sup>7</sup> Robert Brown. "On the organs and mode of fecundation in Orchideae and Asclepiadeae", *Trans. Linn. Soc. Lond.*, vol. 16, 1833, p. 689. On page 728: "Pollen masses of *Asclepias peruviana* being applied to the stigma of *Epipactis palustris*, and immersed in its viscid secretion, the dehiscence, contrary to expectation, not only took place, but even more speedily than usual, that is within twenty-four hours. Some of the grains were also found discharged from the mass unchanged, while others, both discharged and still enclosed, had begun to produce tubes."

<sup>8</sup> William Herbert. "On the Production of Hybrid Vegetables; with the Result of many Experiments made in the Investigation of the Subject", *Trans. Hort. Soc.*, vol. 4, 1832, p. 13. On page 24: "I touched its [Analeas] stigma therefore with the dust of *Rhododendron Catawbiense*. The capsule swelled, . . ."

<sup>9</sup> William Francis Edwards. *On the Influence of Physical Agents*, translated by Hodgkin, p. 54. This translation has not been accessible, but in the original work, *De l'influence des agents physiques sur la vie*, Paris 1824, the passage in question is on page 111: "M. Corvier, qui a fait de belles recherches sur ces animaux, a constaté que l'œcotele avait la structure d'une larve de salamandre; que la sêrène et le protée devaient constituer des espèces de genres différens, et que les poussons de ce dernier étaient dans un état presque rudimentaire."

Hodgkin p. 54 The axolotl, siren & Proteus, affinity to tadpoles, p. 210, shows<sup>1</sup> that the action of light is concerned with the developement of form; but that tadpole increased in size. — | Now the Proteus anguiformis he remarks lives in dark caverns of Carniola

p. 112. Man<sup>2</sup> "standing alone in the gift of intellect, he resembles other mammalia in the effects produced on organization by physical agents."

p. 466. Many facts given of high temperature at which fish &c can live.<sup>3</sup> —

135 Lyell<sup>4</sup> says that naked cuttle fish now bear a very large proportion to other mollusca in cold parts of sea, like Cetacea, although the | Cephalopoda seem to have decreased since earliest times —

Apterix has a most perfect Struthio head pulled out, yet feathers retain character? If separation in horizontal direction is far more efficient in making species, then time, (as cause of change) which can hardly be believed, then, uniformity in geological formation intelligible.

No, but the wandering & separation of a few probably would be most efficient in producing new species: also one being reduced in numbers, but not so much then, because circumstances.<sup>5</sup> |

136 Cestracion. Port Jackson shark. Owen<sup>6</sup> thinks Australia part of old World.

It may be said that wild animals will vary according to my Malthusian views, within certain limits, but beyond them not, — argue against this — analogy will certainly allow variation as much as the difference between species, — for instance pigeons — : then comes question of genera. It certainly appears that swallows have decreased in numbers, what cause ?? |

137 Seeing the beautiful seed of a Bull Rush I thought, surely no "fortuitous" growth could have produced these innumerable seeds, yet if a seed were produced with infinitesimal advantage it would have better chance of being propagated & so &c. The greatest difficulty to my theory, is same type of shells in oldest formations: — The Cambrian formations do not however, extend round world. Quartz of Falkland. — Old Red Sandstone — Van Diemen's land — Porphyries of Andes. — |

138 A familiar history of birds by the Rev. E. Stanley<sup>7</sup> vol. 1, p. 72. — Goldfinches placed near, but not in sight of each other will sing till they drop off their perch. —

p. 101 — Kingfisher in northern parts of England stationary, in southern stays only winter. — Jays & chaffinches sometimes migratory.<sup>8</sup>

<sup>1</sup> William Francis Edwards. *Ibid.* p. 466: "Ainsi ces deux séries d'expériences concourent à prouver que la présence de la lumière solaire favorise le développement de la forme, et servent à faire distinguer ces genres de croissance de celui qui consiste dans l'augmentation des dimensions générales du corps."

<sup>2</sup> William Francis Edwards. *Ibid.* p. 292: "Unique par son intelligence, il se rapproche des mammifères par les nécessités de la vie, communes à tous les êtres qui ont une organisation sensible."

<sup>3</sup> William Francis Edwards. *Ibid.* p. 601: "Tableaux de l'influence de la température sur la vie des poissons." "at seq."

<sup>4</sup> Charles Lyell. Presumably personal communication.

<sup>5</sup> This paragraph inserted at the bottom of the page.

<sup>6</sup> Richard Owen. Presumably personal communication.

<sup>7</sup> Edward Stanley. *A Familiar History of Birds*, London 1814, vol. 2 p. 72: "Goldfinches . . . are put in small cages, with wooden backs, and placed near to, but so that they cannot see, each other: they will then raise their shrill voices, and continue their vocal contest till one frequently drops off its perch, perfectly exhausted."

<sup>8</sup> Edward Stanley. *Ibid.* p. 220: " . . . the Kingfisher, which in the northern parts of England may be seen all the year round, on some parts of the southern coasts only makes its appearance in October in considerable numbers, and as regularly departs in the following spring. Few would suspect our constant and lively companions, the Jays and Chaffinches to be at times travellers, but so it is: there is proof of the fact."

144 shows there is tendency to prevent the crossing. — | in animals where there is much facility in crossing there comes the impediment of instinct —

The possibility of rearing by seeds hollyhocks<sup>1</sup> (how far is this so) shows either there is not so much crossing as I think, or that these varieties have become as fixed as species, & prefer their own pollen to that of other variety. —

Elizabeth<sup>2</sup> & Hensleigh<sup>3</sup> seemed to think it absurd that the presence of the Leopard & Tiger together depended on some nice qualifications each possess, & that tiger springing so much further would determine his preservation — if killed by some other animal then that quality which saved him, would be the one encouraged. — |

145 Wilkinson's<sup>4</sup> Manners & Customs of the Ancient Egyptians vol. III p. 33 — They have several breeds of dogs — like greyhound — fox-dog — turnspit & two other kinds.

It seems absurd proposition, that every budding tree, & every buzzing insect & grazing animal owes its form, to that form being the one alone out of innumerable other ones, which has been preserved. — but be it remembered how little part of the grand mystery is this. — the law of growth, that which changes the acorn into the oak. — In short all which nutrition, growth & reproduction is common to all living beings. vide Lamarck<sup>5</sup> vol. II p. 115 four laws.<sup>6</sup> |

146 Who can say, how much structure is due to external agency, without final cause either in present or past generation — thus cabbages growing like Nepenthes — cases of pigeons with tufts &c. &c. here there is no final cause yet it must be effect of some condition of external circumstances, results of complicated laws of organization ; as we see there strange plumage in pigeons yet no change of habits, so no | corresponding change in Birds of Paradise. — All that we can say in such cases is that the plumage has not been so injurious to bird as to allow any other kind of animal to usurp its place — & therefore the degree of injuriousness must have been exceedingly small. — This is far more probable way of explaining, much structure, than attempting anything about habits —

No one can be shocked at absence of final cause. Mammæ in man & wings under united elytra |

148 The law of generation is only modification, though important one of growth. Lamarck<sup>7</sup> vol. II, p. 120 — Observe it commences only when growth stops. —

<sup>1</sup>The reference is to hollyhocks. cf. William Herbert. *Amaryllidaceæ*, London 1835, p. 366.

<sup>2</sup>Sarah Elizabeth Wedgwood (1793-1880), eldest sister of Darwin's wife.

<sup>3</sup>Hensleigh Wedgwood (1803-1891), brother of Darwin's wife. This paragraph is inserted at the bottom, of the page.

<sup>4</sup>John Gardner Wilkinson, *op. cit.* vol. 3, p. 32 : "The Egyptians had several breeds of dogs, some solely used for the chase, others admitted into the parlour, or selected as companions of their walks ; and some, as at the present day, selected for their peculiar sagacity."

<sup>5</sup>Jean-Baptiste de Lamarck. *Philosophie Zoologique*, Paris 1809, tome 2, p. 115 : "Les facultés conservées à tous les corps vivans, c'est-à-dire, celles dont ils sont exclusivement doués, et qui constituent autant de phénomènes qu'eux seuls peuvent produire, sont : 1° De se nourrir ... 2° De composer leur corps ... 3° De se développer et de s'accroître ... 4° Enfin, de se régénérer eux-mêmes. ... (This passage appears on page 106 of tome 2 of the reprint of 1873.)

<sup>6</sup>From this paragraph to MS. page 132 inclusive the text is written in pencil.

<sup>7</sup>Jean-Baptiste de Lamarck. *Ibid.* tome 2, p. 120 : "cette faculté de reproduction se commence à jeûe de son intensité que lorsque la faculté d'accroissement commence à diminuer : on sait bien combien l'observation confirme cette considération ; puisque les organes reproducteurs (les parties sexuelles), dans les végétaux comme dans les animaux, ne commencent à se développer que lorsque l'accroissement de l'individu est sur le point de se terminer." (1873 reprint tome 2, p. 120.)

p. 103. Turtles finding their way to the Caymans from Honduras good case of migrating shows my theory insufficient.<sup>1</sup> —

p. 120. An Eagle is said to have been seen carrying a lamb two miles towards the Morne mountains, it<sup>2</sup> |

139-140 excised.

141 May 4<sup>th</sup> The Brussels Sprout returning suddenly to type when brought back to home (& yet all the varieties of Brassica certainly not becoming Brussels Sprouts) & yet in all probability the Brussels Sprout was slowly formed, — is analogous to Primrose & Cowslip suddenly changing into each other, & depends on character of antecedent races. —

if it shall be difficult to show that the fixity of characters from antiquity prevents their variation, which is not improbable as Mr. Herbert<sup>3</sup> does not seem to recognize any difference in crossing between varieties & species, yet the amount of [blank] |  
142 may depend on many circumstances, time of domestication (see W[il]kinson<sup>4</sup> on dogs of Egypt & Cuvier<sup>5</sup> on mummies).

NB TIME is *element* in change, as in *Dallias*<sup>6</sup> all much varied breeds both plants & animals have long been subject to domestication. — The constitution of some may resist the means man can offer of changes, — as desert or rock plant probably would do — or be with difficulty be kept alive. — Nevertheless much probably depends on circumstances favouring the reappearance of characters formerly possessed or rather the parents having passed through many changes. — |

143 It is very important Mr Herbert's<sup>7</sup> fact about the hybrids (mentioned in letter to Henslow) fertilising each other, better than the pollen of same flower, — as it tends to show my view of infertility<sup>8</sup> of hybrids with parent species false, which makes it determined by a facility in returning to old type.

Mr Herbert<sup>9</sup> showing the extreme facility of crossing in plants proves how much depends on instincts in animals. — yet the existence of wild close species of plants

<sup>1</sup> Edward Stanley. *Ibid.* p. 103: " . . . it has been observed in turtles, which cross the ocean, from the Bay of Honduras to the Cayman Isles, near Jamaica, a distance of 450 miles, without the aid of chart or compass, and with an accuracy superior to human skill: for it is affirmed, that vessels which have lost their reckoning in heavy weather, have steered entirely by the noise of the turtles in swimming."

<sup>2</sup> Edward Stanley. *Ibid.* p. 120: " . . . in Ireland a large Eagle was seen to alight and take up a lamb, and carry it away in a straight direction towards the high range of the Morne mountains."

<sup>3</sup> William Herbert. *Amaryllidaceae*, London 1837, p. 27: "It seems to me utter waste of words to argue whether vegetables, if of one genus or identical kind, are species or varieties." p. 341: "In fact there is no real or natural line of difference between species and permanent or descendible variety."

<sup>4</sup> John Gardner Wilkinson. *Manners and Customs of the ancient Egyptians*, London 1837, vol. 3, p. 32.

<sup>5</sup> Georges Cuvier. "Sur l'Histoire des anciens Egyptiens", *Annuaire du Muséum national d'Histoire Naturelle*, tome 4, an XII (1804), p. 126. On page 128: "J'ai partagé l'erreur des hommes célèbres que je viens de nommer, jusqu'au moment où j'ai pu examiner par moi-même quelques momies d'ibis."

<sup>6</sup> From "NB" to "Dallias" enclosed between square brackets.

<sup>7</sup> William Herbert. *cf. Amaryllidaceae*, London 1837, p. 342: "Subsequent experiments have confirmed this view to such a degree as to make it almost certain that the fertility of the hybrid or mixed offspring depends more upon the constitutional than the closer botanical affinities of the parents."

<sup>8</sup> The initial  $\phi$  of "infertility" is crossed out.

<sup>9</sup> William Herbert. "On the production of Hybrid Vegetables; with the result of many Experiments made in the Investigation of the Subject". *Trans. Hort. Soc.*, vol. 4, 1837, p. 13: " . . . I am, however, satisfied, from the progress I have already made, that several plants, which I have raised, are not only, in the fair sense of the word, hybrid, but also fertile; and if they should perpetuate themselves by seed, without reverting to the form of either parent, they will be entitled to be considered by the Botanists as distinct species. . . . and I doubt very much whether such a multiplication of distinct species may not also have taken place in the animal and insect tribes; but, to produce an intermixture between species that may have so diverged, the will of the animal must consent, while that of the plant need not be consulted."

Spallanzani's facts in connection with buds. — They differ from possibility of concourse of two individuals, & the action always of two organs — instead of one part as in producing bud. — Fewer of the lately acquired peculiarities are transmitted than by growth — generation : it is doubtful whether any are transmitted, for the changes in fruit trees, mentioned by Mr. K(night)<sup>2</sup> may be caused by the diversity of stocks, on which they are grafted.<sup>3</sup> No<sup>4</sup> & more of the effects of conditions on the propagating constitution, but not structure of the parents. — Thus would a cut |  
 149 tree vary if planted in rich soil. I presume not, but its seeds, I presume probably would — at least the experiment of the carrot seems to show this. — This would be a curious law. Certainly Australian Dog is not affected by domestication, yet offspring are. — if Australian Dog could bud, analogy tells us, offspring would be similar to first form. — The great effect of conditions on offspring, but not on individuals is very curious & important.<sup>5</sup> — |

- 150 The existence of "law of organisation" had better be shown, soil on colour of flowers, Hydrangea — black bullfinches — & all varieties must be presumed to be result of such laws. — The effect of one part being greatly developed on another, must not be overlooked. — It makes fourth cause or law of change. — The weakest part of my theory is the absolute necessity, that every organic being should cross  
 151 with | another — to escape it in any case we must draw such a monstrous conclusion, that every organ is become fixed & cannot vary — which all facts show to be absurd. — As there are plants in northern latitudes, which are generated by buds alone or roots, & never flower, so there may be animals as Coralline, or others which only generate once in a thousand generations. — any amount of generation may take place by gemmation, my theory will not admit this, now that tulips break by cultivation, can a form become permanent? because its very essence is | that little change  
 152 is produced. —

The fact just alluded to of Northern flowers, throws enormous difficulty in the way of Mr. Knight's theory, without seeds are freshly transported — throw over this theory, & the sexual reproduction of species may stop for any number of generations — Gorse in Norway, which never flowers || — How did it get there ?<sup>6</sup> |

- 153 According<sup>7</sup> to the above suggestion my theory would require, that individuals propagated by gemmation should be absolutely similar ; all the gorse in Norway ought to be thus characterised study von Buch.<sup>8</sup> Now Mr Knight's<sup>9</sup> statement about

<sup>1</sup> Lazzaro Spallanzani. It seems that the reference is to Spallanzani's work on regeneration-buds, described in *An Essay on Animal Reproduction*, London 1769.

<sup>2</sup> Thomas Andrew Knight. "On the want of permanence of character in varieties of fruit, when propagated by graft and buds," *Trans. Hort. Soc.*, vol. 2, 1822, p. 160: "few, if any, varieties of fruit can, with strict propriety, be called permanent, when propagated by buds or grafts."

<sup>3</sup> The words "it is doubted" to "grafted" inserted between lines in ink.

<sup>4</sup> The word "No" added in pencil to the insertion in ink.

<sup>5</sup> This sentence is scored in the margin.

<sup>6</sup> Thomas Andrew Knight. "An account of some experiments on the fecundation of vegetables", *Phil. Trans. Roy. Soc.* 1799, p. 192. cf. Charles Darwin. *Variations in animals and plants* . . . , London 1868, vol. 2, p. 173: "it is a law of nature that organic beings shall not fertilise themselves for perpetuity. This law was first plainly hinted at in 1799, with respect to plants, by Andrew Knight." This principle is sometimes referred to as the Knight-Darwin law.

<sup>7</sup> These five words crossed out.

<sup>8</sup> From here the text is written in ink.

<sup>9</sup> Leopold von Buch. *Reise durch Norwegen und Lappland*, Berlin 1800. These 13 words enclosed between square brackets.

<sup>10</sup> Thomas Andrew Knight. "On the want of permanence of character in varieties of fruit when propagated by grafts and buds," *Trans. Hort. Soc.*, vol. 2, 1822, p. 160.



fruit-trees grafted altering is hostile to this: but on other hand, fruit trees are propagated by means, which wild plants never are, namely on stocks of other varieties & we know that the kind of stock greatly affects the graft. — Plants circumstanced as the gorse must be propagated by its roots: now it is curious Mr K[night]<sup>7</sup> has observed that to graft from the roots is the best way to get young trees from worn-out | kinds, & quotes from Pliny that it is bad to graft from top shoots. — If pro-  
 154 longation of life by gemmation being impossible can be overturned, then the conclusion that the two kinds of generation have some most important difference is forced on us. — My theory only requires that organic beings propagated by gemmation do not now undergo metamorphosis, but to arrive at their present structure they  
 155 must have been propagated by | sexual commerce. The fact of corallaria & Halimeda is case in point. — The relation of these sexual functions to complexity is evident, yet the inference from some plants & some mollusca being hermaphrodite is, that intercourse every time is of no consequence in that degree of development — It is singular there is no true hermaphrodite in beings which have<sup>8</sup> fluid sperma. — )

I<sup>9</sup> utterly deny the right to argue against my theory because it makes the world  
 156 far older than what geologists think: it would be doing what | others but fifty years since [did] to geologists, — & what is older — what relation in duration of planet to our lives — Being myself a geologist, I have thus argued to myself, till I can honestly reject such false reasoning |

157 Bell<sup>10</sup> Bridgewater Treatise on the Hand. — p. 94. "The resemblance of the foot of the Ostrich to that of the camel has not escaped naturalists". Before he alludes to the resemblance of the snout of the mole & Pig in having two additional bones to give strength to it. — p. 139. Doubts altogether the law of balancing of organs.<sup>11</sup> — In the Batrac[h]ian Order the 32 ribs are wanting. p. 144 in the Ichthyosaurus 60 or 70 bones in the paddle, yet all in the arm are perfect. — p. 144. Alludes to two theories; — the species are the result of circumstances;<sup>12</sup> — or the will of the  
 158 animal. | p. 145. Seems to argue, that as the transformation from the egg, a larva, or foetus to perfect animal are adapted by foreknowledge,<sup>13</sup> so must the mutations of species!! — p. 203 Chaetodon squirting water at fly,<sup>14</sup> — instinct, for how could

<sup>7</sup> Thomas Andrew Knight. "Upon the advantage of propagating from the roots of old ungrafted fruit trees". *Trans. Hort. Soc.*, vol. 2, 1822, p. 132.

<sup>8</sup> The words "which have" substituted in pencil for "with". This sentence enclosed between square brackets.

<sup>9</sup> From here to the end of page 158 the Text is written in pencil.

<sup>10</sup> Sir Charles Bell. *The Bridgewater Treatise. The Hand, its mechanism and vital endowments as revealing design*. London (1835), p. 94.

<sup>11</sup> Sir Charles Bell. *Ibid.* p. 139: "Shall we follow a system which informs us that when a bone is wanting in the cavity of the ear we are to seek for it in the jaw!" With a race degree of irony, this is exactly what Reichenow's established theory of homologies of the mammalian ear-ossicles requires in demonstrating that the malleus and incus of the mammal are the articular and quadrate of the reptile.

<sup>12</sup> Sir Charles Bell. *Ibid.* p. 144: "It is, above all, surprising with what perverse ingenuity men seek to obscure the conception of a Divine Author, an intelligent, designing and benevolent Being—rather clinging to the greatest absurdities, or interposing the cold and inanimate influence of the mere "elements", in a manner to extinguish all feelings of dependence in our minds, and all feelings of gratitude."

<sup>13</sup> Sir Charles Bell. *Ibid.* p. 145: "We do perceive surprising changes in the conformity of animals. Some of them are very familiar to us; but all show a foreknowledge and a prospective plan."

<sup>14</sup> Sir Charles Bell. *Ibid.* p. 203: "We have a more curious instance of the precision of the eye and of the adaptation of muscular action in the Chaetodon reptaine. This fish inhabits the Indian rivers and lives on the smaller aquatic flies. When it observes one alighted on a twig or flying near (for it can shoot them on the wing) it darts a drop of water with as steady an aim as to bring the fly down into the water, when it falls an easy prey."

experience teach distances in air, in which it never touches objects. — far better case than chicken pecking fly. — " whilst the shell sticks to its tail " as mentioned by Sir J. Banks<sup>2</sup> p. 212. — p. 282. Allows this instinctive power in chicken, yet says it is evidently acquired by experience in baby<sup>3</sup> |

- 159 Lamarck<sup>2</sup> vol. II, p. 152 *Philosophie Zoologie*. says it is not sufficiently proved that any shell fish is really hermaphrodite, & even oyster may fecundate each other, by the means of the medium in which they live.

ditto<sup>4</sup> " *Additions* " p. 454. — does really attribute metamorphoses to habits of animals & takes series of flying mammals — says lemur volans has skin between its legs. — strangely consider existing long-organized forms as parent forms of existing highly organized forms — this resulted from the necessity of supposing some inward progressive developing power. — |

- 160 My theory leaves quite untouched the question of spontaneous generation. —

Introduction to Bartrams<sup>5</sup> *Travels* p. XXIII. Both sexes of some birds sing equally well, and then reciprocally assist in domestic cares, as building nest, sitting on eggs & feeding & defending their young. — The oriolus (icterus cat.) is an instance of this, & the female of the icterus minor is a bird of more splendid plumage than the male. — |

- 161 Athenaeum<sup>6</sup> May 18 1839, p. 377. — Statement that the climate is on the decline, as far as vegetation is concerned, in parts of the Northern French expedition. — rather the reverse of facts stated by Smith<sup>7</sup> of Jordan Hill. — |

- 162 May 27<sup>8</sup> Henslow.<sup>8</sup> One of the 4 species of Lemma only reproduces itself in hybrid, as yet observed by buds — (the other three by buds & seeds though by the latter very rarely) here is a case in answer to Mr Knights<sup>9</sup> doctrine. — Case like Corallina —

<sup>1</sup> Sir Charles Bell. *Ibid.* p. 212: " The late Sir Joseph Banks, in his evening conversations, told us he had seen, what many perhaps have seen, a chicken catch a fly whilst the shell stuck to its tail."

<sup>2</sup> Sir Charles Bell. *Ibid.* p. 281: " This faculty of reaching for the object is slowly acquired in the child: and, in truth, the motions of the eye are made perfect, like those of the hand, by slow degrees. ... It is no contradiction to this, that the faculty of vision is made perfect in the young of some animals from the beginning: no more than that the instinct of the duck, when it runs to the water the moment that the shell is broken, should contradict the fact that the child learns to stand and walk after a thousand repeated efforts."

<sup>3</sup> Jean-Baptiste de Lamarck. *Philosophie Zoologique*, Paris 1809, tome 2, p. 152: " on voit que quantité de mollusques, réellement hermaphrodites, se fécondent néanmoins les uns les autres. A la vérité, parmi les mollusques hermaphrodites, ceux qui ont une coquille bivalve, et qui sont fixes comme les bœufs, semblent devoir se féconder eux mêmes." (1873 reprint tome 2, p. 152.)

<sup>4</sup> Jean-Baptiste de Lamarck. *Ibid.* tome 2, p. 454: " les écureuils volans ... dans l'habitude d'étendre leurs membres en sautant, pour se donner de leur corps une espèce de parachute ... par des répétitions fréquentes de pareils sauts dans les individus de ces races, la peau de leurs flancs s'est dilatée de chaque côté en une membrane lichte qui recouvre les parties postérieures à celle de devant." (1873 reprint tome 2, p. 454.)

<sup>5</sup> William Bartram. *Travels through North and South Carolina, Georgia, East and West Florida, Philadelphia, 1791.* The passage referred to is on p. xxviii of the Introduction.

<sup>6</sup> *Athenaeum*, 18th May 1839, p. 377: " French scientific expedition in Northern Europe." " We learned one thing, however, which is not without interest, concerning the climate. It has long been believed that vegetation, in the more northern parts of Lapmaria, is constantly on the decline; and large tracts of land are found under the lee of the mountains, formerly covered with fir woods, where now only stumps and rotten roots of fir trees, with a few miserable birch, are to be seen."

<sup>7</sup> James Smith. " On the climate of the newer pliocene tertiary period." *Proc. Geol. Soc. Lond.*, vol. 3, 1839, p. 218: " Mr. Smith observed, that many of the most common shells in the raised beds of the basin of the Clyde are identical with species found by Mr. Lyell at Uddesvalla in Sweden; and he has been induced to conclude from the arctic character of the faunas, that the climate of Scotland during the accumulation of these beds was colder than it is at present."

<sup>8</sup> John Stevens Henslow.

<sup>9</sup> Thomas Andrew Knight. " An Account of some experiments on the foundation of vegetables." *Phil. Trans. Roy. Soc.*, vol. 89, 1799, p. 259. See above footnote to MS. page 152.

Does it flower anywhere? Yes on the Continent <sup>1</sup>— is there more variation in its character? — No — well characterized. —

Tulips are cultivated during several years & then they break. — each tulip is the product of fresh bud — here then is case of change analogous to change in grafted trees: so is not effect of different stocks in this case — & strong case showing analogy of production by gemmation & by seed — which Henslow is inclined to think very close. — A fruit tree by certain treatment will suddenly send forth quantities of blossoms. — |

- 163 The case of the Lemna, and the viviparous grasses, which no doubt are propagated during hundreds of years, without fresh seeds arising. — throws a very great difficulty on my theory, here we have a plant remaining constant, without crossing. — & propagation by buds does not injure constancy of form. — is the constancy owing to similarity of conditions — & that no change would affect them in short period & hence no change would affect them, without affecting all the individuals — hence there would be real gradation in species from one region to another. — These simple forms perhaps oldest in world & hence most persistent — if forms exceedingly difficult to vary, the run of chances, would prevent it varying | A plant propagating itself by buds is in same predicament, as one, in which structure does not allow of crossing with other individuals with facility — such as cryptogamic plants & true hermaphrodite mollusca, & probably corals. — these forms then ought to be very persistent, & their necessity of crossing is much less. — now certainly in the higher animals, changes seem to have been more rapid, & the facility for intermarriage is greater (Hence Dioecious plants highest — Palms &c &c) — Is there greater resemblance between carboniferous & recent mollusca, than between the corresponding aculeata? — But if Aculeata do not cross there would by my theory [be] gradation of form from one species to other: therefore my theory does require crossing. — The case of Lemna shows dispersion of germs is not end of seminal reproduction. — Likewise grasses having seeds, — as *Cocos de mer* — analogy shows some most important end. — |

165-176 *omitted*.

- 177 *Cocos* 1st<sup>4</sup> & *Preparis* between Andaman & Pegu abound with monkeys & squirrels. — Horsburgh<sup>2</sup> E. J., Directory vol. II, p. 46.

Carimon Java (between Borneo & Java) Lat 5° 50' S adjoining it are several small islands abounding with deer. — Horsburgh<sup>2</sup> vol. II p. 527. —

Journal of Asiatic Society<sup>3</sup> vol. I, p. 261 Catalogue of Birds of India

ditto p. 555 Lieut. Hutton<sup>5</sup> counted the ova of a tick in India & found there were

<sup>1</sup> These four words inserted between lines.

<sup>2</sup> James Horsburgh. *India Directory, or Directions for sailing to and from the East Indies, China, Australia, Cape of Good Hope, Brazil, and the interjacent Parts*: London 1796, p. 46: "Little Cocos. . . These islands, and Preparis, abound with monkeys and squirrels; larger animals have not been seen upon them."

<sup>3</sup> James Horsburgh. *Ibid.* p. 527: "Carimon Java. . . Adjoining to it, are several small islands and rocks, some of which abound with deer. . . ."

<sup>4</sup> *Journal Asiatic Soc. Bengal*, vol. I, 1832, p. 261. "Catalogue of Indian Birds", comprising the collections of Major James Franklin and Mr. John Gould.

<sup>5</sup> Thomas Hutton. "Notes in Natural History", *Journal Asiatic Soc. Bengal*, vol. I, 1832, p. 554: On p. 553: "I found that I had waded through the almost incredible number of 3,283 ova."

178 5.283 attached to its body | Journal of the Asiatic Soc. Vol. I, p. 335 Catalogue of animals of Nepal by B. Hodgson<sup>1</sup> p. 336 In the *most pestiferous* region (mentioned by Heber)<sup>2</sup> from which *all* mankind (& yet afterwards says native tribes can live there) flee during 8 months out of 12, — the largest mammals in the world constantly reside & are bred<sup>3</sup>. — take tame animals into this region between April & October & like man almost (this looks inaccurate C.D.) they will catch the Malaria & die. — On the other hand there are breeds of men the Thakú & the Dhanger who can live there & do not pine visibly. p. 337 it would appear as if<sup>4</sup> |

179-182 excised.

183 The possibility of different varieties being raised by seed is highly odd — as it is not so with the esculent vegetables — how is it with hollyoaks, flaxes, &c &c<sup>5</sup> Mr. Herbert<sup>6</sup> in letter says distinctly, that Hollyoak reproduce each other & yet I presume seed raised in same garden. — Now this good question, single or half double — anyhow fertile because they are raised by seed. — Where has Duchesne<sup>7</sup> described Atavism. — ask Dr Holland<sup>8</sup> case where peculiarity has first appeared. — Storia della Riproduzione Vegetale by Gallesio,<sup>9</sup> Pisa 1816 p. 27 Dr Holland.<sup>10</sup> |

184 Are there instances of plants, in becoming double losing [losing] fertility of, sometimes one sex & sometimes other, so as to become monoecious. — Are there not wild plants, some partly Dioecious?

Mushroom Hybrids?

Any wild plants in England which do not perfect their seed? — What animals can be budded & rendered of great age as must be inferred from what Mr Knight<sup>11</sup> says. Hort. Transact. V. II, p. 252.

<sup>1</sup> Bryan Houghton Hodgson. "On the Mammalia of Nepal" *Ibid.* vol. 1, 1832, p. 335.

<sup>2</sup> Reginald Heber. *Journey through the Upper Provinces of India, from Calcutta to Bombay, 1824-5*, (with notes on Ceylon); to Madras, & South Provinces, 1826; & Letters written from India, London, 1826.

<sup>3</sup> Bryan Houghton Hodgson. *op. cit.* p. 336: " . . . it is worthy of remark, that in this pest-house, from which all mankind flee, during 8 months of every 12, constantly reside and are bred some of the mightiest quadrupeds in the world. The royal tiger, the panther, the leopard, the elephant, the oxen or wild buffaloe, the rhinoceros, and stags of the noblest growth, abound; and, what to our fancies is less singular, the same malarious region cherishes Boa constrictors of the largest size, and other huge creatures of their kind."

<sup>4</sup> Bryan Houghton Hodgson. *Ibid.* p. 337: (the sentence continues) "the principal thought is that of inherited habits of body, or acclimatization, carried to such perfection by course of time, in respect to the great quadrupeds, as to have superseded their original and natural habits of body."

<sup>5</sup> From the top of the page to here the text is in pencil. This page and page 184 are written across the narrow width of the paper and have been lightly scored through.

<sup>6</sup> William Herbert. See footnote to MS. p. 144 *supra*.

<sup>7</sup> Henri-Gabriel Duchesne. *Author of Manuel du Naturaliste*, Paris 1797, in which, however, there is no entry under Atavisme.

<sup>8</sup> Henry Holland (1788-1873).

<sup>9</sup> Giorgio Gallesio. *Storia della Riproduzione Vegetale*, Pisa 1816, p. 27.

<sup>10</sup> Henry Holland. *Medical Notes and Reflections*, London 1833.

<sup>11</sup> Thomas Andrew Knight, "Upon the advantage of propagating from the roots of old ungrafted fruit trees" (read 3rd December, 1806), *Trans. Hort. Soc.*, vol. 2, 1807, p. 132: "the general law of nature appears to be that no living organized being shall exist beyond a limited term of years: and that law must be obeyed. It is nevertheless in the power of man to extend the lives of individual vegetable beings far beyond the period apparently assigned by nature; and parts of the same annual plant may be preserved through many years, perhaps through ages, though it cannot be rendered immortal." Darwin's question was answered about eighty years later by C. M. Child's experiments on rejuvenation of planarians and A. Carroll's tissue-cultures of chick heart muscle for periods far exceeding the normal life-span of poultry.

Is there any very sleepy *mimosa*, nearly allied to the Sensitive Plant. —  
p. 290 Dr Edwards<sup>1</sup> in an essay on Spermatie animalcules has described instrument for galvanising them.

Cross Irish & Common hare.

Decandolle<sup>2</sup> has chapter on sensitive plants: Physiology |

*Inside back cover.*

Get Hubbersty<sup>3</sup> to try experiments about raising plants when they cannot [be] crossed yet.

Make Hybrid mosses — Leighton or some ones.

Father, <sup>4</sup> diseases common to man & animals, — likeness of children<sup>5</sup>

Does any annual give buds or tubers — yes — but they are same as trees. —

Shake some sleeping *mimosa* — do stamina of *C. speciosus* collapse at night, if so irritate them, as by an insect coming always at same time, see if by so doing can be made sensitive.

The function of sleeping some way useful — it is only the association which is useless.

Grandfathers handwriting to compare with my own.<sup>6</sup>—

<sup>1</sup> William Francis Edwards. *Essai sur les animalcules spermatiques*. (not accessible). This subject is referred to in his *De l'influence des agents physiques sur la vie*: Paris 1822, p. 349.

<sup>2</sup> Augustin-Pyramus DeCandolle. *Physiologie végétale*, Paris 1822, tome 2, p. 883: "Article II. Des mouvements excitables par les chocs, les piqûres ou quelques causes analogues. . . . Les mouvements les plus extraordinaires sont ceux qu'on observe dans les feuilles de plusieurs *mimosas*, du *Smithia sensitiva*, et de plusieurs *crucifères*." This entry is pencil is written from the opposite end of the paper.

<sup>3</sup> Nathan Hubbersty, cf. "Darwin's Journal", *Bull. Brit. Mus. (Nat. Hist.) Historical Series*, vol. 2, 1930, p. 3.

<sup>4</sup> Robert Waring Darwin.

<sup>5</sup> These three words in pencil.

<sup>6</sup> The entries on this cover are lightly scored through.