

DARWIN'S NOTEBOOKS ON
TRANSMUTATION OF SPECIES
PART III. THIRD NOTEBOOK
JULY 15th 1838—OCTOBER 2nd 1838

Edited with an Introduction and Notes

BY

SIR GAVIN DE BEER.

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INTRODUCTION

DARWIN began his Third Notebook on Transmutation of Species on 15th July 1838 and finished it on 2nd October of the same year. From the list of books read, appended to the Second Notebook, it is known that he did not read Malthus's *Essay on Population* before 3rd October 1838, from which it can be seen that the contents of the Third Notebook owe nothing to Malthus's work. It is therefore of great importance to note that Darwin hit on the principle of natural selection independently. After a consideration of changes resulting in the formation of new species, he wrote:—"All this agrees well with my view of those forms slightly favoured getting the upper hand and forming species" (III 175).¹ Darwin himself realized the historical importance of these lines, because at a later date, probably 14th December 1856 when he looked through his Notebook, he wrote at the head of it: "Towards close I first thought of selection owing to struggle".

It has always been a puzzle to know why the stimulus of Malthus's book should have been necessary to put Darwin on the scent of natural selection about which Malthus knew nothing, and Darwin's Third Notebook now shows that the problem has hitherto been incorrectly formulated. From the various passages in the extant portions of the first three Notebooks it is clear that Darwin had independently grasped two ideas. One was the parallel between the effects of artificial selection by man and those of natural selection. It is contained in the Third Notebook and supported by the observation that the magnitude of the differences between domestic breeds of cattle exemplified in the hump of Indian cattle is comparable to that of the differences between the species of cattle and of bison (III 65).

The second idea was that of forms slightly favoured getting the upper hand and forming species. But it was an idea of natural selection without stress on the heavy and unavoidable penalties for failure in the struggle for existence, although the probability of extinction as the price to be paid for insufficient adaptation was already recognized in the First Notebook (I 38). It seems that it was the mathematical demonstration of the insufficiency of food supplies if numbers increased too fast, and the consequent inevitableness of the penalties, that Darwin derived from Malthus's work, not the principle of selection itself which completely undermines the validity of Malthus's own thesis that mankind was unimprovable.

¹ References are made to the Notebook on Transmutation of Species concerned in Roman figures, and to the MS. pages in Arabic figures.

The proof of the correctness of this interpretation of the story is to be found in the letter³ which Darwin wrote to Wallace on 6th April 1859, in which he explained that after reading Malthus's book he "saw at once how to apply the principle of natural selection". He had already grasped the principle of natural selection and had seen how it could result in unlimited change away from the ancestral type and the production of new species; but he had not recognized how nature enforced it until he read Malthus.

The Third Notebook contains a number of passages which reveal Darwin's outlook on his own work and that of his predecessors. The most important is the following:—"Seeing what von Buch, Humboldt, G. St. Hilaire & Lamarck have written I pretend to no originality of idea (though I arrived at them quite independently & have used them since) the line of proof and reducing facts to law only merit if merit there be in following work." (III 63). These words come early in the Third Notebook and refer to the period *before* his discovery of the principle of natural selection. They are in complete agreement with what Darwin wrote⁴ to Baden Powell twenty eight years later, after the publication of the *Origin of Species*:—"No educated person, not even the most ignorant, could suppose that I meant to arrogate to myself the origination of the doctrine that species had not been independently created. The only novelty in my work is the attempt to explain *how* species became modified, & to a certain extent how the theory of descent explains certain large classes of facts; & in these respects I have received no assistance from my predecessors."

After the *Origin of Species* was published, Darwin wrote⁵ to F. W. Hutton, 20th April 1861:—"I am actually weary of telling people that I do not pretend to adduce direct evidence of one species changing into another, but that I believe that this view is in the main correct, because so many phenomena can be thus grouped together and explained. . . . I generally throw in their teeth the universally admitted theory of the undulations of light . . . admitted because the view explains so much."

The stress on the value of his theory in explaining the "large classes of facts" is already made in the Third Notebook:—"In comparing my theory with any other, it should be observed not what comparative difficulties (as long as not overwhelming) [but] what comparative solutions and linking of facts" (III 72).

The Third Notebook also contains some interesting remarks on Darwin's methods. "Although no new fact be elicited by these speculations even if partly true they are of the greatest service towards the end of science, namely prediction, till facts are grouped & called there can be no prediction. The only advantage of discovering laws is to foretell what will happen & to see bearing of scattered facts." (III 67).

Much ink has been used to argue the question whether Darwin arrived at his conclusions as a result of inductive processes of reasoning. Writing at a time when so-called Baconian principles of induction were widely thought to be the only "correct" method of scientific inquiry, Adam Sedgwick⁶ accused Darwin of deserting

³ *More Letters of Charles Darwin*, edited by F. Darwin and A. C. Seward, London 1903, vol. 2, p. 128.

⁴ Sir Gavin de Beer. "Some unpublished letters of Charles Darwin". *Notes and Records of the Royal Society of London*, 1939, vol. 14, pp. 11-66.

⁵ *M. L.*, vol. 1, pp. 183, 184.

⁶ *Life and Letters of Charles Darwin* edited by Francis Darwin, London 1887, vol. 2, pp. 247-250.

these principles and used this argument for the express purpose of discrediting the theory of evolution by natural selection. Other critics, more recent, have accepted Darwin's conclusions but claimed that he was mistaken in thinking that he had arrived at them inductively and even reproached him for "speculating" in his Notebooks, as if it was reprehensible. Darwin himself always maintained that he had used induction and wrote¹ in his Autobiography that he "worked on the true Baconian principles, and without any theory collected facts on a wholesale scale". This did not mean that he must refrain from basing a hypothesis on each fact as he came to it, if he could. In the Notebooks he explained his method of working quite clearly: "The line of argument often pursued throughout my theory is to establish a point as a probability by induction & to apply it as hypotheses to other points & see whether it will solve them" (III 117). This is precisely what the Notebooks show. An authority is quoted for some observation believed to establish a fact, and immediately Darwin began asking questions suggested by the fact to see if a hypothesis constructed *ad hoc* was applicable to other situations. The Notebooks are littered with these queries.

Later in his life, in a letter² to Sir John Fiske dated 8th December 1874, Darwin described his method more explicitly but less correctly: "my mind is so fixed by the inductive method, that I cannot appreciate deductive reasoning. I must begin with a good body of facts and not from principle (in which I always suspect a fallacy), and then as much deduction as you please." In place of "deduction" he should have said "hypothesis and deduction". The hypotheses and deductions can follow immediately from each fact.

The facts and the tentative hypotheses based on them follow one another pell mell through the Notebooks, and the attempts to reproach Darwin for speculating in his Notebooks are futile. He was seldom more than one jump ahead of his facts, and it was precisely because he was one jump ahead that he made progress. As Darwin wrote³ to Lyell, 1st June 1860, referring to a paper by Hopkins who refused to accept the explanatory value of a theory as evidence of its correctness: "on his standard of proof, natural science would never progress, for without the making of theories, I am convinced there would be no observations". In a letter to Henry Fawcett, 18th September 1861 Darwin wrote:⁴—"About 30 years ago there was much talk that geologists ought only to observe and not theorise; and I well remember some one saying that at this rate a man might as well go into a gravel pit and count the pebbles and describe the colours". When Darwin was speculating without a firm basis of fact he was careful to warn himself: "*Pave hypothesis be careful*" (III 58).

In a masterly study of the problem, Alvar Ellegård⁵ has shown that the method of hypothesis by means of which Darwin worked was perfectly legitimate. As early as 1860 T. H. Huxley had pointed this out:⁶ "There cannot be a doubt that the

¹ Autobiography of Charles Darwin edited by Nora Barlow, London 1958, p. 129.

² L. & L., vol. 3, p. 193.

³ L. & L., vol. 3, p. 313.

⁴ M. L., vol. 1, p. 202.

⁵ Alvar Ellegård, "The Darwinian Theory and Nineteenth-Century Philosophies of Science", *Journal of the History of Ideas*, 1957, vol. 18, pp. 362-393.

⁶ T. H. Huxley, *Westminster Review*, 1860, vol. 17, p. 346.

method of inquiry which Mr. Darwin has adopted is not only rigorously in accordance with the canons of scientific logic, but that it is the only adequate method". Huxley also had a rod in pickle² for the philosophers of science who cavilled at Darwin's method in order to try to invalidate his results:—" Critics exclusively trained in classics or in mathematics, who have never determined a scientific fact in their lives by induction from experiment or observation, prate learnedly about Mr. Darwin's method, which is not inductive enough, not Baconian enough, forsooth, for them. But even if partial acquaintance with the process of scientific investigation is denied to them, they may learn, by the perusal of Mr. Mill's admirable chapter " On the Deductive Method ", that there are multitudes of scientific inquiries in which the method of pure induction helps the investigator but a very little way".

The attempts by Darwin's opponents to discredit his views by appealing to " Baconian principles of induction " as the only true path of science are particularly disingenuous. As Stanley Jevons³ showed many years ago, not only are the processes of inductive and deductive reasoning inseparable in the construction of theories capable of generalisation, but they must be accompanied by hypothesis; and in any case it is incorrect to ascribe the principle of inductive reasoning in scientific method to Francis Bacon. Darwin was abundantly justified in his procedure " of inventing a theory and seeing how many classes of facts the theory would explain."⁴ The Notebooks show that he had already realized the importance and value of this method.

An hypothesis is an idea based by induction on facts, in an attempt to find a consistent formula to fit other facts. Furthermore, as James K. Feibleman⁵ has stressed, " an induction to an hypothesis is just what it is quite independently of whether it was suggested by one fact or a thousand; the hypothesis itself is what is important, and depends for its staying powers upon its truth or falsity".

In Darwin's case the first three facts from which he started are known.⁶ They were the discovery by him of " great fossil animals covered with armour like that on the existing armadillos ", " the manner in which closely allied animals replace one another in proceeding southwards over the Continent ", " the South American character of most of the productions of the Galapagos archipelago, and . . . the manner in which they differ slightly on each island of the group ". Darwin's observations and reflections on the conditions which he found in the Galapagos Islands led to his now famous entry in his Ornithological Notebook ⁴—" When I recollect the fact, that from the form of the body, shape of the scale and general size, the Spaniards can at once pronounce from which Isl. any tortoise may have been brought:— when I see these islands in sight of each other and possessed of but a scanty stock of animals, tenanted by these birds but slightly differing in structure and filling the same place in Nature, I must suspect they are only varieties. The only fact of a similar kind of which I am aware is the constant asserted difference between the

² T. H. Huxley, *Lectures and Essays*, London 1908, p. 171.

³ W. Stanley Jevons, *Logic*, London 1889, p. 79.

⁴ *L. & L.*, vol. 2, p. 242.

⁵ J. K. Feibleman, " Darwin and Scientific Method ", *Tulane Studies in Philosophy*, 1959, vol. 8, p. 8.

⁶ *Ibid.*, p. 108.

⁷ Charles Darwin and the Voyage of the Beagle edited by Nora Barlow, London 1945, p. 248.

wolf-like Fox of East and West Falkland Islands. If there is the slightest foundation for these remarks, the Zoology of Archipelagoes will be well worth examining; for such facts would undermine the stability of species."

The problem presented to Darwin did not admit of many degrees of freedom in its solution. If the various species had not all been specially created with the observed differences between them ready-made, then they must have been produced by descent with modification from their ancestors. But this was the idea which had been put forward by Erasmus Darwin and Lamarck, extolled by Grant, condemned by Lyell, and hitherto rejected by Darwin. As Darwin explained, he independently arrived at the same idea as a hypothesis, and the First Notebook on Transmutation of Species¹ contains Darwin's earliest known formulation of that hypothesis and search for facts wherewith to test it.

The first 54 pages of the First Notebook are devoted to a straightforward exposition of the reasons which led Darwin to abandon the view of the immutability of species and to accept the hypothesis of transmutation or evolution. It is noteworthy that the three facts which started Darwin on his train of thought do not figure in this exposition, and this is a measure of the amount of consideration which Darwin had given to the problem between the time when he was in the *Beagle* and July 1837 when he opened his First Notebook on Transmutation of Species.

As the problem was one of differences between species, the first step in the analysis was the question of the origin of differences or variation. Here he found Erasmus Darwin's statement of empirical fact that variation was the natural result of sexual reproduction. But if variation occurs, deductive reasoning leads to the conclusion that species ought not to remain constant. Why, then, do species remain as constant as they do? Hypothesis: interbreeding within the whole population quashes variation of the species away from the type. This was the nearest approach to empirical fact that the then-prevailing total ignorance of the processes of genetics allowed him to make. If interbreeding within the whole population quashes variation, then what will happen if a portion of a population is prevented from interbreeding with the remainder by geographical isolation? Hypothesis: the portion of the population will vary, form a variety, and ultimately a new species. If this be so, then by deduction it ought to be observable that in some isolated regions this has happened. It is: the inhabitants of isolated areas such as the Galapagos Islands, Falkland Islands, Ireland, etc. show forms which are permanent varieties or different species as compared with the inhabitants of neighbouring lands.

If species are formed in this way from pre-existing species, there must be divergence in the lines of descent; but the number of different species living together in one region cannot be unlimited: therefore hypothesis: some species should die out. They have done so: extinction is a fact. Now if species are related to one another by common descent and some of them have gone extinct, hypothesis: there ought to be differences between the magnitudes of difference between the different species. There are: species are grouped in different ways, some close together belonging to the same genus, others wide apart belonging to different genera.

¹ *Bull. Brit. Mus. (Nat. Hist.) Historical Series*, 1960, vol. 2, pp. 23-75.

In this manner by a sequence of observation of empirical facts, induction into hypothesis, deduction, and exposure to test by a search for new facts leading to refutation or confirmation of his hypothesis, Darwin gradually acquired confidence. His hypothesis became "my theory" and he foretold the results of its establishment: a common ancestor for man and all animals, netted together by affinity (I 232).

In all this argument so far, there is no explanation how species are caused to become modified, if they are. In the First three Notebooks up to nearly the end of the Third, about 1st October 1838, Darwin was in the stage described in the *Autobiography*: "it was equally evident that neither the action of the surrounding conditions, nor the will of the organisms (especially in the case of plants) could account for the innumerable cases in which organisms of every kind are beautifully adapted to their habits of life, . . . and until these could be explained it seemed to me almost useless to endeavour to prove by indirect evidence, that species have been modified."

The idea of natural selection, so far as can be seen from the extant portions of the Notebooks, seems to have occurred to Darwin as a combination of the effects on him of the facts of variation, adaptation, and extinction. Variation must result in some forms being slightly more and others slightly less favoured. If this is so, hypothesis: "of those forms slightly favoured getting the upper hand & forming species" (III 175).

Once he was in the possession of the key of natural selection, Darwin worked by a combination of induction and deduction to construct the full theory of evolution by natural selection, as Sir Julian Huxley² and P³ have shown. But this belongs to a stage in the development of Darwin's thought later than is represented by the first three Notebooks on Transmutation of Species, and is found in the Fourth Notebook, the Sketch of 1842, and the Essay of 1844.

The remainder of the Third Notebook is largely taken up with the search for facts at a time when they were lamentably few. Even the facts of fertilisation⁴ were unknown, to say nothing of genetics. In trying to acquire the elements of zoology, botany, and physiology when there were no text-books, Darwin scoured whatever he could find and was led astray as often as not. With the hindsight of a hundred and twenty years of progress of knowledge in biology, there is something rather pathetic in the spectacle of Darwin wrestling with the problem of dominance of characters of different domestic breeds when crossed (III 3, 13, 42) and the hypothesis that dominance was determined by the relative ages of the breeds (III 26, 27, 43, 49, 108); with the relative importance of paternal and maternal influence on offspring (III 8, 44); with the explanation of the sterility of hybrids (III 15, 19) and with the possibility of teleology (III 8, 172).

¹ *Autob.* p. 119.

² Sir Julian Huxley. *The Living Thoughts of Darwin*, London 1928, p. 22.

³ Sir Gavin de Beer. "The Darwin-Wallace Centenary", *Endeavour*, 1928, vol. 17, p. 63.

⁴ Although sperms were first discovered in 1677 by Haver, and Spallanzani's experiments proved that sperms and not the liquid in which they swim are the element responsible for fertilisation, the penetration of an egg by a sperm was first observed by G. Newport in the frog's egg in 1824, and by N. Pringsheim in 1825 in an alga. It was not until 1875 that Oscar Hertwig discovered in the sea urchin that after fertilisation one of the pronuclei contained in the egg is derived from the egg and the other from the sperm.

All the more remarkable, therefore, are the sound conclusions that he was sometimes able to draw :—*Regeneration* : " each part of animal must have structure of whole comprehended in itself " (III 130, 167) ; *degeneration* : " as Larva may be more perfect . . . than [adult] parent, so may species retrograde " (III 57) ; *adaptation* : " if animals became adapted to every minute change, they would not be fitted to the slow great changes really in progress " (III 167) ; *instinct* : " the simplest transmission is direct instinct & afterwards enlarged powers to meet with contingency " (III 118) ; *man* : " comparison of man with expression of monkey when offended, who loves who fears who is curious " (III 22), and the similarity of the sexual impulse in female animals and in women (III 99, 130).

Almost prophetic is Darwin's search for material on which to carry out researches in experimental embryology : " cannot I find some animal with definite life and split it, and see whether it retains same length of life " (III 165). It was nearly a century before Driesch and Spemann showed how this could be done.

There is something scientifically heroic in Darwin's wondering whether a man's amputated arm could not regenerate a man, if it could be kept alive in a form of tissue-culture (III 131).

As in the other Notebooks a number of pages were cut out of the Third by Darwin in 1856. Seventy two pages of it have been lost out of one hundred and eighty, but it is a matter for congratulation that the extant pages contain as much of importance as they do.

Darwin's Third Notebook on Transmutation of Species, also known as Notebook " D ", is Darwin MS 123 in the Cambridge University Library, to the authorities of which acknowledgement is warmly made for their unflinching assistance and courtesy, as also to Dr Sydney Smith and Mr. P. J. Gautrey for their kind and valuable help with the decipherment of some obscure passages.

Inside Front Cover

Charles Darwin 36 Great Marlborough Street 1838.

Did² Eyton's² hybrids when interbred show any tendency to return to either parent? Is the first cross which makes hybrids productive like geese? — Are the number of kittens between Lion & Tiger at litter as numerous as in common lion?

Are the number of nipples in domesticated very fertile animals increased? Where offspring heterogeneous in plants are the number of seeds greater? — Mem. for Eyton. — Sir R. Heron's² case of breed of pigs with solid feet. —

(In this Book some curious note on monkeys recognizing sexes of animals.⁶)

(All selected Dec. 14 — 1856)

Towards close I first thought of selection owing to struggle |

1 July 15th 1838 Finished October 2^d.

As a proof what unknown causes act upon people my father² mention that for ten years, he never saw one case of malignant erysipelas spreading over the head, not caused by a wound, when suddenly during one time he had three patients at very distant quarters of the county, who had had no sort of communication, were seized with it, & for ten years afterwards, he then did not see other cases. — He
2 thinks Apoplexy affects people all over England at same periods. | When he began practice, he remember during a year or two he saw many cases of virulent cancer in women, & since that time it has been rare disease, but now (July 1838) he has seen more cases in a month, than in several previous years, two having consulted him on one day. — |

3 Mark² at Shrewsbury thinks the half bred Alderney cows take more after Alderney than the Durham, with which they have been crossed — is Alderney oldest breed — He believes all pretty much alike. — My Father's Water in the brain¹ a century since used to be called Worm Fever, as used much more lately diseased mesatine glands. — My Father has seen case of pleurisy, broken limb in children & other such disorders accompanied with some fever, be attended by the transmission of
4 large number of worms | the child not having passed them before. Hence disordered intestines are not healthy to worms, (like parasites of Tropical countries cannot endure this climate). —

July 23rd. Eyton,² a stone blind horse, seemed to perceive turn on road where no houses to Caton Muscote, where he had been accustomed to turn down, — applicable to birds migrations & mistakes in Savages. |

5-7 excised.

8 [sic] When two dogs line the same bitch & perfect spaniels & setters are produced one would argue the whole effect of race was determined by male: & How completely is Lor² Moreton's² case opposed to this fact & views.

¹ The remaining words on this cover inserted at a later date.

² Thomas Campbell Eyton.

³ Sir Robert Heron, cf. *Variation of Animals and Plants under Domestication*, London 1868, vol. 2, p. 94. Footnote:—"Extract of a letter from Sir R. Heron, 1838 given me by Mr. Yarrell".

⁴ This and the following two sentences, inserted in pencil at a later date.

⁵ Robert Waring Darwin.

⁶ Mark, Dr Darwin's coachman at Shrewsbury, cf. Emma Darwin, Cambridge 1904, vol. 2, p. 13.

⁷ "Water in the brain" appears to have been Dr. Darwin's term for this disorder.

⁸ Thomas Campbell Eyton. Probably personal communication.

⁹ Lord Morton. "A Communication of a singular fact in Natural History", (read November 1800) *Phil. Trans. Roy. Soc.*, 1801, vol. cxi, p. 20.

Fox¹ says a cousin, one of Mr. Strutt of his used to breed to common & Muscovy Ducks. — English, China & Canada Geese, & that this first cross were equally fertile with pure bred animals. — Mem. number of mules. — He recollects one hatch of 20 hybrid geese very fine. — How is it | with plants? This indicates a remarkable law, that first cross plentiful, second absolutely sterile. —

My case of stallion, according to Erasmus² preferring young mare to old, explained by stallion (according to Fox) being guided entirely by their smell.

Fox³ says he knew a carter well who placed his stallion as second horse between shaft mares |

11-12 excised.

13 Fox⁴ says where common & China geese are crossed the neck is not intermediate in its peculiar long neck, but much nearer to common geese. —

What has long been in blood, will remain in blood, — converse, what has not been, will not remain, — yet offspring must be somewhat like parents, — therefore offspring will tend to go back, or have none, — this argument does not apply to first 14 parents, because they are not new breed. — the first hybrids may be | compared to animal with amputated limb. Hereditary six-fingered people, Lord Renwick(?) family with defective palates, hereditary & therefore exceptions to above law. — Study what these monsters are: — are they abortive twins. — The fertility of first cross, as stated by Fox, is very important, as showing above facts as first cross being new species. —

15 Are not dreadful monsters abortive, just like mules. | Fox's⁵ half bred Persian cats favour the Persian side. — Theory of abortive hybrids. — If mules did breed the offspring would as in all other animals be like either parent or intermediate within certain small limits (within which limits they might return to either parent). Then according [to] law, that in proportion as things are long in blood so will they remain, a male being new species will have every tendency to have offspring like parent, but as they must [be] like or there will be none, therefore a mule can have no offspring. — But as badly deformed people & as mutilations (produced very quickly) sometimes have similar offsprings, so will the worst mules (as real mule) have offspring. — Slight deformities as supernumerary fingers (that is slight alteration of primitive stocks related to changes which every species undergoes) & hybrids between very near species (that is slight alterations of primitive stock) are hereditary: Hybrids & Varieties is different because not long in blood. —

16 The case of union of perfect animals is | distinct case, — gradation from physical impossibility to (perhaps increased) fertility — (but many animals are fertile, — when offspring infertile, — two considerations are here combined.) In last page, we have seen [that] mules could have no offspring, & this being [the] case, owing to the cordations of system, the organ of generation would necessarily fail. — In last page, I should have said, "an animal is able to transmit only those peculiarities 17 to its offspring, which have been gained slowly, now all the mules | have their whole

¹ William Darwin Fox. Darwin's second cousin.

² Presumably Erasmus Alvey Darwin, Darwin's elder brother.

³ William Darwin Fox. Personal communication.

⁴ Idem.

⁵ Idem.

form of body gained in one generation, so it is impossible to transmit them, & as offspring must be like parent, therefore mule has no offspring & therefore no generative organ.

Same Prop. better enunciated. — An animal in either parent cannot transmit to its offspring any change from the form which it inherits from its parents stock without it be small & slowly attained. N.B. The longer a thing is in the blood the more persistent any amount of change & shorter time less so. The result of this is that animal would endeavour to return to parent stock, but if both parents are alike, offspring must be like. |

- 18 Hence mutilations not hereditary, but size of particular muscles. — When two animals cross, each sends his own likeness & the union makes hybrid, in fact the parents beget child like themselves. expression of countenances, organic diseases, mental disposition, stature, are slowly obtained & hereditary; if the change be congenital (that is most slowly obtained with respect to that individual) it is more easily inherited, — but if change be in blood long, it becomes part of [the] animal, — by a succession of generations, these small changes become multiplied, & great change be effected, but | in a mule these conditions are not fulfilled. My grand-fathers' theory of mules not hereditary, because generation highest point of organization, false. — The creator would thus contradict his own law. So far is there any appearance of animals being created, it is probable if created at once, according to ordinary laws, the character of offspring would vary, or rather they would not have offspring. —

On the idea of generation being a bud from parent, if whole parent not entirely imbued with the change, a bud could not be taken, without it either went back, or not being perfect would perish. — |

- 20 The varieties of the domesticated animals must be most complicated, because they are partly local & then the local ones are taken to fresh country & breed confined to certain best individuals. — scarcely any breed but what some individuals are picked out, — in a really natural breed, not one is picked out, & few even of local varieties approaches quite to wild local variety. our European varieties must be very unnatural. — Italian Greyhound is probably the effect of local variety many times changed | together with some training in the earlier branches as in common greyhound & much intermarriage. —

In my speculations, must not go back to first stock of all animals, but merely to classes where types exist, for if so, it will be necessary to show how the first eye is formed, — how one nerve becomes sensitive to light, (Mem. whole plant may be considered as one large eye — have they smell, do plants emit odour solely for other parts of creation) & another nerve to finest vibration of sound, which is impossible. — |

- 22 Mr Spence² remarks that the *Fringilla domestica* of North Europe is replaced by

¹ Erasmus Darwin. *Zoönomia*, London 1794, vol. 1, p. 513:—"males which evidently partake of both parents, but principally of the male parent".

² William B. Spence. "Observations on a mode practised in Italy of excluding the Common House-fly from Apartments". *Trans. Entom. Soc. Lond.*, 1838, vol. 1, p. 1. On p. 8:—"it would also be desirable to have similar experiments made as to the house-flies of America and other hot countries, in which it is probable that in the same way as our common sparrow (*Fringilla domestica*, Linn.) is replaced in Italy by another species (*F. alpestris*, Temm.), which to an ordinary observer seems identical with ours, but is really distinct, . . ."

the *F. cisalpina* in Italy which is so like that difference would not be discovered by an unscientific observer. — Transactions of the Entomological Soc.

A capital passage might be made from comparison of man, with expression of monkey when offended, who loves who fears who is curious &c. &c. &c. who imitates. — who will say there is distinct creation required if he believe Hyaena & squirrel seal & mouse elephant, come from one stock. — |

23 *Theory of Geograph. Distrib. of organic beings.* —

Animals of same classes differ in different countries in exact proportion to the time they have been separated; together with physical differences of country: the time of separation depends on facility of transport in the species itself, & in the local circumstances of the two countries in times present & past. The effect of physical conditions of country is not perhaps so great, as separation or interbreeding, for otherwise we could not understand the vast number | of domesticated races. —

24 Athenaeum, ¹ p. 305, some (very poor account) of plants of Nova Zembla in review of Baer's work.

Edinburgh Royal Transact.² — p. 297, vol. 9, Dr Ferguson seems most clear that the ideosyncrasy of the Negro (& partly malatto) prevents his taking any form of Malaria — Adaptation & species-like. — Says Negro thick skinned.

My hairdresser (Willis)³ says that strength of hair goes with colour, black being strongest. |

25 V p. 63. Note Book M³ for case of change in food in insects entered by mistake.⁴ Surely the fossil Mammalogy of Britain & Europe is African, & the only difference is by the extinction of certain forms from northern part & not by fresh creation of new forms. — What is range of Hyaena? Hippopotamus? Indio-African, or Pure Africa? — Fossil Elephant of Africa most important under this view, & Hippo[po]tamus of Madagascar: because contemporaries.

In introduction to Eytone's Anatidae — recurs to idea of only animals from distant countries breeding! mem. 3 species of goose Has not goldfinch & greenfinch bred, & surely wild duck & pintail & widgeon! — Divides world into zoological Provinces, animals according to varieties of man. ?Will it hold good. — Thinks Temminck⁵ doubtful when he says no genera. — In Australia plants E & W very different, — man not so but N. & S. New Zealand, New Caledonia two races of man

26 but not plants. thinks | there are some small divisions. — does not seem to think

¹ Karl Ernst von Baer. Review of "Expedition to Novaya Zembla and Lapland" (St. Petersburg Bull. Soc., III, 1838, *Atlas*, 1838, July 21, p. 309.

² William Ferguson. "On the Nature and History of the Marsh Plover", *Trans. Roy. Soc. Edinb.*, (read Jan. 3, 1841) 1841, vol. 9, p. 273. On p. 297 there is a note "On the Negro Skin" From peculiarity of ideosyncrasy, he appears to be proof against endemic lovers; One of the most obvious peculiarities of the Negro, compared with the European, is the texture of his skin, which is thick, oily "cf. recent research on the immunity against malaria conferred by sickle trait, A. C. Allison: "Human Haemoglobin types", *New Biology*, 21, 1950, p. 43. (Penguin Books).

³ Mr. Willis. Hairdresser. cf. below MS. p. 113.

⁴ The reference is to Darwin's First Notebook on Metaphysics, Morals & Speculations on Expression (Cambridge University Library, Darwin MS. 124) begun 19th July 1838, finished end October 1838, from which p. 63 was excised by Darwin on 16th December 1845.

⁵ Thomas Campbell Eytone. *A Monograph on the Anatidae*, London, 1838, p. 1 — " . . . that those animals upon which this experiment has been tried have invariably been brought from countries far apart.

⁶ Conrad Jacob Temminck. *Presumably Observations sur la classification methodique des oiseaux*, Amsterdam & Paris 1807.

any improbability to animals being distributed after flood (!) according to affinities confounds, like Whewell,¹ affinity with analogy. — Good table at end of distrib.: of Anatidae. — Consult this book again. —

Mine is a bold theory, which attempts to explain, or asserts to be explicable every instinct in animals.

Heard at Zoolog. Soc. that Pintail & Common Ducks, breed one with another — & hybrids fertile inter se (No) directly against Eyton's rule.² ?Are the hybrids similar inter se — |

27-34 excised.

35 Owen³ says relation of Osteology of birds to Reptiles shown in osteology of young Ostrich.

16th [Aug.] D Israeli⁴ (Cur. of Literat. vol. II, p. 11) accidentally says " — is distinctly marked as whole dynasties have been featured by the Austrian lip & the Bourbon nose ", if this be not imagination, then old peculiarity overbears the crossing with females not thus characterized. — |

36 16th Aug. What a magnificent view one can take of the world Astronomical causes modified by unknown ones, cause changes in geography & changes of climate suspended to change of climate from physical causes, — then suspended changes of form in the organic world, as adaptation, & these changing affect each other, & their bodies by certain laws of harmony keep perfect in these themselves. — instincts alter, reason is formed & the world peopled with myriads of distinct forms from a period short of eternity to the present time, to the future. — How far grander than
37 idea from cramped | imagination that God created (warring against those very laws he established in all organic nature) the Rhinoceros of Java & Sumatra,⁵ that since the time of the Silurian he has made a long succession of vile molluscos animals. How beneath the dignity of him, who is supposed to have said let there be light & there was light. — whom it has been declared " he said let there be light & there was light " — bad taste.

August 19th Two regions may be Zool.-geographically divided either by development of new forms in one, or apparently so by the extinction of prominent ones in one: The latter will take place when conditions are unfavourable to numbers of
38 animals as in changing from warm to | cold, damp to dry. — Thus Tierra del Fuego has only one Guanaco of this characteristic form of S. America.

With respect to future destinies of mankind, some of [the] species or varieties are becoming extinct, others though the negro of Africa is not losing ground, yet, as the tribes of the interior are pushing into each other from slave trade & colonization of S. Africa, so must the tribes become blended & prevent the strong separation
39 which | otherwise would have taken place otherwise in 10,000 years. Negro probably

¹ William Whewell, author of *History of the Inductive Sciences*, London 1837.

² Thomas Campbell Eyton. "Some remarks upon the theory of Hybridity", *Mag. Nat. Hist.*, 1833, vol. 3, p. 257.

³ Richard Owen. "On the anatomy of the Southern Apteryx (*Apteryx australis*, Shaw)." Communicated 20th April 1848. *Trans. Zool. Soc. Lond.*, vol. 2, 1848-1851, p. 257. On page 189:—"The close resemblance of the Bird to the Reptile in its skeleton is well exemplified in the young Ostrich. . . ."

⁴ Isaac Israeli. *Characteres of Literatures*.

⁵ cf. Darwin's Sketch of 1845 and his Essay of 1844: in *Evolution by Natural Selection with a Foreword by Sir Gavin de Beer*, Cambridge 1958, pp. 83 and 149.

a distinct species — We know how long a mammal may go on as one species from Egyptian mummies & from the existing animals found fossil when Europe must have worn a quite different figure.

19th [Aug.] With respect to the Deluge, it may be worth adding in note that amongst the Mammalia of Europe the shells of ditto — shells of N. America — shells of S. America, — there is no appearance of sudden termination of existence, — nor is there in the Tertiary geological epochs. — |

40 There are some admirable tables on geograph distribution of reptiles in Suites de Buffon.¹ —

Vigors² has given list in Linnean Transactions of birds of Java — Caterpillars not being fertile is same as children not being so. — consider this with reference to "new species & hybrid doctrine". — I have read there are exceptions to this in some larvae of insects. (glowworm) breeding — imago state fertile at once. — Consider this with reference to those insects which have fertile offspring. Entomostraca & Aphides. |

41 The extreme difference of sexes is probably arrived at wing case of insects as glowworm.

The case of one impregnation sufficing to several births analogous to superfoetation, & the successive fertile offspring in Entomostraca & Aphides. Development of sexes in caterpillars, very valuable facts — they are eating foetuses, as young of Marsup. is sucking foetus. —

August 23rd The Rev. R. Jones³ gave an admirable harrier from Ireland to Brighton Pack — first rate bitch — tried to breed from her, but | her offspring came out one big & one small. Now Jones, before this happened from her looks thought she was half bred Beagle & Staghound. the grandchildren went back to either parent & breed not fixed, though she resembled a harrier & her husband was pure harrier.

Three gentlemen of parts all thought with pigs &c, that hybrids were uncertain. The peculiarities of our breeds must have been acquired, & hence this is true case of avitism.

Mr Drinkwater⁴ thought that a "first blood" animal must have gone on for many years, before deserves to be so called, — the short horned cattle have gone on for 50 or 70? years, — now well fixed breed: Jones⁵ says Sussex cattle | were all white headed, but this was bred out & now all are pure red, yet calf every now & then born with white head (or short-horned with black lip) & then calf in both cases is killed.

Notes from Glen Roy Note Book.⁶

Why is not Tetrao Sooticus an American form (if so)? —

¹ F. M. Daudin. *Histoire naturelle, générale et particulière des reptiles; ouvrage faisant suite aux Œuvres de Linnæus de Buffon.* Paris an XII [1802].

² Nicolas Aylward Vigors (& Thomas Horsfield.) "A description of the Australian birds in the collection of the Linnean Society; with an Attempt at arranging them according to their natural Affinities." *Trans. Linn. Soc. Lond.* vol. 13 Part 2, 1837, p. 170. This paper contains no list of Javanese birds, but on p. 331 there is a statement that "These two species very closely accord with the Javanese species of *Pernisorientalis*, *P. montanus*, described in these Transactions."

³ Rev. R. Jones. Unidentified.

⁴ Drinkwater. Unidentified.

⁵ Rev. R. Jones. Idem.

⁶ Darwin visited Glen Roy at the end of June and beginning of July 1838. ("Darwin's Journal", edited by Sir Gavin de Beer. *Birch. Assoc. (Nat. Hist.) Historical Series*, vol. 2, London 1929, p. 8.)

A Shepherd of Glen Tuset said he learnt to know lambs, because in their faces they were most like their mothers, believe this resemblance general. Depend upon mother being oldest breed? —

Quarterly Journal of Agriculture² p. 367, Dec. 1837. Generally received. |

- 44 Opinion that male impresses offspring more than female, yet instances given on opposite side. —

The theory of males impressing most is in harmony with their wars & rivalry. — The very many breeds of animals in Britain shows, with the aid of seclusion in breeding how easy races or varieties are made. —

The Highland Shepherd dogs coloured like Magellanic Fox. — peculiar hair & appearance — good case of Provincial Breed — Highland Sheep jet black legs, & face & tail, just like spencer³ [?] high active breeding |

- 45-48 excised.

- 49 L'Institut⁴ p. 249 (1838). Eggs discovered to Taenia, — hard so as to resist external influence.

27th August. There must be some law that whatever organization an animal has, it tends to multiply & improve on it. — Articulate animals must articulate, & in vertebrate tendency to improve in intellect, — if generation is condensation of change, then animals must tend to improve. — Yet fish same as, or lower than in old days: for a very old variety will be harder to vary & therefore more apt to be extinguished. — ???

Mayo⁵ (Philosoph. of Living) quotes Whewell⁶ as profound because he says length of days adapted to duration of sleep of man!!! whole universe so adapted!!! & not man to Planets. — instance of arrogance!! |

- 50 August 29th. — Macleay⁷ in A. Smith Zoolog. — of Africa. —

² Quarterly Journal of Agriculture, Edinburgh 1837, vol. 8, p. 367:—" . . . According to the generally received opinion, that the male imprints his character more indelibly than the female on the progeny, there may be a risk of breeding from too large a horse for the usual purposes of the farm; but, on the other hand, it is frequently seen that small stallions and bulls produce large stock. . . ." Probably by one of the editors.

³ Lord Spencer, *Journ. Roy. Agr. Soc.*, vol. 1, p. 24:—" It is therefore very desirable, before any man commences to breed either cattle or sheep, that he should make up his mind to the shape and qualities he wishes to obtain, and steadily pursue this object." cf. *Variation of Animals and Plants under Domestication*, London 1868, vol. 2, p. 105.

⁴ Félix Dujardin, L'Institut, 1838, 2 août, p. 249:—" . . . les œufs de Taenia protègent par une coque très résistante, parvient résister aux causes accidentelles de destruction . . ."

⁵ Herbert Mayo, *The Philosophy of Living*, London 1838, p. 138, Chapter III, "Of Sleep."

⁶ William Whewell, "The Length of the Day," *The Bridgewater Treatise on the Power Wisdom and Goodness of God as manifested in the Creation*, Treatise III, On Astronomy and General Physics, p. 38. On p. 39:—" . . . Man, in like manner, in all nations and ages, takes his principal rest once in twenty-four hours; and the regularity of this practice seems most suitable to his health, though the duration of the time allotted to repose is extremely different in different cases. So far as we can judge, this period is of a length beneficial to the human frame, independent of the effect of external agents. In the voyages recently made into the high northern latitudes, where the sun did not rise for three months, the crews of ships were made to adhere, with the utmost punctuality to the habit of retiring to rest at nine, and rising a quarter before six; and they enjoyed, under circumstances apparently the most trying, a state of salubrity quite remarkable. This shows, that according to the common constitution of such men, the cycle of twenty-four hours is very commodious, though not imposed on them by external circumstances."

⁷ The hours of food and repose are capable of such wide modifications in animals, and above all in man, by the influence of external stimulants and internal emotions, that it is not easy to distinguish what portion of the tendency to such alterations depends on original constitution. . . .

⁸ William Sharp Macleay, "Annulosa," in Andrew Smith: *Illustrations of the Zoology of South Africa*; . . . London, 1838.

p. 4. sticks¹ to genus or group of any kind not being perfect till circular.

p. 5 Most clearly shows² that genus expresses as now used almost any group. — all groups natural (p. 6) as expressing natural affinities. Macleay's plan of arrangement depends on the organs judged to be of importance in inverse ratio to their variability. — (Now *ceteris paribus* these will be the oldest.) "The most important characters break down in certain species & become worthless"³ — *Mammalia Edentata*. We do [p. 6] say⁴ such is group because it has such characters of importance, "but we say such happens to be the character, of no matter of what importance, which prevails throughout the group & serves to insulate it". — i.e. what characters |
51 chance to be hereditary whether important or not.

p. 7. "The natural arrangement of animals themselves is the question in point."⁵ Now what is natural arrangement, — affinities, what is that, amount of resemblance, — how can we estimate this amount, when no scale of value of difference is or can be settled. — I believe affinity may be taken literally, though how far we can ever discover the real relationship is doubtful, — not till much knowledge is elicited. — It will rest upon the discovery what characters vary most easily, — those which do not vary being foundation for chief divisions. —

p. 7. In some cases the circular arrangement from fewness of forms, cannot be discovered until we descend to subgenera & families,⁶ in the *Cetoniadae*, — when will *Ornithorhynchus* come in circle?!!! |

52 p. 8 — Anomalous structures, as in *Hippo[po]tamus*, solely owing to number of lost links, if all species know[n] they would be innumerable⁷ — does not know any difference between permanent variety & species!⁸ (given in note) — Macleay uses term *genus* when it is so many steps from a head as subkingdom — evidently artificial, as interloping of marsupials will change all, — & so on no one will settle number

¹ *Ibid.* p. 4:—"Ordnis scilicet naturalis circularis, per se classum exhibet."

² *Ibid.* p. 5:—" . . . has the word *genus* any signification which is universally deemed definite?"

³ *Ibid.* p. 8:—" . . . the most important characters break down in certain species, and become at times perfectly worthless . . ."

⁴ *Ibid.* pp. 6-7:—" . . . We do not argue that such must be the groups, because such and such are in our opinion, good and distinct characters: but we say, such happens to be the character, of no matter what importance, which prevails throughout the groups, and which serves in some degree to insulate it from other groups."

⁵ *Ibid.* p. 7:—" . . . we ought not to forget that the true question under consideration is, the natural arrangement of the animals themselves; . . ."

⁶ *Ibid.* p. 7:—" . . . for owing to the rarity of its species, the first circular grouping of the species *Cryptodera*, for instance, is into sub-genera; . . ."

⁷ *Ibid.* p. 8:—"Thus, when the naturalist talks of any anomalous structure, I understand merely that so many links, that is so many groups, of the great plan of creation are wanting. . . . If I say that the *Hippopotamus* forms a stirps by itself, I only mean that it is the sole species of its stirps known; and that, speaking theoretically, four families are wanting. . . . or rather twenty-four genera to connect it well with other tribes of *Pachyderma* . . ."

⁸ *Ibid.* p. 8 footnote:—"Some persons have imagined that I only assign five species to the lowest groups in nature; but the above theory evidently proceeds on the assumption that if we knew all the species of the creation, their number would be infinite, or in other words, that they would pass into each other by infinitely small differences. This actually takes place sometimes in nature; and as yet I do not know any good distinction between a species and what is called 'a permanent variety.'" cf. William Herbert: *Amaryllidaceae*, London 1835, p. 29:—"That in some genera intermediate diversities from different localities so confound the limits of species that it is waste of words to argue whether a plant is a species or a permanent local variety; . . ."

of primary divisions. — Complains² (p. 53) of M. Edwards² thinking any group good, though not circular, if characters can be established — clearly so. — N.B. — This paper worth referring to again. — According to my theory, every species in any subgenus will be descended from one stock, & that stock with other subgenera. |

53-56 excised.

57 Foetus of man undergoes metamorphosis, heart altered & umbilical cord. — Broderip² alluded to Hunter's views⁴ on this subject. — Monstrosities kind of determined by age of foetus. —

As Larva may be more perfect (as we use the word) than parent, so may species retrograde, but these facts are rare. —

2^d Sept. Those animals which have many abortive organs might be expected to have larva more perfect — this is applicable to young of Cochineal ?? |

58 Is there some law in nature an animal may acquire organs, but lose them with more difficulty — contradicted by abortive organs but number of species with abortive organs of any kind few. — hence become extinct, & hence the improvements of every type of organization. Such law would explain every thing. — *Pure Hypothesis* be careful. —

Argument for circularity of groups. When a group of species is made, father probably will be dead — hence there is no central radiating point, all united, (like an uncle must be granted unequal, because fossil) now what is group without centre but circle, two or three | lines deep — with respect to Macleay's⁵ theory of analogies — when it is considered the tree of life must be erect not pressed on paper, to study the corresponding points.

59 The present geographical distribution of animals countenances the belief of their extreme antiquity (i.e. much intervening physical change) — distribution especially of Mammalia.

As every organ is modified by use, every abortive organ must have been once changed. — What is abortive? when it does not perform that function which experience shows us it was for. — Most important law. — Penguins wing perhaps not abortive ??? Apteryx certainly. — |

60 Lyell's⁶ excellent view of geology of each formation being merely a page torn out of a history & the geologist being obliged to fill up the gaps. — is possibly the

¹ *Ibid.* p. 53: — "M. Milne Edwards . . . produced a classification, of which I can only say, that it makes an approach to be a rare exception to the well-known fact, that professed comparative anatomists are the persons, of all others, who in general are most incapable of using their own observations for purposes of natural arrangement. And indeed this very arrangement of Edwards is not natural, since he unfortunately conceived that every group he can invent, provided he can furnish it with a character, must therefore be a good one."

² Henri Milne Edwards. *Histoire naturelle des Crustacés*, Paris 1834-40, vols. 3 & Atlas (forming one of Bonet's "Collection des Suites à Buffon").

³ William John Broderip. Presumably personal communication.

⁴ John Hunter to Richard Owen: *Descriptive and Illustrated Catalogue of the Physiological Series of Comparative Anatomy contained in the Museum of the Royal College of Surgeons in London*, London 1833, vol. 1, p. iv, footnote: "I should imagine that monsters were formed monsters at the very first formation, for this reason, that all superfluous parts are joined by their similar parts, viz. a head to a head &c. &c." Hunterian MSS."

⁵ William Sharp Macleay. *Novae Entomologicae*, London 1840-51, p. 301.

⁶ Charles Lyell. *Elements of Geology*, London 1838, p. 293: — ". . . of a series of sedimentary formations, they are like volumes of history, in which each writer has recorded the annals of his own times, and then laid down the book, with the last written page uppermost. . . ."

same with the philosopher who has traced the structure of animals & plants. — He get[s] merely a few pages.

Hence (p. 59) looking at animal, if there be many others somewhat allied whether like parent stock, or not, now wings for flight — therefore ostrich not. The peculiar Malacca bears belong to same section with those of India. |

63-64 revised.

65 man have carries the range — Argue the case of probability, has Creator made rat for Ascension — The Galapagos mouse probably transported like the New Zealand one — It should be observed with what facility mice attach themselves to man.

Sept 7th. I was struck looking at the Indian cattle with Bump, together with Bison of some resemblance as if the "variation in one was analogous to specific character of other species in genus". — Is there any law of this. Do any varieties of sheep evidently artificial approach | in character to goats, — or dogs to foxes¹ (yes Australian dog) or donkeys to zebras. — Mr. Herberts variety of horse, dun coloured with stripe approaches to ass, or fowls to the several aboriginal species or ducks (here argue if it be said domestic fowls are descended from several stock[s] then species are fertile; as long as opponents are² not able to tie themselves down, they can find loopholes) "It is well worthy of examination whether variations are produced only in those characters which are seen to be different in species of same genus".

67 Law of monstrosity not prospective, but retrospective in showing | what organs are little fixed — (Hunters³ law of monstrosity with regard to age of foetus distinct consideration). Now in different species of genus Sus, see Cuvier⁴ *Ossemens fossiles*, do vertebrae vary? Although no new fact be elicited by these speculations even if partly true they are of the greatest service towards the end of science, namely prediction, till facts are grouped & called there can be no prediction. — The only advantage of discovering laws is to foretell what will happen & to see bearing of scattered facts. — |

68 What takes place in the formation of a bud — the very same must take place in copulation — (man & woman separate parts of same plant) — now in some Polypi we see young bud changing into ovales. —

Captain Grants⁵ Himalaya shells (see Paper in Geolog Transact) same appearance with secondary species distinct but close. — Mem. Von Buch⁶ on Cordillera fossils same remark. ? Was then formerly one great sea, & two Polar Continents. Marsupial, Edentata, Pachydermata &c. &c. — |

¹ William Herbert. *Amygdalaceae*, London 1837. On p. 339:—" . . . I have lately had under my observation a dog, whose father was a fox in an incaged at Nipon, and it has singularly the manner as well as the voice of a fox, but it is the parent of many families of puppies: and I feel satisfied that the fox and the dog are of one origin, and suspect the wolf and jackal to be of the same; nor could I ever contemplate the black line down the back of a dun pony without entertaining a suspicion that the horse, unknown in a wild state except where it has escaped from domesticity, may be a magnificent improvement of the wild ass in the very earliest age of the world: . . . "

² Altered in MS. from "will not tie themselves down."

³ John Hunter in Richard Owen: *Descriptive and Illustrated Catalogue of the physiological series of Comparative Anatomy contained in the Museum of the Royal College of Surgeons in London*, London 1832, vol. 1, p. iv, footnote. See above, footnote to MS. p. 57.

⁴ Georges Cuvier. *Recherches sur les Ossemens Fossiles des Quadrupèdes*, . . . Paris 1811.

⁵ Captain C. W. Grant. Presumably "Mémoire to illustrate a geological map of Cutch", read 22d February 1837, *Trans. Geol. Soc. Lond.*, 1840, vol. 4, p. 189.

⁶ Leopold von Buch, "Ueber den geologischen Charakter der Secundäre-Formationen in Süd America", *Monatssch. K. Pr. Acad. Wissensch.*, Berlin, 1818, p. 34. (*Gesammelte Schriften*, Berlin 1883, Band 4, p. 497.

69 It is important with respect to extinction of species, the capability of only small amount of change at any one time.

Seeing what Von Buch¹ (Humboldt)² G. St. Hilaire,³ & Lamarck⁴ have written I pretend to no originality of idea — (though I arrived at them quite independently & have used them since) the line of proof & reducing facts to law only merit if merit there be in following work. —

The history of medicine, the extraordinary effects of different medium on organs leads one to suspect any amount of change from eating different kinds of food. Grazing animals which eat every species new. — |

70 Sept. 8th A Golden Pippin or Ribstone ditto producing occasionally (as Fox⁵ says) same fruit trees is analogous to some hybrids breeding — there is tendency to reproduce in each case, but something prevents the completion. —

Say my grandfathers⁶ expression of generat[ion] being highest end of organization good expression but does not include so many facts as mine. |

71 The facts about half bred animals being wilder than parents is very curious as pointing out difference between acquired & hereditary tameness. —

In comparing my theory with any other, it should be observed not what comparative difficulties (as long as not overwhelming) [but] what comparative solutions & linking of facts.

Savages over whole world (Major Mitchell⁷ p. 244, vol. I) spit & throw dust. According to my theory of generation (p. 175) of⁸ |

72 Yarrell⁹ told me he had just heard of Black game & Ptarmigan having crossed in wild state — & the English & some African Dove. — The extinction of the S. American quadrupeds is difficulty on any theory — without God is supposed to create & destroy without rule. But what does he in this world without rule? The destruction of the great Mammals over whole world shows there is rule. — S. America & Australia appear to have suffered most with respect to extinction of larger forms. —

From observing way the Marsupials of Australia have branched out into orders one is strongly tempted to believe one or two were landed |

73-74 excised.

¹ Leopold von Buch. *Description physique des îles Canaries*, Paris, 1826, p. 144. (cf. Darwin's First Notebook MS. p. 156) *Ibid.* p. 148. (cf. Darwin's First Notebook MS. p. 158).

² Friedrich Heinrich Alexander von Humboldt. *Personal Narrative of Travels to the Equinoctial Regions of the New Continent, during the years 1799-1804*, London 1821, vol. 5, p. 563. (cf. Darwin's First Notebook MS. p. 148).

³ Eyzedem. *De Distributione geographica plantarum secundum eorum temperiem et altitudinem montium, proregetama*. *Lectioes Parisiorum* 1817 (cf. Darwin's First Notebook MS. p. 156).

⁴ Etienne Geoffroy-Saint-Hilaire. *Principes de philosophie zoologique*, Paris 1830. (cf. Darwin's First Notebook MS. *passim*.)

⁵ Jean-Baptiste de Lamarck. *Philosophie Zoologique*, Paris 1809. *Histoire naturelle des animaux sans vertèbres*, 1815, Paris (cf. Darwin's First Notebook *passim*.)

⁶ Eyzedem. *Hydrogéologie, ou recherches sur l'influence générale des eaux sur la surface de globe terrestre, sur les causes de l'existence du bassin des mers, de son déplacement, de son transport successif sur les différents points de ce globe, enfin sur les changements que les corps organiques ont éprouvés ainsi sur la nature et l'état de cette surface*, Paris 1808. (cf. Darwin's Second Notebook MS. p. 119.)

⁷ William Darwin Fox. Probably personal communication.

⁸ Erasmus Darwin. *Zoonomia*, vol. 1, London 1794, Section XXXIX.

⁹ Thomas Livingstone Mitchell. *Three Expeditions into the Interior of Eastern Australia*, . . . London 1838, vol. 1, pp. 244, 245.

⁸ These words were crossed out in MS.; they refer to MS. p. 173 below.

⁹ William Yarrell. Personal communication.

75 Mitchell's *Australia* vol. I, p. 306 "The crows were amazingly bold, always accompanying us from camp to camp; it was absolutely necessary to watch our meat, while in kettles on the fire, & on one occasion, notwithstanding our vigilance a piece of pork 3 lb was taken from a boiling pot, & carried off by one of these birds". Case of birds of different family having very same habits in some respects as the *Cara cara*. |

76 Sept. 9th It is worthy of observation that in insects where one of the sexes is little developed, it is always female which approaches in character to the larva, or less developed state. —

The female & young of all birds resemble each other in plumage. — (That is where the female differs from the male?) children & women — "women recognized inferior intellectually". Opposed to these facts are effects of castration on males & of age or castration in females. — |

77-90 excised.

91 This keeper has seen when sickly tigers have first come over, insects somewhat like between lice & fleas, sticking on them, — but never in an animal, that had long been in confinement — is this effect of climate, or state in which they are kept? —

Is there any mistake about Yarrell's law,³ is it local (not artificial variation) which impresses offspring most & not slow thinking of the Penguin duck & Herbert's law of ideosyncrasy⁴. |

92 I have hitherto thought that a small difference of any kind, if very firmly fixed from long time, made no difference what its kind was, — but if it were opposed to the difference in other sex, it would be much more difficult to propagate — as if one bird had very bright red breast & other very bright blue, it might be harder for |

93 both parents to transmit their peculiarities, that if both had mottled breasts, of a sort that would allow the offspring to have some different kind of mottle, each feather partaking of character of other, — the most aquatic & most terrestrial species, might be harder to cross than two less opposed in habits, though externally similar, — this

94 however is a sophism for | their brain or stomach would be different. — Or if one species left its type in having very long legs, & another in having very long tail, & other in having very short tail. — I can readily see that two first might cross easier than two last. |

95-98 excised.

99 September 13th. The passion of the doe to the victorious stag, who rubs the skin of [I] horns to fight, is analogous to the love of women (as Mitchell remarks⁵ seen in savages) to brave men. —

Effect of castration horns drop off, replaced by hairy ones, which never dry up & peel off their skin (not being wanted for war) & hence never fall off. Curious the rapidity of the change in 5 or 6 weeks after castration, fresh horns begin to grow.

¹ Thomas Livingstone Mitchell, *op. cit.*, vol. 1, p. 306.

² William Yarrell, *cf.* Darwin's Second Notebook on Transmutation of Species, MS. pp. 1 & 100 (The supposition that the oldest variety has the greatest effect on offspring when crossed).

³ William Herbert, *Amerythidæus*, London 1877. On p. 343:—"In further confirmation of the fact that the sterility depends on constitutional discrepancy, or difference of what medical men call ideosyncrasy."

⁴ Thomas Livingstone Mitchell, *op. cit.*, vol. 1, p. 304:—" . . . the gins have it in their power on such occasions to evince that universal characteristic of the lair, a partiality for the heave."

— Mr Yarrell² says the male Axis of India, breeds at times when horns not perfect — (is not this so in S. America with *C. campestris*, refer to my notes) & Mr Yarrell supposes this a consequence of that female breeding all the year round. Ask Colonel Sykes³. |

100 Even our domesticated cattle have tendency to breed at particular times.

Mr Yarrell has old book 1765? *Treatise on Domestic Pidgeons*,⁴ in which it appears that all the varieties now known were then existing. — he has also some very fine recent drawing of prize pidgeons in 1834. — now this would be most curious to show that in sixty years (how many generations) the strangest peculiarities have been kept perfect — also to trace the laws of change in this time. — The impossibility of discovering their origin. — I see only some, but very strange races of them have the forked black mark of the Rock Pidgeon, — several have a group |

101-106 excised.

107 which it must have taken to separate Van Diemens Land from Australia &c. &c.

September 14th. When Macleay⁵ says there is no difference between "permanent varieties" & species, he overlooks those restricted in their range by man & by art — the former only giving average of effects of country (& no monstrosity or adaptations to unhealthy state of womb). —

One can perceive that natural varieties or species, all the structure of which is adaptation to habits (& *habît second nature*) may be more in constitutional,—more conformable to the structure which has been adapted to former changes than a mere monstrosity propagated by art. |

108 Yarrell² told me of a cat & of a dog born without front legs — the former of which had kittens with imperfect ones, — now Sir J. Sebright⁶ thought if he had had a pair he could have produced from them — this instance of monstrous variety which could not have been persistent in nature. —

According to my view, the domesticated animals would cease being fertile inter se, or at least show repugnance to breeding if instincts unchanged, & if their characteristic qualities were all deeply imbued in them from long permanence, so that all their peculiarities must be transmitted if their |

109-110 excised.

111 every case common to many good species, & therefore to genera (& the uncles & aunts) & therefore does not tell against transmutation of species — will it against genera. — How long will the wretched inhabitants of N.W. Australia go on blinking their eyes without extermination, & change of structure. — When will the mosquitoes of S. America take an effect — would perfect impunity from mosquitoes bite influence propagation of species. —

¹ William Yarrell. Personal communication.

² Col. William Henry Sykes, author of the "Catalogue of Mammals of Dakhan", *Proc. Zool. Soc. Lond.*, 1831, vol. 1, p. 65 — cf. *Variation of Plants and Animals under Domestication*, 1868, vol. 1, p. 62.

³ The book referred to is probably *A Treatise on Domestic Pigeons, comprehending all the different species known in England* . . . to which is added a . . . description of that celebrated . . . pigeon called the *Almond Jubiler*, London 1765.

⁴ William Sharp Macleay. "Amakoa" in A. Smith (*Illustrations of the Zoology of South Africa*, London 1848, p. 3, footnote. (cf. footnotes to MS. p. 52 above.)

⁵ William Yarrell. Personal communication.

⁶ Sir John Sebright. Probably personal communication.

Case of association very disagreeable hearing maid servant cleaning door outside as often as she touched handle, though really fully aware she was not coming in, — could not help being perfectly disturbed, referred to Book M.¹ |

- 112 Is there any law of variation (as Hunter² supposes with scouters) — if armless cat can propagate, i.e. with the chance of two being born at same time, & make breed, one would doubt any law. — yet seeing the feathers along one toe of the Pointer one thinks there is a law, — that there must have been a tendency for feathers to grow there. That mutilations will not alter form may be inferred from Australian knocking out teeth. — The account of the people on the N.W. Coast blinking to keep out flies might be used.

The wild ass has no cross, how comes it that the tame donkey has. Old Buffon³ should be read on mare.

My view why hybrids are infertile, supposes that when foetus is forming the ovum within it is forming & this must be so else avitism could hardly ever occur. — and if that cannot be formed, general organ by that co-relation of parts will not be produced. — |

- 113-114 revised.

- 115 p. 482 (same book, Hunter Animal Economy) Owen says⁴ " the necessity of combining observation of the living habits of animals, with anatomical & zoological research, in order to establish entirely their place in nature, as well as fully to understand their oeconomy, is now universally admitted ". — p. 483 Owen⁵ thinks from climate of Australia & from Ornithorhynchus & Hydromys not being Marsupial (but also vice) & there being water animals these structures " may have reference to the great distances which the mammalia of N.S. Wales are generally compelled to traverse in order to quench their thirst " — But New Guinea! S. America. — Such difficulties will always occur if animals are thought to have been created. — it might as well be attempted to be shown from peculiarities of climate cause of N. Zealand not having any Mammalia. — Type of geographical organization. No more can be said |

- 116 In paper on bees in same work it is said⁶ that some kinds lay up honey even for single rainy day — & from case of wasps is supposed cells properly are made for larvae. — (p. 451) — Wasps breed many females, but almost all die — bees breed but few, because they are kept in security. — Hunter doubts about production of Queens. — Neuters are bred first, then males — how has this been arranged — Neuters are true female, but with parts little developed. —

Sept. 19th There is no scale according to importance of divisions in arrangement, of the perfection of | their separation. — Thus Vertebrata blend with Annelida by some fish. — But birds quite distinct. —

- 117

¹ The reference is to Darwin's First Notebook on Metaphysics, Morals and Expression.

² John Hunter in Richard Owen: *Descriptions and Illustrated Catalogue of the physiological series of Comparative Anatomy contained in the Museum of the Royal College of Surgeons in London*, London 1833, vol. 1, p. 17.

³ Georges-Louis Leclerc, Comte de Buffon. *Histoire naturelle. Quadrupèdes*, Paris.

⁴ Richard Owen in John Hunter: *Observations on certain parts of the Animal Oeconomy with Notes by Richard Owen*, London 1837, p. 482, footnote 1.

⁵ Richard Owen in John Hunter. *Ibid.*, p. 483, footnote.

⁶ John Hunter. *Ibid.*, p. 451. " On the number of Queens in a hive ".

Collect cases of difficulty of growing plants in all parts of world, thus tea trees in Brazil must have degenerated, as must spices &c &c.

The line of argument often pursued throughout my theory is to establish a point as a probability by induction, & to apply it as hypotheses to other points, & see whether it will solve them. — |

- 118 It is less wonderful that child's nervous system should build up its body like its parent than that it should be provided with many contingencies how to act. — So with the mind the simplest transmission is direct instinct & afterwards enlarged powers to meet with contingency. —

Sept. 23rd. Saw in Loddiges' garden 1279 varieties of roses!! proof of capability of variation. — Saw his collection of Humming birds, saw several greatly developed tails & one with beak turned up like Avocette. here is what |

119-126 excised.

- 127 that it shall beget young different in colour, form, & so altered in disposition as to be more easily trained up to the offices " &c. &c.

Owen illustrates² case of Dingos (he alludes to the Dhoolies or wild dogs of India) in Zoolog. Garden having coloured offspring — but surely in all these cases an unseen change is produced in parent — colour is a doubtful subject, but what other instances are there of such changes, not acquired by parent, being handed down? |

- 128 Are not Loddiges' 1279 roses kept in same soil, same atmosphere? — may they not be transplanted?, & yet year after year, successive roses & bud are produced, like parent stock or if different deteriorating very slowly. — I presume most of these roses, without circumstances very unfavourable, will continue of same variety as long as life lasts, yet they cannot transmit through seeds these characters though transmitting them with such facility to bud. — This must be owing to their unity in one stem. — | A bud may be transplanted & carry all these peculiarities — not so a seed. — Bud probably is like cutting off tail of Planaria, claw added to crab,

- 129 tail to lizard, healing of wound. — reproductive faculty simplest forms of budding. Why does Gecko produce always different tail? The whole grows to that part — in the separated part every element of the living body is present, in generation something is added from one part of the body, (or of other similar body) to another part of body. — (in plants does not whole individual change into generative organs?) it is of no consequence if it does — Do plants lose any qualities by being buds — more than if whole branch transplanted? |

- 130 An individual bud may be thus produced from the growth of one part, (not strictly new individual) or he may [be] produced by having undergone the endless changes which its parents have, — not this is effected by short method in *generation*. —

¹ Conrad Loddiges. *Catalogue of Plants in the Collection of Conrad Loddiges & Sons, Nurserymen at Hackney near London*. 12th edit. London 1823, p. 35 gives Rosa f. simpl. 1209; 12th edit. London 1830, p. 57 gives Rosa f. simpl. 1470. Presumably Darwin worked from the 12th edition.

² Richard Owen in John Hunter. *Op. cit.* p. 330, footnote:—"The existence of wild dogs which are not wolves, as the Dingos of Australia and the Dhoolies of India, which have either lost or have never acquired the common character of domestication, variety of colour, it is itself a strong argument against the original of the domestic dog ever having been a wolf."

³ Conrad Loddiges. *op. cit.*

Ehrenberg¹ considers artificial division of animals as gemmation. I consider gemmation as artificial division. — On this view each particle of animal must have structure of whole comprehended in itself. — it must have the knowledge how to grow & therefore to repair wounds — but this has nothing to do with generation.

- 131 Why crab can produce claw but man not arm, hard to say. — |
if it were possible to support the arm of man,² when cut off, it would produce another man. — That the embryo the *skewasak* of inch should produce a Newton is often thought wonderful, it is part of same class of facts, that the skin grows over a wound. —

Does likeness of twin bear on the subject ?

A mass arm would produce arm if supported, & in making true bud some such process is effected, — a child might be so born, but it would be very different from true generation, — there is no caterpillar state : the vast difference of two kinds of generation shown by their happening in same plant. — |

- 132 The Marsupial structure shows that they became Mammalia, through a different series of changes from the placentalia. Having hair like true Mammalia, no more wonderful than Echidna & hedgehog having spines. —

Does not male pidgeon (yes surely) secrete milk ? from stomach, analogous to other males feeding young, & to abortive mammae in male Mammalia — ? is not this argument for mammalia recent creation. — why what tendency can there be for abortive organ ever disappearing ?? — Have Marsupial abortive mammae ? —

My view would make every individual a spontaneous generation : what is animalcular semen but this — the living nerve massed in mould. — |

- 133-136 excised.

- 137 it, & made it meet in front. — Dr Smith³ every baboon & monkey, big & little that ever he saw knew women. — he has repeatedly seen them try to pull up petticoats, & if women not afraid, clasp them round waist & look into their faces & make the st. st noise. — The cercopithecus chinensis⁴ (or bonnet faced) monkey he has seen do this. — These monkey[s] had no curiosity to pull up trousers of men. Evidently knew women, thinks perhaps by smell, — but monkeys examine sexes of every [animal]. |

- 138 Has repeatedly seen one he kept pull up leathers of tail of Hen, which lived with it, — also of dogs but did not seem to evince more lewdness for bitch than dog : monkeys thus examine each other sexes by taking up tail. — Mem.: Ourang Jerry with Tommy. — Good evidence of knowledge of woman. —

The noise st st which the C[cercopithecus] sphingiola makes is also made by the C. porcarius, together with a grunting noise, the former signifies recognition with pleasure, as when food is offered, as much as to | say give me — the other when Dr Smith more distant. — But he thinks other monkeys make st. — noise. In case of woman instinctive desire may be said more definite than with bitch, for some

¹ Christian Gotthied Ehrenberg. *Abhandl.*, 1828, 8th Sept. p. 623. (8th Meeting of the Brit. Assoc. Adv. Sci. Section Zool.) " . . . believes that process of multiplication by division to be merely the development of a gemma or bud. " —

² Darwin is using the expression " to support the arm of a man " in the sense of keeping it supplied with its physiological requirements. An anticipation of tissue culture by 70 years.

³ Dr. Andrew Smith. Personal communication.

feeling must urge them to these actions. These facts may be turned to ridicule, or may be thought disgusting, but to philosophic naturalist pregnant with interest.

Hyaena, thinks, when pleased cocks his ears, when frightened depresses them.

England was united to Continent when elephants lived, & when present animals lived — we know the great time necessary to form channel & (& Bassez St.) yet no change in English species — time no element in *making* change, only in *fixing* it: only circumstances a contingency of time. |

- 140 When we multiply the effects of earthquakes¹, elevating forces in raising continents, & forming mountain-chains, when we estimate the matter removed by the waves of the sea, on beaches, we really measure the rapidity of change of forms, & instincts in the animal kingdom. — It is the unit of our calendar — epochs & creations reduce themselves to the revolutions of one system in the Heavens. —

Is not *puma* same colour as *lion* because inhabitant of plain & Jaguar of woods &c like ground birds. |

141-152 excised.

- 153 If an animal breeds young her growth is immediately checked — the *vis formativa* goes entirely to the offspring — This is clearly the converse of animal being rendered inessential, the hardness of life in female moth &c.

Mr Y.² says that Macleay considers the house bug, as a female which has larvae which have bred before the *vis formativa* had completed them — (but the argument is very weak without knowing whether if kept they would have wings. —). — Says p. 84. Hens like Cocks from effect of heredity in & in. — Mr Yarrell does not know

- 154 of any case of old male becoming like female, though many | of old females becoming like cocks. — It is very singular so many Gallinaceous birds have cock & hen plumage so different, yet the Cassowary & Guinea fowl cannot be distinguished. —

A capon will sit upon eggs as well as & often better than a female. — this is full of interest, for it shows latent instincts even in brain of male. — Every animal surely is hermaphrodite — (as is seen in plumage of hybrid birds) |

- 155 After animal has copulated, though no offspring, milk sometimes comes in mammae, & even when bitch is in heat. —

Yarrell believes gestation is always some multiple of seven — if woman does not menstruate in the month, she will in 3 weeks. —

A Bull is never taken from his own field to bull a cow. — A dog if led in string will not. — Some of the tigers — cat, though caterwhalling & put into female when muzzled, he is disabled. — so elephant in confinement, & so imagination in man, has strange effect. — |

- 156 Directly a capon is cut, it increases in size *prodigiously* —

Animal Oeconomy by Hunter (edited by Owen) p. 34. — Owen³ classifies Hermaphrodites Cryptandrous (only female organs visible) Oyster, Cystic Entosoa, Echinodermata, Aculeophes, Polyyps, Sponges.

Hermatandrous, male organs formed to fecundate females (as in plants) Cirripeds, rotifers, trematode and cestoid Entosoa.

¹ This word crossed out in MS.

² William Yarrell. Personal communication.

³ Richard Owen, in John Hunter, *Observations on certain parts of the Animal Oeconomy with Notes by Richard Owen*, London 1837, footnote on p. 35 (not p. 34).

Allriandrous Mollusca, with [*recit* without] pectinibranchiate order — the Annelida, all other² are Dioecious as Cephalopoda, pectinibranchiate molluscs, insects, spiders crabs — (all these however do not require coition every generation) Epizoa, the nematoid Entozoa —

157 Therefore highness in scale has no constant relation to separation of sexes, as may be | seen in Monoecious & Dioecious plants. — NB. in Heautandrous animals is there gradation of structure leading to supposition, that the Cryptandrous are really Heautandrous. — How is fecundation effected in latter: are organs open to water? Would not ferns according to this doctrine be considered as really cryptandrous, & they have hybrids — This is most important support to my views — Seeing sexes separate in some of the lowest tribes, leads one to suppose still more that they must in effect be so in all. — 2 NB. In Pectinibranch mollusca or Cephalopoda are there abortive traces of other sexual organs; for if so, separation of sexes very simple — as in plants. Even in same genus some dioecious & some monoecious — (& cultivation might make one set of organs barren in one plant & not in other). Hunter p. 36 is thought by Owen³ to ask whether a Heautandrous animal is actually split in two — keeping sexes separate. Owen says such view worthy of a Lamarckian. — Mine is much simpler. — |

158 Hunter⁴ shows almost all animals subject to Hermaphroditism, — those organs which perform nearly same function in both sexes, are never double, only modified, those which perform very different, are both present in every shade of perfection. — How comes it nipples though abortive, are so plain in man, yet no trace of abortive womb, or ovarium, — or testicles in female. — the presence of both testes & ovaries in Hermaphrodite — but not of penis & clitoris, shows to my mind, that both are present in every animal, but unequally developed. — surely analogy of Molluscs & neuter bee would shew this. (Do any male animals give milk) — But this not distinctly stated by Hunter,⁴ — Do testes, & ovaria when |

159-160 *excised*.

161 Hunters Animal Oeconomy (by Owen)⁵ p. 44 Classification of Monsters (1) from præternatural situation of parts, (2) addition of parts, (3) deficiency of parts, (4) combined addition and deficiency of parts, as in Hermaphrodites. (shows my doctrine of Hermaphrodite differs from Hunter) — Hunter⁶ (p. 43) observes "every species has a disposition to deviate from Nature in a manner peculiar to itself". Each part of each species not similarly subject. —

Divides sexual marks into primary & secondary, the latter only being developed when the first become of use. Great characteristic of male greater strength — (p. 45) and that strength⁷

In speaking of generation always put female first.

Will not even a fruit tree or rose degenerate during its life so that successive buds

¹ The word "animals" here crossed out in MS.

² Richard Owen, in John Hunter. *Ibid.* p. 36 footnote 2.

³ John Hunter. *Ibid.* "An account of the Free-Martin", p. 36.

⁴ John Hunter. *Ibid.*

⁵ Richard Owen in John Hunter. *Ibid.* p. 44 footnote.

⁶ John Hunter. *Ibid.* p. 43 "An account of an extraordinary pheasant".

⁷ This sentence was crossed out by Darwin.

do differ — any variety is not handed down but is handed down for some generations. |

162 Theory of sexes (woman makes bud, man puts primordial vivifying principle) one individual secretes two substances, although organs for the double purpose are not distinguished, (yet may be presumed from hybridity of ferns) afterwards they can be seen distinct (in dioecious plants in their abortive sexual organs?): they then become so related to each other as never to be able to impregnate themselves (this never happens in plants, only in subordinate manner in the plants which have male & female flowers on same stem. —) so that Molluscous hermaphroditism takes place. — thus one organ in each becomes obliterated, & sexes as in Vertebrates take place. — ∴ every man & woman is hermaphrodite: — ∴ developed instincts of capon & power of assuming male plumage in females, & female plumage in castrated male. — Men giving milk — |

163 Sept. 25th Young man at Willis' Gt Marlborough St Hair dresser assures me he has known many cases of bitch going to mongrel, & all subsequent litters having a throw of this mongrel. — I did not ask the question. — His bitch will not take, & if she did take, probably would not be fertile, without she knows & likes him & then is actually obliged to be held, — like she wolf of Hunter² — there is great difference between hybrids & inter se offspring in latter being unhealthy. — young take distemper very readily & are subject to fits. — Males bred in & in never lose passion. (mem. so it was said little cock yet very bad losing virile powers in Zoolog Gardens & Kings at Otaheite) Last litters are considered the most valuable because smallest sized dogs, — one litter big & then second small & so [on]. — Says there is breed of

164 Fowls called everlasting layers — or Polish breed (He thinks | half pheasant, half fowls) — eggs fertile but parent bird will never sit on them. —

May be just worth remembering that ovarium of women (Paper in Vol. I of Irish Royal Academy)³ have contained perfect hair, showing foetus has gone on growing, I believe same has happened in boys bodies.

Lavater Essays on Physiognomy⁴ transl by Holcroft vol. I, p. 195 says children resemble parents in their bodies "It is a fact equally well known, that we observe in the temper, especially of the youngest children, a striking similarity to the temper of the | father, or of the mother, or sometimes of both". If L. can be trusted this is Lord Morton's law. — "How often do we find in the sons the character,

¹ Mr. Willis. Hairdresser of. above MS. p. 24.

² John Hunter. *Ibid.* "Observations tending to show that the wolf, jackal, and dog, are all of the same species". p. 329. On p. 324 — "I communicated to Mr. Symonds my wish that we should endeavour to prove the fact of the wolf and dog being of the same species, by having either his female or mine lined by a dog."

³ James Cleghorn. "The History of an Ovarium, wherein were found Teeth, Hair and Bones," *Trans. Irish Royal Acad.*, 1787, vol. 1, p. 77.

⁴ John Caspar Lavater. *The Catalogue of the Library of Charles Darwin, Cambridge 1908*, lists this book as the French edition Paris 1800. In the translation by Holcroft (London 1840) on p. 364 the following words appear:—" . . . From all observations, on the resemblance between parents and children, which I have been able to make, it appears to me evident that neither the theory of Bossuet nor Buffon give any systematic explanation of the phenomena, the existence of which cannot be denied . . . sometimes, [they] resemble the mother, sometimes the father, often both, and often neither . . ." The edition which Darwin used has not been traced.

⁵ Lord Morton. "A Communication of a singular fact in Natural History", (read November 1800), *Phil. Trans. Roy. Soc.*, 1801, vol. cxi, p. 20.

constitution, & most of the moral qualities of the father !! In how many daughters does the character of the mother revive! Or the character of the mother in the son, & of the father in the daughters !" This last remark good because showing probably not education. —

Cannot I find some animal with definite life & split it, & see whether it retains same length of life — like Golden Pippin? How is this with buds of plants, does annual give buds. — Life may be thus prolonged, bud being formed & one part dying for great length of time. — |

166 There is probably law of nature that any organ which is not used is absorbed. — this law acting against hereditary tendency causes abortive organs. — The origin of this law is part of the reproductive system, — of that knowledge of the part of what is good for the whole — if cut off nerves in snail? (Encyclop of Anat & Phys) can make a head: the other parts may surely absorb a useless member, — in fact they do it in disease & injury. —

167 The sympathy of parts is possibly part of same general law, which makes two animals out of one | & heals piece of skin, — if the tail knows how to make a head, & Head a tail, & the half both head & tail — no wonder there should be sympathy in human frame.

One of the final causes of sexes to obliterate differences, final cause of this because the great changes of nature are slow. if animals became adapted to every minute change, they would not be fitted to the slow great changes really in progress. —

Annals of Natural History, 1838, p. 123. Ehrenberg² makes gemination in animals very different from that of plants (though latter does sometimes occur in animals). letter the division taking place from outside inwards & in animals from inside to the outside. is this not owing simply to more importance of internal regions in animals. One invisible animalcule in four days could form 2 cubic stone, like that of Billin [Bilin] |

168 It³ is very singular the same difference from parental stock having been repeated several times, that it becomes fixed in blood. — Looking at ovum of mother & ovum in offspring, as similar to the several ova in mother (with only difference of time) is the above law anyways connected with the case of successive copulation impresses offspring more & more with the added difference, like Lord Moreton's case & Dr Andrew Smith.⁴ If A.B.C.D.E. be animals: if (X) male impresses ovum in A with

¹ T. Hymer Jones, "Gastropoda", *Encyclop. Anat. & Phys.*, London 1830, vol. 2, p. 306. Regeneration of the tentacles in snails was first demonstrated by Spallanzani and published in 1768. His results were confirmed by Voltaire in the same year. (Sir Gavin de Beer, *Science and the Humanities*, London, 1926).

² Christian Gottfried Ehrenberg, "Communication respecting Fossil and Recent Infusoria made to the British Association at Newcastle", *Ann. Hist. Nat.*, 1838 (1839), vol. 2, p. 121. On p. 123:—"... of as many individual animalcules as contained in 2 cubic feet of the stone from the polishing slate of Bilin. This increase takes place by voluntary division; and this is the character which separates animals from plants. It is true that the gemination in plants, especially in very simple cells, is at times very similar to the division in animals, but this relates to the form not to the formation. A vegetable cell apparently capable of self division always becomes one, or contemporaneously many exterior warts (germs) without any change in its interior. An animal which is capable of division first doubles the inner organs, and subsequently increases exteriorly in size. Self division proceeds from the interior towards the exterior, from the centre to the periphery; gemination, which also occurs in animals, proceeds from the exterior towards the interior."

³ At the top of the page are the words "Generation [crossed out] v. p. 132."

⁴ Lord Moreton' op. cit., p. 20.

⁵ Dr. Andrew Smith. Reference untraced.

some peculiarity that is (B) to some degree, & likewise ovum in (B) that in (C) in lesser degree — Then when (C) unites with male (X)² assume that every peculiarity
 169 has a tendency to descend to several generations | If A & B be two animals which have some peculiarity for first time, & if their all their offspring inherit the same peculiarity in lesser degree & theirs again in lesser degree — now if the second race both have this peculiarity strongly; they transmit with same force as first pair, but to this tendency is added the 3rd tendency from first pair. — Now if two of third pair of same peculiarity breed they will have the same influence as first pair + tendency they inherited from second pair, + the influence they themselves inherit.

Annals of Natural History² p. 96, vol. I. [note II] Notice the *Syngnathus* or Pipe fish the male of which receives eggs in belly. — Analogous to men having mammae. — |

170 There is an analogy between caterpillars with respect to moths, & monkeys & men. — each man passes through its caterpillar state. The monkey represents this state. —

When it is said, that difference between bud & seed, that latter carries with [it] stock of food, — the generalization begins low — it goes through transformation nearly independently of its parent therefore wants independent supply of food, — is real difference — but this does not apply to potato. |

171 With respect to offspring being determined by impregnation of mother — we see in a litter every possible variation from being very near mother, & some very near father. — Now if one of these staid in the womb, when it came out, it might partake of shade of fathers character. — according to this view more seems to one child, more like father. — Stuff! — |

172 How much opposed the Quagga case appears to that of a dog[s] begetting different puppies out of same mother. —

The following views show the transmission of mutilation impossible it should be observed that transmission bears no relation to utility of change. hence hare-lips hereditary, disease, extinction.

The view that man or cock pheasant &c is abortive hermaphrodite is supported by change which takes place in old age of female assuming plumage of cock, & beards growing in old women — Stags horns & testes curious instance of correlation in structure — Neuter bee having both sexes abortive fact of same tendency. — Mammae in men having given milk, testes & ovaria. —

Animals in domestication (mem. elephant) not breeding — remarkable. Athenaeum 1838, p. 653. Ehrenberg³ thinks multiplication by division in development of gemma |

173-174 existed.

175 Why are twin[s] in man more like each other, than twins or triplets &c or in litter. Why is there some law about sexes of twins in former case. — (many monsters are really twins.) —

It is absolutely necessary that some but not great difference (for every brother & sister are somewhat different) should be added to each individual before he can procreate. then change may be effect of differences of parents, or external circumstances during life. — if the circumstances which must be external which induce

¹ From the words "H A. B. C. D. E" to here crossed out in MS.

² B. F. Fries. "On the genus *Syngnathus*", *Ann. Nat. Hist.*, 1838 (1839), vol. 2, p. 96.

³ Christian Gottfried Ehrenberg. *Athenaeum*, 1838, 8th Sept., p. 433.

change are always of one nature species is formed, if not — the changes oscillate backwards & forwards & are individual differences. (hence every individual is different). (All this agrees well with my view of those forms slightly favoured getting the upper hand & forming species.) — (Aphides having *fertile* offspring without coition or addition of differences, shows that difference need not be added each time, but after some time.)

What kinds of plants are monoecious or dioecious. Very curious how this was super-induced? (Surely all are really *dioecious*) only simple forms of life are monoecious. |

176 Proved facts relating to Generation.

One copulation may impregnate one or many offspring, it affects the subsequent offspring, though other male may have copulated. — two animals may unite & each have offspring by same mother. — one animal will fecundate female for several births, & even produce fertile offspring. — *Desire* lost when male & female too closely related: this most important with regard to theory, showing generation connected with whole system, as if there was a superabundance of life like tendency to budding, which wishes to throw itself off, — as may be inferred from annual plant being prolonged till it has bred. — Offspring like both father & mother, or very close to either. — Male & female as foetus one sex; & therefore both capable of

177 propagating, but one is rendered abortive | as far as parturition is concerned. — Generation being means to propagate & perpetuate differences, (of body, mind & constitution) in the end frustrated, when near relations & therefore those very close are bred into each other. — this is somehow connected. (This seems case, for by careful observing cattle can be bred in & in.) — The life of passion in hybrids perhaps connected with this same case (& not merely as I have stated it) it is certainly very remarkable that too much difference should produce same effect as too little, — in (latter case female often takes males but does not produce) tendency to deformity this does not happen with hybrids? Plants must stand much breeding in & in (those which have solitary flowers) exotics brought from foreign country & so must those forms which are produced by budding only as cryptogams & hydras — (this repugnance to breeding in & in seems connected with more developed forms). Study buds — gemmae & monocotyledonous, do those which are monocotyledons have many flowers in same spathe, as they have only one *bud*. — |

178 Every individual foetus would reproduce its kind was it not for the necessity of some change. Without some small change in form, ideosyncrasy or disposition were added or subtracted at each or in several generations, the process would be similar, to budding which is not object of generation. — therefore passions fail. — In fruit trees no doubt there is tendency to propagate the whole difference of parent tree, but it fails. Therefore crab seedlings of one apple ought to differ from those of other. — The upshot of all this is that effect of male is to impress some difference to make the *bud* of the woman not a bud in every respect. — Is this connected with the physical differences in almost all male animals? If the male in the case of some generations has gained some difference from what it received (for it is probable that breeding more in would not be deleterious if the relation had come from different quarters) then it causes a secretion of something someways different from himself, for it

179 should be observed that from | the effects of breeding in, it is not merely the too

close animals which will not breed, but the female at least (?male?) loses all appetite. — It is the comparison of each animal with its ancestors, and not its comparison of difference with other sex.

The highest bred Blood hound would be infertile with highest bred of other ? breed. Therefore it is not really breeding in & in but breeding animals that have neither varied from their stock, for to breed (as Sir J. Sebright¹ urges²) one with opposed characters is by impiance to breed two which have each varied from parent stock. — The very theory of generation being the passing through whole series of forms to acquire differences, if none are added, object failed, & then by that correlation of structure, desire falls. Every individual except by incestuous marriage has acquired from father some differences v. Sykes.³

Books to read Buffon Suites⁴ &c. — Horse & cattle Library of useful Knowledge.⁵ Bell's Quadrupeds.⁶ |

180 Will ova of fishes & Mollusca & Frogs pass through birds stomachs & live ?

In Muscovy ducks do young take most after father or mother, according as they are crossed ? & how is it with China & Common geese. How are their instincts ? Chinensis & Common pigs. —

Experimentize on crossing of the several species of wild fowl of India, with our common ones in Zoolog. Gardens⁷ :

Buffalo, common cattle, Esquimaux (& Australian) dogs with common dogs⁸ — Ask my father to look out for instances of avitium.

Examine English breeds in hot houses, will they flower.

Make Hybrids with moths, where fecundation can be made artificially. — |

Inside back cover :

Are hybrids pintail & common duck similar inter se ? Zoolog. Gardens.⁹

Are the hybrids of those species which cross & are fertile heterogeneous ?

When bird fanciers say the throw of two varieties is uncertain do they mean they cannot tell first result, or that hybrid breed is uncertain.⁶

Is there any peculiarity or variation common to any zoophyte both in succession which is not transmitted by generation ??

Is it chiefly in high bred dogs i.e. (bred in & in) that one copulation with other dogs renders subsequent progeny faulty. Does male fall in passion. —

Disposition of half bred cattle at Combermere ? How is jackall & dog of Z. Gardens.

¹ Sir John Sebright. Reference untraced.

² Col. William Henry Sykes. Reference untraced.

³ *Collection des Suites à Buffon, formant avec les œuvres de cet auteur un ouvrage complet d'Histoire Naturelle*, Paris 1834 (or other editions).

⁴ William Youatt. "The Horse, with Treatise on Draught", *Library of Useful Knowledge, Farm Series*, 39, 1831; "Treatise on British Cattle, their Breeding, Management and Diseases", *Library of Useful Knowledge, Farm Series*, 51, 1834.

⁵ Thomas Bell. *A history of British quadrupeds, including the Cetacea*, London 1837. This list of books is at the top of the page and crossed out in MS.

⁶ This sentence is crossed out in MS.