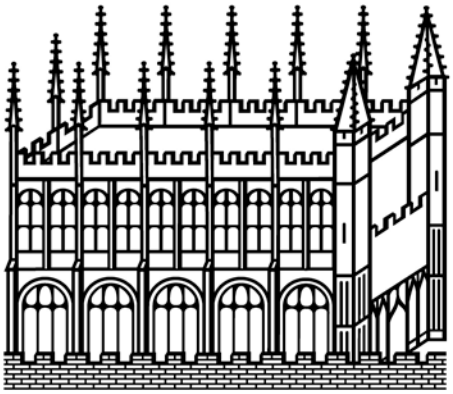

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CREATION

BY THE

IMMEDIATE AGENCY OF GOD,

AS OPPOSED TO

CREATION BY NATURAL LAW;

BEING A REFUTATION OF THE WORK
ENTITLED

Vestiges of the Natural History of Creation.

BY

THOMAS MONCK MASON, B.A.

'Ο πατήρ μου ἕως ἄρτι ἐργάζεται, κἀγὼ ἐργάζομαι.

JOHN v. 17.

LONDON:
JOHN W. PARKER, WEST STRAND.

M.DCCC.XLV.

LONDON:
HARRISON AND CO., PRINTERS,
ST. MARTIN'S LANE.

TO

HIS GRACE

THE DUKE OF MANCHESTER,

THE FOLLOWING PAGES

ARE,

IN GRATEFUL ACKNOWLEDGMENT

OF

HIS EXERTIONS IN THE CAUSE OF REVEALED RELIGION,

Inscribed,

BY HIS GRACE'S MOST OBEDIENT

AND FAITHFUL SERVANT,

THOMAS MONCK MASON.

ADVERTISEMENT.

FOUR editions of the *Vestiges of the Natural History of Creation*, have already been published, each in some degree differing from the rest. This difference consists not so much in the introduction of new matter, as in the omission from the later editions, of observations and arguments, which are only to be found in the former. As, however, these omissions have not been occasioned by any sentiment of the impropriety, or insufficiency of the parts withdrawn, but, as it appears from a paragraph in the Third Edition, (p. 381,) by the desire to remove unnecessary grounds of offence, from which we have a right to conclude, that although not in actual service, they are still intended to be considered as virtually in force, I have not felt myself at liberty to leave them out of a Review that is designed to embrace the whole subject, so far as it has been brought before us by the author of the volume under consideration. Accordingly, I have drawn up the following pages with especial reference to the First Edition, as the most copious; introducing, however, as occasion requires, whatever has been added in the others that appears worthy of remark. The reader will therefore remember that it is to the pages of the First Edition that the numbers refer throughout, except where it is otherwise expressed.

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INTRODUCTORY REMARKS.

THE Book from which the Christian deduces his principles of religion and religious history is in this respect peculiarly distinguished—that, assuming to proceed from an infallible authority, and resting its claims to be received upon that authority alone, its credibility is entirely dependent upon the credibility of all its parts: its title to be regarded as a divine memorial is unconditionally subservient to the distinct approval of every particular of which it is composed.

Hitherto it must be allowed that it has stood this test. The religion of the Bible *is* the religion of the whole civilized world. It is therefore only reasonable to suppose, that nothing which it alleges has ever yet been satisfactorily disproved. Its integrity, alike, and the integrity of every thing which it contains, has hitherto been virtually unimpaired.

In no particular has this integrity been more frequently or severely tried than in respect of the account of the original creation of all things, with which the volume is commenced, and the details of which are more or less interwoven throughout the entire record. Not to speak of the crude assaults of

mere unenlightened infidelity, or those general denunciations whereof it comes in for a share by virtue of the connexion in which it stands as part of a disputed whole, a more systematic kind of warfare has, of late especially, been waged against it, in which philosophy and the sciences are assumed to be enlisted in the attack. The boasted annals of the Egyptians and Chinese, the varied characters of the human race, the recently developed relics of defunct creations, indicating a lapse of ages measurable only by periods of indefinable duration, have each in their turn been brought forward to disparage its descriptions and impugn its facts. And yet the cosmogony of Moses maintains its ground; the account of the Jewish legislator continues to be the all but universally accredited representation of the facts and circumstances which it has undertaken to reveal.

Hallowed by time—sanctioned by the acceptance of all the great and good that have existed since Christianity first dispelled the pagan darkness that overshadowed the earth—and lastly, and above all, connected inseparably with the truth of the whole Christian Scriptures—it cannot be otherwise than with sentiments of the most lively concern that our attention becomes directed to the consideration of another mode of accounting for the same events, upon principles irreconcilably contrasted, and claiming to be supported by evidence partaking of the nature of demonstration.

It is possible that in thus characterising the principles upon which the author of the *Vestiges of the*

Natural History of Creation has undertaken to explain the great events to the illustration of which its pages are devoted, it may be alleged that a construction has been attached to them which they are not intended to bear—which the author himself disavows—nay, more, which he has furnished some arguments to show they are not justly entitled to receive.

The answer to this allegation might perhaps, be safely left to a simple juxtaposition of the contrasted cases with the explanation by means of which they are assumed to be reconciled. If the principle of a theory be to ascribe the absolute creation of all things to the uncontrolled operation of the laws of nature exerted upon the elementary particles of matter, without any interference whatever on the part of a Supreme Being, (which is only a condensed representation of the theory now under consideration,) it will not surely, by any one who has a just recollection of the Mosaic cosmogony, be thought sufficient to satisfy the requirements of a perfect harmony between them, merely to assign to a God the original formation of matter and the appointment of its laws, that in their operations, He may be said to be the operator, by the same figure of speech that a man is said to do that which he has procured to be done by another. And yet to this simply is reducible the only explanation by which a conformity is attempted to be established between the two accounts:—

'When,' he observes (p. 155), 'we carefully peruse the Mosaic record with awakened minds, we find that all the

procedure is represented primarily and pre-eminently as flowing from commands and expressions of will, not from direct acts. Let there be light—let there be a firmament—let the dry land appear—let the earth bring forth grass, the herb, the tree—let the waters bring forth the moving creature that hath life—let the earth bring forth the living creature after his kind: these are the terms in which the principal acts are described. The additional expressions—God made the firmament—God made the beast of the earth, &c.,—occur subordinately, and only in a few instances: they do not necessarily convey a different idea of the mode of creation; and indeed only appear as alternative phrases, in the usual duplicate manner of Eastern narrative. Keeping this in view, the words used in a subsequent place, "God *formed* man in his own image," cannot well be understood as implying any more than what was implied before—namely, that man was produced in consequence of an expression of the Divine will to that effect. Thus, the Scriptural objection quickly vanishes, and the prevalent ideas about the organic creation appear only as a mistaken inference from the text, formed at a time when man's ignorance prevented him from drawing therefrom a just conclusion.'

It is obvious that, even if the mode of explanation here adopted were good in itself, and admissible as far as it goes, it would still fall short of affording the means of reconciling the two statements, inasmuch as, after all, there are only certain of the particulars to which it is capable of being applied. Others, of paramount importance—such as the incubation of the Spirit of God, and the formation of Eve—would still remain, to which it is evidently incapable of being extended.

Of this, indeed, the author himself appears to have been in some sort aware; and, accordingly, as a measure of relief, has recourse to an assumption which, in point of fact, only serves the more irreconcilably to establish the difference between them:—

'I freely own,' he observes, in continuance of the preceding quotation, 'that I do not think it right to adduce the Mosaic record, either in objection to or support of any natural hypothesis, and this for many reasons, but particularly for this, that there is not the least appearance of an intention in that book to give philosophically exact views of nature.'

It is indeed quite true that there is no intention, either on the part of Moses in this his opening description, or of any of the other writers in the sacred volume, to give philosophically exact—if by *exact* is meant *complete*—views of nature; and therefore it is that we hold them exempt from any charge whatsoever in respect of any thing that they may happen *not* to have advanced. But if by *exact* is intended *correct*—in which sense only it can have any real bearing upon the author's argument—then do I most decidedly dissent from his proposition, as utterly incompatible with the Christian, or indeed any view that can consistently be entertained upon the subject. It is a plea, under shelter of which no one, who could give any real 'reason for the hope that is in him,' could think of taking refuge when the charge, as in the present case, was in respect of something that had been actually advanced; whether the communication had reference to the operations of

nature, as they are commonly reckoned, or those matters which might be thought more properly to come within the scope of their design. To me the observation appears neither more nor less than a virtual admission of the charge in its fullest extent; for what is it but a simple declaration that philosophically exact views, by which of course his own are intended, are not the views which the Mosaic record professes to give? In other words, that his views and those of the Mosaic record do really not agree*.

* The manner in which this question of the interpretation of Scripture in matters of natural or scientific detail has of late been wont to be treated, even by persons whose attachment to revealed religion is beyond a reasonable suspicion, renders a slight explanation necessary to justify the general proposition which is involved in what I have stated above. When, therefore, I assert that every thing communicated in Scripture must be regarded as true, whatever it relates to, I think the difficulty will be entirely met by drawing attention to the meaning of the word 'communicated,' as implying the *purpose* of God in the phraseology which is ascribed to Him. The Almighty, in condescension to human ignorance, always employs expressions suitable to the understanding of those for whose instruction they are intended; and occasionally these involve views which are not strictly correct. But the views involved are not in those instances the object of the communication, and consequently offer no exception to the generality of the rule to which I have above conformed. To illustrate this by reference to an example, in the expression 'the sun went down,' an act is implied which is not properly correct. But this act is not included in the purpose of the communication, which is not designed to explain an astronomical phenomenon, but merely to note a point of time. What is intended to be communicated is correct. With what is not intended to be communicated we have no concern, whether it be correct or not.

But it must not be imagined that the contradiction between the canon of Scripture and the conclusions of the work before us is confined to the mere question of the consistency or inconsistency of the principles of the theory it is intended to support with the account of the creation detailed in the commencement of the book of Genesis. Disagreeable as the acknowledgment cannot fail to be to all who have been accustomed to look upon the Bible as a revelation of the Divine will, we must not attempt to disguise from ourselves—what, indeed, the author of the contrasted volume has not himself really endeavoured to conceal—that in principle and detail these two are no less irreconcilably opposed, than that the fallacy of the one or the other becomes a fact incontestably ascertained. Not to dwell upon the evidences of variance afforded in the expressions with which the subsequent pages of the Bible abound, declaratory of a distinct personal agency in the works of creation, and which will admit of no such lax mode of interpretation as is here proposed; such as, 'Before I formed thee in the belly I knew thee' (Jer. i. 2)—'Thine hands have made me and fashioned me' (Job x. 8; Psalm cix. 73)—'Of old thou hast laid the foundations of the earth, and the heavens are the work of thy hands' (Psalm cii. 25): not to dwell upon the testimony of facts and doctrines entirely incompatible with the hypothesis of a creation by natural law—such as the original state of man before the fall, and the endowment of a soul, distinct from the perishable material of the body: omitting the

consideration of these and all secondary differences and disagreements, I would simply refer to the one great fact of the Bible, the main object of the whole revelation, if that revelation be true—the redemption of the human race by the sacrifice of the Eternal Son of God; and I ask if it is possible to reconcile this fact with any hypothesis by which man is degraded into a mere mechanical production, the necessary result of natural causes, a link in a chain of organic self-development, at present the last and highest upon earth, but destined to *give rise* to another of greater intelligence and worth* (p. 276), the common occupant of every sphere of space (pp. 164, 203-4), whom, so far from being dependent for the means of life, creation and preservation, upon the special interference of God, collectively and individually God himself could not have prevented from existing, unless he had altogether abstained from the creation of matter and its laws†?

With such repugnancy in principle, conclusions equally repugnant must naturally be expected to

* According to the theory of the author of the *Vestiges*, to be explained hereafter, every species of animated being, the human race among the rest, has been produced from the species next inferior to it by virtue of a law of development, the operation of which the author does not conceive limited to any race of beings yet produced.

† The law of development by which the human race has been produced is, according to the author of the *Vestiges*, part and parcel of the original constitution of matter, and of necessity, like all the other laws of nature, *must* have operated to the effect assigned, unless causes can be supposed to exist without their effects.

prevail. Accordingly, statements and sentiments constantly occur throughout the work which are directly opposed to the specific declarations of Scripture upon the same points, so as to place their mutual disagreement beyond the reach of question. In p. 275, the common origin of the human race, or its descent from a single pair of parents, is called in question, and the opposite conclusion, if not expressly adopted, yet evidently treated as the more probably correct.

'It may be asked,' he observes, 'is the existing human race the only species designed to occupy the grade to which it is here referred? Such a question evidently ought not to be answered rashly; and I shall therefore confine myself to the admission that, judging by analogy, we might expect to see several varieties of the genus homo. There is no other family approaching to this in importance which presents but one species*.'

'After all,' he adds in another place (p. 296), 'it may be regarded as still an open question whether mankind is of one or of many origins. The first human generation may have consisted of many pairs, though situated at one place, and these may have been considerably different from each other in external characters.'

It is scarcely necessary to observe that this hypothesis is equally opposed to the Scriptural account of

* This paragraph, with a considerable quantity of matter of the same character, extending from page 262 to page 276 in the first edition, has been omitted from the third and fourth. The *principle*, however, is equally advocated in the second of the paragraphs above quoted, which is retained in all the editions.

the Noachian deluge, after which the re-establishment of the population of the world would still have to be referred to a single original pair. In pp. 383, 384, the providence of God, his interference, in any way or degree, with the course of affairs in this world, is unequivocally denied, and the fate of every individual, whether for good or ill, referred exclusively to chance. The argument by which this position is defended introduces another statement equally at variance with the doctrine of the Christian Scriptures:—

'It will occur to every one,' he observes, speaking of the apparent hardship of these conditions, 'that the system here unfolded does not imply the most perfect conceivable love or regard on the part of the Deity towards his creatures. Constituted as we are, feeling how vain our efforts often are to attain happiness or avoid calamity, and knowing that much evil does unavoidably befall us from no fault of ours, we are apt to feel that this is a dreary view of the divine economy; and before we have looked farther we might be tempted to say, "Far rather let us cling to the idea, so long received, that the Deity acts continually for special occasions, and gives such direction to the fate of each individual as he thinks meet; so that, when sorrow comes to us, we shall have at least the consolation of believing that it is imposed by a Father who loves us, and who seeks by these means to accomplish our ultimate good." Now, in the first place, if this be an untrue notion of the Deity and his ways, it can be of no real benefit to us; and, in the second, it is proper to inquire if there be necessarily in the doctrine of natural law any peculiarity calculated materially to affect our hitherto supposed relation to the Deity. It may be that, while we

are committed to take our chance in a natural system of undeviating operation, and are left, with apparent ruthlessness, to endure the consequences of every collision into which we knowingly or unknowingly come with each law of the system, there is a system of mercy and grace behind the screen of nature which is to make up for all casualties here, and the very largeness of which is what makes these casualties a matter of indifference to God*.'

Here grace and mercy, looking, as we must take it, to a future life, are explained entirely with reference to physical requirements, and eternal happiness (if it is to be eternal) proportioned to suffering and not to worth. Besides these, a variety of secondary inconsistencies occur, of which I can only adduce a few examples. In p. 351, all wickedness is ascribed to organic developments; in p. 348 the love of God is made an inherent quality of the natural man, contrary to the express declaration of St. Paul (Rom.

* The former part of this paragraph is likewise among the portions which a desire 'to remove out of the way illustrations and arguments which had been made the grounds of sweeping objections,' has induced the author to omit from the subsequent editions of his work. The latter clause, which is still retained, comprises, however, enough of the spirit of the whole to justify the quotation of it as attesting the *principle;* which is, indeed, so much a part of the theory itself that, without any specific declaration on the subject, it would be impossible to regard them apart. An hypothesis that considers it incompatible with the character and dignity of God to *make* man, could not consistently admit his interference in the minor affairs of life. And, accordingly, to this intent and effect is the whole bearing of the chapter from which the paragraph above has been extracted.

viii. 7); and in p. 363 the admixture of evil in the world, physical and moral, is represented as a part of the necessary constitution of the human state, contrary to the doctrine of original sin.

With these facts before us it would be mere affectation to hesitate any longer as to the light in which we are to regard the present work in its relation to the Christian Scriptures. Without meaning to infer which of the two is most entitled to our acceptance, certain it is that one or the other is false—one or the other *alone* is true. Of the importance of the interest at stake there can be no doubt. It is, in fact, to those who believe, nothing less than a question of life and death. If the theory of the *Vestiges of the Natural History of Creation* be true, then are all the hopes of the Christian illusory and vain; the Bible is a fiction; the light we have been following from infancy is a mere *ignis fatuus*; the mighty structure of the Christian faith, under the shadow of which all our institutions have grown up, and with reference to which all the moral, civil, and political arrangements of the civilized world have been devised, is but the 'baseless fabric of a vision,' destined to vanish before the light of approaching day, and 'leave not a wreck behind.'

Nor are the consequences confined to the Christian believer only. The whole world has a paramount interest in the result; for as certainly as there is no Bible, so surely is there no religion or morality of any kind. For what religious obligations can bind man to a God who only makes him as a matter of

course, and when made takes no concern in him? Or what moral relations can exist between individuals independent of any common tie but that of interest (p. 383), who are mere 'electro-chemical' machines (p. 204), created with no view but that of their own personal gratification and enjoyment? (p. 379).

Such being the indisputable character of the work before us, I humbly conceive no apology can be required for the extended consideration which I have felt myself impelled to bestow upon it. To endeavour to ascertain the truth or falsehood of principles, the admission of which involves such portentous consequences, can never be deemed a work of superfluity. I am aware that this endeavour has already been made by others, and some of far greater ability and research than I can pretend to lay claim to. Nevertheless what has hitherto been done has not appeared to me to supersede the necessity for further exertions in the same design, even admitting that nothing new remained to be said upon the subject. Different authors, independently examining the same propositions, will take different modes of representing the same views; and as different readers have likewise minds differently constituted, some of these modes may produce conviction where others, better qualified for the purpose, may previously have failed.

In the investigation into which I have here entered, my sole object has been the determination of the question of 'creation by natural laws,' as

opposed to that view of the original constitution of the organic and inorganic worlds which is adopted by all on the authority of the Bible, where that authority is received, or of tradition and common sense, where the higher authority has hitherto not been vouchsafed. In the prosecution of this design, I have taken each point of evidence presented by the author of the *Vestiges* in the order in which it occurs, and applied to each such reasoning as I conceived most appropriate for its disproval. Finally, I have endeavoured to lay down some general propositions affecting the principle of material or natural causation, from which the character of the theory and its pretensions may be more accurately and conclusively ascertained.

It will be perceived that I have, in this inquiry, altogether avoided the question of the truth or falsehood of the geological conclusions respecting the antiquity of the earth and its pre-adamite occupation with successive tribes of animated beings. Considering the unsettled state of the public mind upon the matter, and the length of space it would occupy properly to exhibit the evidence as it really stands, and to expose the manifold errors into which the author of the *Vestiges* has fallen in the representations he has made of it, I have thought it better to take it upon the author's own account, and admitting all that is claimed in respect of it, to show that it gives no colour or encouragement to the hypothesis of an organic creation by natural law. In like manner, with regard to the majority of the facts of minor

importance, adduced in evidence of the same views, I have considered it more advisable to meet them upon the supposition of their truth, where that could be done without prejudice, than to repose upon a denial the merits of which I could not enforce without a larger share of argument and proof than I conceived the particular case required. And with this preliminary explanation, for which I entreat the reader's forbearance, I proceed to the examination of the work itself, to which our attention is more particularly due.

THE object of the volume before us is to establish a theory of creation, the principle of which is, that all things are produced by the simple uncontrolled agency of the laws of nature exerted upon the elements of matter originally distributed throughout space, and that this production takes place according to a law of gradual development; in other words, that the formation and arrangement of the heavenly bodies, the constitution of the globe we inhabit, with all the creatures it contains, and all the phenomena it exhibits, the establishment of organic existence, the appointment of the means of life, the principles of thought and action, the instinct of animals and the reason of man, are only the necessary results of natural causes, operating progressively, without interference on the part of any superior intelligence, except so far as may regard the first establishment of those causes—the elementary principles of matter, and the laws by which they are governed.

It is true there is no denial of the existence of a God, either expressed or implied, in the theory itself or the statements by which it is supported. On the contrary, the work abounds with those expressions of admiration of the power and attributes of a Deity so commonly to be met with in works of an infidel description, and which are of course to be regarded as concessions to the prejudices of an age not yet prepared altogether to relinquish its dependence upon a great First Cause. But with this admission of his existence, all connexion with the Deity is at an end. So far from any introduction of Him or his agency into the details of the scheme, the object of the work is especially to show that there is no necessity whatever for Him; that all things have been done without Him; and, as a matter of course to be inferred from the analogy of the past, will continue to be so to all eternity, unless some other laws shall in time be developed by which they shall be resolved into their primitive non-existence, or God himself interpose to put an end to their career.

The purport of the work being as described, a structure of argument is adopted in accordance with the character of the theory it is intended to sustain. Starting from what may be regarded as the very lowest point in the scale of material existence, the occupation of space with the elementary principles of matter, it assumes to trace the progress of the creative energy, through all its stages of development, up to the highest point to which, in the estimation of the author, it has hitherto attained—the endowment

of the intellectual and moral faculties in the human race. In the first chapter is detailed the mode in which, conformably with the doctrine of natural causes, the various heavenly bodies are presumed to have been composed, arranged, and invested with the motions and other physical properties by which they are distinguished. The second chapter is devoted to the consideration of their constituent materials, founded upon analogy with that one of them to which our actual researches have of necessity been exclusively confined. Abandoning thenceforward the regions of infinite space, the argument now takes up the conformation of the earth, and in the third and eight succeeding chapters carries the history of the development of the mineral, vegetable, and animal creations throughout the several geological 'eras,' as they are termed, from that of the 'primary rocks,' supposed to represent the primitive condition of the terrestrial globe, in which no organic remains have ever yet been discovered, to that of the 'superficial formations,' in which the present species are assumed and stated to commence. 'General' and 'particular considerations respecting the origin of the animated tribes,' occupying the twelfth and thirteenth chapters, next precede a more detailed exposition of the 'hypothesis of the development of the vegetable and animal kingdoms,' in which the creation of the species, by the sole agency of the ordinary laws of nature, is asserted and illustrated by reference to experiments in chemistry, crystallography, and electro-galvanism. With a view to the further corrobo-

ration of the theory, whereof this hypothesis is a component part, the 'system of animated nature' propounded by Messrs. Swainson, Vigors, and Macleay, is next brought into review, and the doctrine of 'representation,' as it is technically designated (according to which all organized beings are explained to be merely the repetitions or 'representations' of other individuals, differing only in the degree of their perfection), made subservient to the elucidation of the alleged principle of creation by natural law, 'according to a scale of gradual or progressive development.' Having, in conformity with the principles of the 'system' referred to, ascertained a *status* for man among the animated tribes, upon grounds strictly physical*, a 'history' is next assigned to the human race, which is intended, by the support it is made to give to the hypothesis of gradual development, to pave the way for the establishment of

* Singular to relate, the whole of that portion of this chapter, in which consists the application of the principles of the 'system' discussed to the conditions of the human race, is omitted from the latter editions of the work; and, in its place, a new mass of text is introduced, the purpose of which, so far as I can collect it, is to throw discredit upon the correctness of views which have only their presumed correctness to excuse their being at all referred to. So far, however, as the *status* of man is concerned, this omission makes no difference; the position of the human race, according to the views of the author of the *Vestiges*, being as decidedly fixed by the hypothesis of specific development, which makes the man the offspring of the monkey, as by any argument founded upon the doctrine of *representation*, which he now appears to have found so difficult to digest.

the 'mental constitution of animals' upon the basis of physical organization, which is the subject of the seventeenth and last chapter but one; the whole being wound up with a representation of the 'purpose and general condition of the animated creation,' founded upon a consideration of the character and principles of the theory which it is intended to recommend.

Now, to this theory, regarded simply as an abstract proposition affirming the creation of all things by the sole agency of the laws of nature exerted upon the elementary principles of matter, I have one preliminary objection to make, upon which I humbly submit we should have been fully justified in relying as fatal to the whole scheme, and exempting us from the necessity of entering any further into an investigation of its details. This objection is founded upon the consideration of a conclusion which, for the sake of greater clearness and because it is a general one, and applicable to every sort of scheme that might be founded upon the same ultimate premises however subsequently diversified, will be best exhibited in the form of an axiom or axiomatic proposition, the character of which I believe it is justly entitled to assume. The proposition is this, that *uniform laws acting freely upon uniform materials, can only give rise to uniform results.* To make this more intelligible to those who may not be in the habit of following up abstract propositions expressed in the language of the schools, if a mass of strictly uniform material be supposed to be subjected to the

action of fixed laws, without interference or control, and by virtue of that subjection be made to assume any determinate conditions of substance, form, or motion, those conditions must be strictly uniform. Whether by the force of electricity it be resolved into simpler principles, or determined into more elaborate combinations—whether it be more condensed by the laws of mutual attraction or more expanded by the laws of heat—the same effect must be strictly discernible in every integral portion of the whole mass.

This follows from the very character of that condition of uniformity which we have assigned to the premises. Uniformity of material implies a condition of perfect identity in its circumstances all throughout. Uniformity of laws implies a condition of perfect identity in their operation under the same circumstances. The uncontrolled operation of such laws upon such materials must of necessity be productive of uniform results. It is only by a variation or difference of circumstances, limiting or affecting their operation, that any diversity could be produced. Now uniform laws acting upon uniform materials can no more give rise to different circumstances affecting their own action than they can give rise to different results under the same circumstances. In fact the hypothesis that they could do so is only a contradiction in terms: circumstances and results are the same when no different agent is employed to produce them; and therefore, to affirm that uniform laws could give rise to circumstances by which their

own results could be varied, is only to affirm that the same laws could give rise to different results under exactly the same circumstances.

With this conviction impressed upon us, it is easy to see that the theory which presumes the varied works of creation to proceed from such a source as the uncontrolled laws of nature acting upon the original principles of matter, must be essentially fallacious. The condition of the elements of matter originally diffused throughout space, exemplified in what is termed the nebulous fluid, is represented to be, and would of necessity, if it had existed, have been a condition of strict uniformity. The laws of matter are, of themselves, strictly uniform, equal and universal in their application, immutable save by Him alone by whom they have been ordained. The results of the operation of such laws upon such materials must of necessity be uniform, whether they act separately or conjointly, so long as they act free from supernatural interference or control. If we suppose the particles of matter diffused throughout space to be compelled by the attraction of gravitation to tend towards a centre, and by such tendency to form a substantial nucleus, as in the theory proposed, this nucleus must be homogeneous: that is, of the same substance all throughout. If they be supposed to affect different centres and form different nuclei, these nuclei must be not only individually but collectively homogeneous and uniform; the one exactly representing the other in *all* its conditions. And if it were possible that by such laws as we have been

describing, these nuclei could become resolved into parts representing our solar and presumed astral systems, in the manner set forth in the theory before us, every one of these systems must be the exact counterpart of the other in every particular of form, number, disposition, motion, or whatever else by which it might be distinguished. And so on for every successive stage in the progress of creation which we can imagine attained by the instrumentality of the same resources. It is true that the operation of the laws of nature do *now* produce varied results by which the truth of the axiom above stated might appear to be impugned. But this is only because the circumstances under which they now operate are necessarily various; the consequence of a state of things which it is the purpose of our argument to show could never have been brought about by conditions in accordance with the premises upon which the axiom is based.

Indeed the force of this truth, howbeit apparently unconscious of its existence, has proved too great for the author of the volume before us to contend with, and has accordingly betrayed him into the elaboration of more than one of those astounding incoherencies by which the subsequent stages of his scheme are so copiously distinguished. In the very first step of the proceeding—the establishment of nuclei, or centres of agglomeration to the surrounding particles (out of which, it will be seen, all the rest is made to accrue), we have the condition of uniformity, assigned to the elements of

matter (p. 27), directly contradicted by the assumption of a 'peculiarity in its constitution' (p. 12), by virtue of which it is supposed to be determined to the production of the nuclei for which he is desirous to account. A peculiarity of constitution, available to account for the establishment of nuclei, must be a peculiarity by which the character of uniformity is denied. It must be a peculiarity in the *parts* which affect to nucleate, not possessed by the rest of the mass; which is, *totidem verbis*, an expression of difformity.

The same contradiction is again displayed at a further stage of the proceeding, when, having constituted his celestial systems, he is about to furnish them with their appropriate contents. A world produced by the simple agglomeration of the elementary particles of matter (the state in which it is left by Sir William Herschel's hypothesis* of its creation, adopted by our author), could evidently of itself never afford grounds for the development of a single variation, by the agency of any power whose influence was equally applicable and directed to every particle in the whole mass. In this dilemma recourse is had to exactly the same inconsistency that we have just been exposing. After observing (p. 27) that the hypothesis, upon which the construction of the

* The nebular hypothesis, as it has been termed, is generally coupled with the name of Laplace as its inventor, but improperly. It was first suggested by Sir W. Herschel, though Laplace, by whom it was adopted, entered more fully into its details.

spheres has been explained, supposes 'matter to have originally formed one mass,' and that 'the same physical laws presided over the whole,' he asks the question, 'Are we to presume that the constitution of the whole was uniform?—that is to say, that the whole consisted of similar elements?' And how does he answer this question? 'It seems difficult to avoid coming to this conclusion, at least under the qualification that, possibly, various bodies, under peculiar circumstances attending their formation, may contain some elements which are wanting and lack some which are present in others, or that some may entirely consist of elements in which others are entirely deficient;' so that the very uniformity which is alleged in the first part of the paragraph, where it is necessary to the hypothesis of the creation of the masses, is contradicted in the last part, where it would interfere with the development of their contents.

Had we to deal with the theory before us merely as a general proposition, and were all men capable of appreciating the force of an established maxim in determining all consequential results, we might, I feel assured, have concluded here, in the full conviction that nothing more was requisite to ascertain the groundlessness of the scheme which is submitted for our approval. But as unfortunately all men have not minds so constituted as to be able to resist the force of an argument simply by virtue of its relation to an established fallacy, where that fallacy happens to be more than ordinarily remote, and as,

moreover, I am desirous to make our examination of the theory in question not only complete in itself, but applicable to the determination of the conditions of any other theory which, proceeding upon the same ultimate principles, might yet avoid the conclusion here established by admitting the agency of God so far as was necessary to account for the variety their several hypotheses might require, I shall wave the right to stand upon this axiom, and proceed with our investigation as if no such obstacle to our progress had been proved to exist.

THE NEBULAR HYPOTHESIS.

Following up the order in which the great scheme of creation by gradual development is laid before us, our first attention is directed to the process by which the 'formation and arrangement of the bodies of space' are alleged to have been accomplished. In order that this process may be the more clearly understood, it will be necessary to take a slight review of the state of the heavenly space, as it is reported to us by those who have cultivated a more extended acquaintance with it by means of instruments than we are able to do by the unassisted powers of sight. Borrowing the words of our author,

'It has long been concluded amongst astronomers, that the stars, though they only appear to our eyes as brilliant points, are all to be considered as suns, representing so many solar systems, each bearing a general resemblance to our own. Attempts have been made to ascertain the distance of some of the fixed stars by calculations founded on

parallax, it being previously understood that, if a parallax of so much as one second, or the 3600th of a degree, could be ascertained in any one instance, the distance might be assumed in that instance as not less than 19,200,000 millions of miles! In the case of the most brilliant star, Sirius, even this minute parallax could not be found; from which of course it was to be inferred that the distance of that star is something beyond the vast distance which has been stated.'

'If we suppose that similar intervals exist between all the stars, we shall readily see that the space occupied by even the comparatively small number visible to the naked eye, must be vast beyond all powers of conception. The number visible to the eye is about three thousand; but when a telescope of small power is directed to the heavens a great number more come into view, and the number is ever increased in proportion to the increased power of the instrument. By the joint labours of the two Herschels, the sky has been "gauged" in all directions by the telescope, so as to ascertain the conditions of different parts with respect to the frequency of the stars. The result has been a conviction that, as the planets are parts of solar systems, so are the solar systems parts of what may be called astral systems—that is, systems composed of a multitude of stars, bearing a certain relation to each other.'

'Nor is this all. Sir William Herschel, so early as 1783, detected a motion in our solar system with respect to the stars, and announced that it was tending towards the star λ in the constellation Hercules.'

'The two Herschels have in succession made some other most remarkable observations on the regions of space. They have found within the limits of our astral

system*, and generally in its outer fields, a great number of objects which, from their foggy appearance, are called *nebulæ;* some of vast extent and irregular figure, as that in the sword of Orion, which is visible to the naked eye; others of shape more defined; others again in which small bright nuclei appear here and there over the surface. Between this last form and another class of objects, which appear as clusters of nuclei with nebulous matter around each nucleus, there is but a step in what appears a chain of related things. Then, again, our astral space shows what are called nebulous stars—namely, luminous spherical objects, bright in the centre and dull towards the extremities. Finally, nebulous stars exist in every stage of concentration, down to that state in which we see only a common star with a slight *bur* around it.'

'A superficial view of the astronomy of the solar system gives us only the idea of a vast luminous body (the sun) in the centre, and a few smaller, though various sized bodies, revolving at different distances around it; some of these, again, having smaller planets (satellites) revolving around them. There are, however, some general features of the solar system, which, when a profounder attention makes us acquainted with them, strike the mind very forcibly. It is, in the first place, remarkable that the planets all move nearly *in one plane*, corresponding with the centre of the sun's body. Next, it is not less remarkable that the motion of the sun on its axis, those of the planets around the sun, and the satellites around their primaries, and the motions of all on their axes, are *in one direction*—namely, from west to east.'

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* I am not aware that Sir W. Herschel ever considered any of the so-called *nebulæ* to lie within the limits of the astral system, to which he imagined us to belong.

'Some of the other relations of the bodies are not less remarkable. The primary planets show a progressive increase of bulk and diminution of density, from the one nearest the sun to that which is most distant*.'

'Then the distances are curiously relative. It has been found that if we place the following line of numbers,

0 3 6 12 24 48 96 192

and add 4 to each, we shall have a series denoting the respective distances of the planets from the sun. It will stand thus:—

4	7	10	16	28	52	100	196
Mercury.	Venus.	Earth.	Mars.	Ceres.	Jupiter.	Saturn.	Uranus.

It will be observed that the first row of figures goes on from the second on the left hand in a succession of duplications, or multiplications by 2.'

'The distances bear an equally interesting mathematical relation to the times of the revolutions round the sun. It has been found that, with respect to any two planets, the squares of the times of revolution are to each other in the same proportion as the cubes of their mean distances—a most surprising result, for the discovery of which the world was indebted to the illustrious Kepler. Sir John Herschel truly observes, "When we contemplate the constituents of the planetary system from the point of view which this relation affords us, it is no longer mere analogy which strikes us, no longer a general resemblance among them, as individuals independent of each other, and circulating about the sun, each according to its own peculiar

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* This is not correctly stated. The density of Uranus is greater than that of Saturn, which is nearer the sun. The densities, also, of Mars, Venus, and the Earth, are nearly the same, and that of the Sun itself only a fourth of the density of the Earth.

nature, and connected with it by its own peculiar tie. The resemblance is now perceived to be a true *family likeness;* they are bound up in one chain—interwoven in one web of mutual relation and harmonious agreement, subjected to one pervading influence which extends from the centre to the farthest limits of that great system, of which all of them, the earth included, must henceforth be regarded as members.'—pp. 2-12.

Resting upon these data, Sir William Herschel first suggested the following hypothesis of the construction of the heavenly bodies, which our author has incorporated into his work, and in describing which I conceive I shall best represent his own views by employing his own language:—

'Of nebulous matter,' he observes, 'in its original state we know too little to enable us to suggest how nuclei should be established in it. But, supposing that, from a peculiarity in its constitution, nuclei are formed, we know very well how, by virtue of the law of gravitation, the process of an aggregation of the neighbouring matter to those nuclei should proceed, until masses more or less solid should become detached from the rest. It is a well-known law in physics that, when fluid matter collects towards or meets in a centre, it establishes a rotatory motion. See minor results of this law in the whirlwind and the whirlpool—nay, on so humble a scale as the water sinking through the aperture of a funnel. It thus becomes certain that when we arrive at the stage of a nebulous star, we have a rotation on an axis commenced.

'Now mechanical philosophy informs us, that the instant a mass begins to rotate, there is generated a tendency to fling off its outer portions—in other words, the

law of centrifugal force begins to operate. There are, then, two forces acting in opposition to each other, the one attracting *to*, the other throwing *from*, the centre. While these remain exactly counterpoised, the mass necessarily continues entire; but the least excess of the centrifugal over the attractive force would be attended with the effect of separating the mass and its outer parts. These outer parts would, then, be left as a ring round the central body, which ring would continue to revolve with the velocity possessed by the central mass at the moment of separation, but not necessarily participating in any changes afterwards undergone by that body. This is a process which might be repeated as soon as a new excess arose in the centrifugal over the attractive forces working in the parent mass. It might, indeed, continue to be repeated until the mass attained the ultimate limits of the condensation imposed upon it.

'If these rings consisted of matter nearly uniform throughout, they would probably continue each in its original form; but there are many chances against their being uniform in constitution. The unavoidable effects of irregularity in their constitution would be to cause them to gather towards centres of superior solidity, by which the annular form would, of course, be destroyed. The ring would, in short, break into several masses, the largest of which would be likely to attract the lesser into itself. The whole mass would then necessarily settle into a spherical form by virtue of the law of gravitation; in short, would then become a planet revolving round the sun. Its rotatory motion would, of course, continue, and satellites might then be thrown off in turn from its body in exactly the same way as the primary planets had been thrown off from the sun.'

'The nebular hypothesis, as it has been called, obtains a remarkable support in what would at first seem to militate against it—the existence in our firmament of several thousands of solar systems, in which there are more than one sun. These are called double and triple stars. Some double stars, upon which careful observations have been made, are found to have a regular revolutionary motion round each other in ellipses. This kind of solar system has also been observed in what appears to be its rudimental state, for there are examples of nebulous stars containing two and three nuclei in near association. At a certain point in the confluence of the matter of these nebulous stars, they would all become involved in a common revolutionary motion, linked inextricably with each other, though it might be at sufficient distances to allow of each distinct centre having afterwards its attendant planets. We have seen that the law which causes rotation in the single solar masses, is exactly the same which produces the familiar phenomenon of a small whirlpool or dimple in the surface of a stream. Such dimples are not always single. Upon the face of a river where there are various contending currents, it may often be observed that two or more dimples are formed near each other with more or less regularity. These fantastic eddies, which the musing poet will sometimes watch abstractedly for an hour, little thinking of the law which produces and connects them, are an illustration of the wonders of binary and ternary solar systems.'—pp. 12–19.

This, then, is the hypothesis, or rather the series of hypotheses, of which the author of the *Vestiges of the Natural History of Creation* affirms that

'It is supported by so many ascertained features of the celestial scenery, and by so many calculations of exact

science, that it is impossible for a candid mind to refrain from giving it a cordial reception, if not to repose full reliance upon it, even without seeking for it support of any other kind.'—p. 19.

And here, indeed, one cannot help admiring the extraordinary indifference with which the author appears to regard the mighty work of creation, the happy readiness with which he admits the explanations of phenomena, hitherto wont to be considered as the most stupendous evidences of supernatural agency that the human mind is capable of conceiving. The construction of spheres, the formation of systems, the establishment of firmaments, are nothing in his estimation but mere matters of routine, flowing out of conditions so natural and easy that they have only to be related to be received.

'The nebulous matter collects around nuclei by virtue of the law of attraction. The agglomeration brings into operation another physical law, by force of which the separate masses of matter are either made to rotate singly, or, in addition to that single motion, are set into a coupled revolution in ellipses. Next, centrifugal force comes into play, flinging off portions of the rotating masses, which become spheres by virtue of the same law of attraction, and are held in orbits of revolution round the central body by means of a composition between the centrifugal and gravitating forces.'—p. 23.

Everything conspires to facilitate the transaction. The powers of Nature are let loose—the heavenly machinery is set in motion—the wheels go round—the plastic material assumes the inevitable forms, and worlds are turned off like peg-tops, and planets and

satellites flung about with such promptitude and profusion, that Nature herself seems to weary of the sport, and

'Panting minds toil after her in vain.'

But this, it may be said, is no argument against the validity of the hypothesis. Ridicule is not reason, and many seeming absurdities have, nevertheless, eventually turned out to be true. I acknowledge the force of the allegation and bow to the reproof. It would, indeed, be arrogance to suppose, that what confessedly great men have received and delivered for truth could be discredited by derision, or set aside by an empty blast from the trumpet of scorn, however skilfully applied. Whatever our own sentiments may be, it is due to the name of Sir William Herschel, and, in his name to the whole scientific world, so largely benefited by his researches, to assign better reasons for dissenting from a theory that has the sanction of his authority, than any which are founded upon mere surmises, or pretend to no higher character than a balance of probabilities equally or nearly equally distributed on either side. Nothing, in short, but substantial evidence of its insufficiency can be expected to satisfy the exigencies of the case. And this evidence I shall proceed to extract by a rigorous examination of its details, *step by step*, as they are assumed to have occurred, so far as the description which is afforded of them will permit us to deal with them upon fixed and certain bases.

The course, then, which I have elected to pursue in this inquiry, presents to our consideration the

following events in the following order of their occurrence:—The occupation of space with the elementary particles of matter—the establishment of nuclei in the body of this elemental mass—the concentration of the nebulous particles into these nuclei by the force of gravitation—the rotation of the bodies so produced by the confluence of the nebulous fluid—the separation of a portion of the outer surface of these revolving masses in the form of rings—the disruption of these rings—and the subsequent recomposition of their fragments into separate spheres, answering to the planets and satellites of our own system, by the conditions of which, I conceive, it will be most advisable to regulate the conduct of our inquiries.

1. With regard to the primary condition of this scheme, the original occupation of space with the elementary principles of matter, considered simply in the light of a *possible* state of things dependent upon the Divine will, I do not well see how it could reasonably be contested. Regarded as a question of *fact*, there does not appear to be any grounds of evidence by which it is capable of being sustained. That matter originally existed in a nebulous form, diffused throughout space, is a position which rests entirely upon the proof of the nature of those appearances, termed *nebulæ*, which at one time were considered as patches of diffused luminous matter, but which recent discoveries have shown to be merely clusters of stars, *apparently* so closely packed together as to produce at this distance the impression of a continuous effect. That this has been found to be so in all cases, I do

not mean to assert. Some of these patches of light are so remotely situated as to have hitherto defied the power of the instruments, by which they have been discovered, to resolve them into their component parts. But this is only what is to be expected where the phenomena are not limited to any definite locality, but are hypothetically assignable to the whole range of that portion of space which we can suppose to be the theatre of material existence. If stars are admitted to occupy all space, it cannot be but that every new improvement in the quality of the telescope will discover some which shall present the same appearance to it, which others nearer present to the naked eye or instrument of weaker power; and consequently fresh *nebulæ* will ever come in to take the place of those which a more accurate survey will have removed out of the same category.

Now the argument to which the consideration of this state of things is alone calculated to give rise, is, I contend, decidedly fatal to the conclusion that any such thing exists at all as the condition of matter, properly termed *nebulous*, upon the hypothesis of which the theory before us is entirely based. If a succession of like effects are found to follow a succession of like operations, I believe there is no argument more conclusive than that the repetition of the same operation, differing only in the scale of magnitude, would, if it were to be tried, exhibit a repetition of the same effect. If upon a succession of trials with instruments of different capacities, a succession of so-called *nebulæ* are discovered, and upon each occasion the

nebulous result of the previous trial be shown to be a delusion by the more perfect scrutiny of that which succeeds, are we not justified in concluding, or rather, would we be justified in *not* concluding, that, had we an instrument as much exceeding in power the best now existing, by which the newest examples of the phenomena in question have been revealed, as *that* surpasses all that have gone before, we should discover that these also are but delusive appearances like the rest—that, in fact, there is no such thing in nature as a nebula at all? And thus the whole theory of nebulous diffusion falls to the ground; for apart from this, there is not anything that can reasonably be referred to as evincing a testimony of such a state of things having ever prevailed*.

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* It is interesting to remark how this reasoning has been illustrated, and its conclusions confirmed, by the observations with the gigantic telescope of Lord Ross, which has just been completed. In Sir J. South's letter to *The Times*, in the month of April last, giving an account of the first experiments with that stupendous instrument, he observes, "The night of the 5th of March was, I think, the finest I ever saw in Ireland. Many nebulæ were observed by Lord Ross, Dr. Robinson, and myself. *Most of them were*, for the first time since their creation, *seen by us in groups or clusters of stars;* whilst some, at least to my eyes, showed no such resolution." "The most popularly known nebulæ observed this night were the ring nebulæ in the *Canes Venatici*, or the 51st of Messier's catalogue, *which was resolved into stars* with a magnifying power of 548; and the 94th of Messier, which is in the same constellation, and which *was resolved into a large globular cluster of stars*, not much unlike the well-known cluster in Hercules, called also 13th Messier." "On subsequent nights, observations of other nebulæ, amounting to some thirty or

2. Admitting, however, what it would be impossible absolutely to deny, the pre-existence of the original elements of matter in a state of diffusion throughout space, subject to the will and by the appointment of the Almighty, the first position in respect of it which claims our attention, as assuming to be the result of the operation of a natural law, is the establishment of nuclei, or centres of agglomeration, in the body of this elemental mass, by virtue of a 'peculiarity in its constitution,' the nature of which we are, however, left to conjecture. After what has already been stated upon the subject of the operation of uniform laws upon uniform materials, it will be sufficient, upon this head, merely to observe, that the conditions assigned to the premises are distinctly opposed to the conclusion which they are here assumed to support. The condition of matter diffused throughout space is confessedly a condition of perfect uniformity, identical in its circumstances all throughout. The laws of nature are equally uniform in their operation under the same condition of circumstances. But the establishment of nuclei is directly opposed to these conditions. It supposes a something somewhere which is not everywhere else—a

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more, *removed most of them from the list of nebulæ*, where they had long figured, *to that of clusters;* whilst some of these latter, but more especially 5 Messier, exhibited a sidereal picture in the telescope such as man before had never seen, and which, for its magnificence, baffles all description." And yet we may fairly venture to predict that its success in the resolution of old nebulæ will only keep pace with its performance in the discovery of new.

condition of matter, or an operation of laws, in the *locus* of every nucleus which belongs to it alone, by which it is distinguished from the rest of space not so affected; contradictory hypotheses which it is not possible to reconcile. Had not the author been more solicitous to exclude the co-operation of the Deity than to secure the foundation of his scheme, he might have avoided the objection to which this particular condition of it is thus shown to be liable, by including it in the same category with the preceding, assignable to the Divine decree. As it stands, upon the basis of natural cause and effect, it is an assumption decidedly fallacious and absurd.

3. In order, however, to be enabled to continue our examination according to the plan proposed, it will be necessary to admit, for the sake of argument, here as elsewhere, the existence of conditions which I shall nevertheless assume to have previously disproved. With this understanding, then, conceding the question of the formation of the nuclei, we proceed to the consideration of the next step in this great chain of events—the concentration of the nebulous element, and its incorporation with the established nuclei 'by the force of gravitation.' Notwithstanding the confident manner in which this transaction is related, and its own apparent plausibility, yet am I prepared equally confidently to maintain, that it is a proceeding which never could have taken place in accordance with the principles and premises set before us. The state in which the elementary particles of matter are represented to be

originally existent is that of a highly rarefied and elastic vapour, abundantly charged with caloric, by the repulsive agency of which it is presumed to have been maintained in its diffusion. That this is the light in which the author desires to have it regarded, is evident from his own description. 'We cannot doubt,' he observes (p. 30), 'that the nebulous form of matter was attended by the condition of a very high temperature. The nebulous matter of space, previously to the formation of stellar and planetary bodies, must have been an universal fire-mist—an idea which we can scarcely comprehend, though the reasons for arriving at it seem irresistible.' And a few pages after, referring to these observations, he repeats,—'We have seen reason to conclude, that the primary condition of matter was that of a diffused mass, in which the component molecules were probably kept apart through the efficacy of heat.'—(p. 40).

I shall not stop to canvass the accuracy of this representation—to inquire what might or could have been the real constitution of the elemental material preliminary to its reduction into its present forms; but taking it according to the author's own account, it is, I conceive, physically demonstrable that its consolidation or agglomeration into masses of superior density could never have been effected by the force of gravity, or any other natural force that we are aware of, or can conceive employed under the circumstances assumed. For every such act of consolidation, admitting the possibility of its occurrence,

would be accompanied by the disengagement of the caloric of fluidity at the focus of condensation, the consequence of which would be the *expansion* of the mass; which is a result contradictory to the conclusion it is intended to establish*.

Had the author, instead of adopting a source of tension for the particles of his elastic fluid that involved the hypothesis of present heat, assumed a repulsion founded upon electricity or some other such agent, real or imaginary, to which no such consequence attached, still, would he not have avoided the objection arising from the contradiction of the premises—namely, the *attraction* of gravity and the

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* To explain this more at large. The fluidity of a fluid depends upon its *latent* caloric, and the elasticity of an elastic fluid is proportioned to its *sensible* caloric. By condensing an elastic fluid you disengage its *latent*, and consequently augment its *sensible* caloric (or temperature), and thereby increase its *elasticity;* which is a condition *contradictory* to the result in view. Gravitation (which is only another name for the weight of the body), could therefore never occasion the consolidation of an elastic fluid, because the effect would be to superinduce that condition which is contrary to the operation of the cause itself. For example: Could the atmosphere be condensed into the earth by its own pressure, however indefinitely increased? No. The moment we suppose such an operation to commence, the temperature of the atmosphere must be supposed to be raised, and therefore its own pressure (the only force concerned), proportionally diminished. And this is a *reductio ad absurdum*, the force of which cannot be evaded by reference to any faculty of dissipation assignable to the heat so disengaged, as by radiation, which could not begin to operate until *after* the event had occurred, for the occurrence of which it is intended to provide.

repulsion of heat—so long as we had suns and stars to look to, the accredited representatives of the nuclei themselves, into which, according to his own admission, (most strangely at variance with the reasoning to which it is allied), has been concentred all that excess of temperature which 'was once diffused through the whole system,' and which we are therefore called upon to believe was actually condensed *simultaneously* with the very fluid whose solidification was to be the consequence of their *disunion.* Upon the whole then, in whatever light we regard the constitution of the nebulous element, whether as existing in the state of gas, or of vapour, or of ultimate atomic subdivision—whether maintained in its diffusion by the agency of caloric, or of electricity, or of any other force, known or unknown, the fallacy of the hypothesis of the creation of the masses by its agglomeration into nuclei by the force of gravity, is equally ascertained.

4. Waving, however, the right to insist upon this conclusion, and consenting to admit the possibility of the event assumed, our attention is next directed to the establishment of the first principles of motion in the rotation of the elemental mass, occasioned by the confluence of the particles towards their respective centres of attraction; from which first principles, as we have already observed, all the motions of the heavenly bodies are presumed to be deduced. This, as indeed it is one of the most imposing, so is it one of the most important of the various positions which enter into the constitution

of the theory we have here proposed for our consideration. The phenomena of the motions of the heavenly bodies, next to, if not, in truth, even yet more than their actual construction, have hitherto been wont to be regarded as indisputable evidences of the working of a Divine will. The complexity of their character, the recondite nature of the principles and conditions involved, and the symmetry, stability, and perfection of the results, immeasurably distancing the possibility of chance, have ever seemed to bespeak the immediate agency of a great First Cause.

According to the theory before us, however, all these are but the necessary effects of natural causes —the development of a simple principle, described as 'a well-known law in physics,' in accordance with which, 'when fluid matter collects towards or meets in a centre, it establishes a rotation;' and for the illustration whereof we are referred to certain terrestrial phenomena, ranging in dignity and magnitude from the mighty whirlpool of the ocean and its congener of the air, to humble eddies and the water sinking through the aperture of a common funnel. Upon the grounds of this law, and supported by these analogies, the simple tendency of the particles of the nebulous vapour towards its presumed focus of condensation is made accountable for the elementary rotation of the whole mass, afterwards continued among the parts of the system into which it is subsequently supposed to be resolved.

Confining our observations to the development of

a rotation in the original nucleus by the confluence of its constituent particles, it is an assumption, I hesitate not to say, based upon a principle no less fallacious than are the analogies by which it is assumed to be sustained. For, first, with regard to these analogies, it requires no very profound examination to perceive that they present no resemblance whatever to the circumstances of the case with which they are brought into relation. They are in fact no analogies at all. The examples quoted are, in the first place, all of them examples of fluids moving in *one* and the *same* plane, as from the periphery of a *circle* to its centre. In the supposed case of the construction of the celestial masses, the tendency of the nebulous fluid is from all quarters, as from the surface to the centre of a *sphere.* And this alone, without going any further, would, I humbly conceive, be justly sufficient to set aside any conclusion which might be sought to be deduced from the consideration of the one to the definition of the other. There might be reasons why a rotation might be the consequence of a current so disposed as that the determination of *all* its force was in a direction coincident with, and favourable to the establishment and continuance of that rotation, and yet no reason why the same result should follow a condition of confluence in which the tendency of a *few* of the particles only was favourable to that result, while that of all the rest was equally powerfully disposed to favour a rotation in any or every other direction.

There is, however, yet another distinction be-

tween the examples adduced and the case they are designed to illustrate, by which the relation of the one to the other is yet more essentially disproved; namely, that in all those of the former which have any real bearing on the case, (that is, that are really examples of fluids tending towards a centre,) the impact of the particles at the focus of confluence is *not in the direction of the centre of gravity* of the focal mass, whereas in the latter it would be. This difference, the importance of which to the present argument all who are acquainted with the first principles of physics will at once appreciate, arises from a difference in the character of the forces occasioning the confluence, by virtue of which the current in the former cases is diverted from its original direction in the moment of impact, while in the latter it remains the same. In all the examples referred to, the confluence of the particles (by which the rotation is effected) is the result of a force altogether incommensurate with the means provided for its dissipation. Thus, in the case of water sinking through an aperture, or of cold air rushing in to restore the equilibrium of density in the atmosphere, disturbed by a local excess of temperature (constituting, as it is now generally explained, the phenomenon of the whirlwind), the pressure of the superincumbent mass of the respective fluids, which is the determining or active cause of their confluence and the measure of its impetuosity, is a given force, entirely independent of and vastly disproportionate to the means provided for the escape of the particles after they have reached

the focus; the consequence of which is, that they arrive with an impetus which there is no power to dispose of but by a *resolution* in which they can all concur, which is none other than a rotation about the common centre of escape. But in the supposed instance of the construction of the heavenly sphere, this is not the case. Here every particle is impelled towards the centre of gravity with a force which is exactly equivalent to, as it is indeed no other than, the *demand* itself, and the conclusion whereof is, therefore, a *neutralization* of effect, and not a *resolution*, from which no result in motion can ensue; for when two exactly equal forces concur from opposite quarters, the consequence of their impact is *nil.* Just the same result would be elicited in the case of the terrestrial elements referred to, if the same relation of equality were preserved between the force of the confluent particles and the means provided for their escape. To exemplify this in water, merely invert the experiment of the funnel, and instead of allowing the fluid to escape by *descending*, cause it to *ascend* by means of a syringe. Here we shall have a case exactly analogous in its conditions to that of the supposed construction of the heavenly sphere; the force by which the confluence is produced is exactly equivalent to, as it really is, the demand, and the consequence will be seen—no rotation will ensue.

With respect to the other cases adduced, such as the dimples in gentle streams, and, on a larger scale, the whirlpools in the sea, together with the eddies in the air, occasionally perceptible by their action upon

light substances, they are literally not cases in point at all. The phenomena of rotation which they exhibit are not the results of a confluence towards a centre, the fluid in which they are produced being in a state of direct progression; but are entirely owing to peculiarities in the bed or channel over which they flow. To the same local causes are likewise *solely* to be attributed those appearances of revolution round each other which these dimples or eddies occasionally display, and to which the author refers for the illustration of the 'wonders of binary and ternary systems' in such arcadian terms that one can scarcely help regretting they should have been so unfortunately misapplied.

And thus much for the analogies, which I should not have dwelt upon so largely but for the strong conviction that it is to these, their apparent plausibility and familiar occurrence, that the favourable reception of the whole theory is in a great measure to be ascribed. As to the *principle* of the argument, it is equally fallacious with the analogies by which it is sought to be supported. There is literally no such '*law* in physics' as that referred to. It is a physical *fact* that, under certain circumstances, fluids tending towards a centre will generate a rotation; but it is in the *circumstances* and not in the expression of any general *law* that we shall apprehend the result, whether it will be a rotation or not. Now the circumstances under which such an event will ensue are simply those upon which we have just been commenting—namely, an identity of plane in the ten-

dency of the confluent particles, and a diversion of the impact from the direction of the centre of gravity of the focal mass—both of which are conditions foreign to the case which is the object of our present consideration.

5. The question of the establishment of the first principles of rotation in the primordial mass being thus, I trust, satisfactorily disposed of, the next stage of the proceeding to which our attention is directed is the separation of a portion of its external surface in the form of a ring, preliminary to its being thrown off and recombined into an individual sphere; an operation by the periodical recurrence of which at stated intervals, according to some hitherto undiscovered but confidently asserted law of refrigeration, the planetary and astral systems are alleged to have been produced. Referring to the description of the author (p. 14), the mode in which this result is supposed to be effected is by the incrustation or solidification of the outer surface of the nebulous fluid, in a state of rotation, occasioned by a reduction of temperature.

'If we suppose the agglomeration of a nebulous mass to be a process attended by refrigeration or cooling, which many facts render likely, we can easily understand why the outer parts, hardening under this process, might, by virtue of the greater solidity thence acquired, begin to present some resistance to the attractive force. As the solidification proceeded, this resistance would become greater, though there would still be a tendency to adhere. Meanwhile, the condensation of the central mass would be

going on, tending to produce a separation from what may now be termed the *solidifying crust*. During the contention between the attractions of these two bodies, or parts of one body, there would probably be a ring of attenuation between the mass and its crust. At length, when the central mass had reached a certain stage in its advance towards solidification, a separation would take place, and the crust would become a detached ring.'

Now this is a process which, equally with the preceding, I believe to be susceptible of a distinct physical disproval. For, limiting ourselves simply to the question of the incrustation of the nebulous mass by reduction of temperature, without regard to any particular form it may be supposed to assume, what authority I would ask, is there for this reduction of temperature?—and where are we to look for it?—in the mass itself or in the empty space beyond it? Most assuredly in neither, so far as the conditions of the case are concerned, but quite the reverse. The process of focal agglomeration, to which we are most strangely referred for the determining cause of this result, is a process which, I have already had occasion to remark, is essentially attended with the most copious evolution of *caloric*, by which the temperature of the condensing body and all about it becomes necessarily and almost indefinitely augmented. Now this process we have assumed to be established, and vigorously carrying on in the very heart of the nebulous accretion, and its consequences in the continued elevation of its temperature is a fact which cannot be doubted or

misunderstood*. What the *real* temperature of space may have been, any more than that of the material itself, are questions with which we have here no concern: our dealing is simply with the fact of its *reduction*, by means of which alone the substance of the nebulous mass could have been brought into a condition different in one part from what it was in another, or in any part from what it was before; conditions implied in the terms of the hypothesis before us. To this reduction the essential circumstances of the case are, as we have seen, diametrically opposed: consequently, so far as *a priori* reasoning can carry us, we are compelled to believe that no such solidification could, under the circumstances, have accrued.

6. Reserving, however, the question of the possible incrustation of the nebulous fluid in the way prescribed, another step brings us to the consideration of the form in which these imaginary incrustations are represented to occur. And here we cannot help remarking how singularly one paramount misconception appears to have pervaded the whole train

* It is no avoidance of this conclusion to refer to external radiation; as a hasty view of the case might be likely to suggest. Radiation could never *reduce* the temperature of a body that has the source of heat in itself. The utmost it could do would be to keep it uniform. It could only carry off the heat as fast as it was generated. But here, by the condition of its creation, the temperature of the mass is always *increasing*. Radiation, therefore, in order to *reduce* the temperature, must proceed at a more rapid rate than the disengagement of the caloric; it must carry off the heat faster than it was generated.

of reasoning by which this wonderful scheme of creation is connected and explained. From some cause or other, which can only be ascribed to the influence of a prepossession in favour of some fancied analogy, like those by reference to which the rotation of the primitive nuclei is attempted to be accounted for, the author of these descriptions seems to have been all along labouring under the impression that he was dealing with *flat circular planes*, and not *solid spheroidal masses*, which is the form that, under the circumstances, the nebulous element would really affect. In the present instance, this perversion of reasoning has led to the adoption of a *ring* as the resulting form of the incrustations presumed to be occasioned by the refrigeration of the external strata of the nebulous accretion. This, however, is a complete oversight. We are really treating of spherical or, more properly, spheroidal masses, and not circular planes, the outer surfaces of which would not be rings, but spheroidal shells, more or less oblate according to the rapidity of the rotation and the consistency of the revolving mass.

The absurdity of this notion becomes doubly assured when we take into consideration the kind of rings to which we are referred for an example. For what can be more unlike a superficial incrustation than the form of the rings of Saturn?—if rings they can be called that are flat circular *plates*, extending in the plane of his equator, having a thickness of only about 100 miles to a diameter of 204,883; resembling in form and disposition nothing more

exactly than a circular sheet of paper, with a hole cut out of the middle for the reception of the orb, of which the remoter edge is the only portion that ever could have formed part of the external surface of any mass out of which it can be supposed to have been eliminated. If the rings of Saturn must be described with reference to their production by the incrustation of the nebulous accretion, it is as a slice out of the centre, and not as any segment of the surface, that they would stand more properly represented.

7. Be the shape, however, what it may, the hypothesis of their disruption, according as it is related, and, indeed, implied in the terms of the theory itself, appears to be equally vague and impossible with the rest of the conditions by which we have seen it supported. In the first place, the want of uniformity in the constitution of these annular incrustations, to which the fact of their disruption is ascribed (p. 15), is of itself alone clearly insufficient to account for this result. So long as the ring continued to revolve unobstructedly, any inequality in its texture that was insufficient to have prevented its assuming the annular form would be equally insufficient to occasion the disunion of its parts. But the real truth is that, so far from a want of uniformity of structure being a rational ground of disruption, it is only by reference to such a condition of irregularity that the possibility of the existence of a ring is at all to be maintained. The truth of this assertion is beautifully illustrated in the case of the rings of Saturn;

the only body, be it observed, that presents us with an example of this, which we are here called upon to consider, the once universal condition of the heavenly spheres. "It is a singular result of theory," as a learned and accomplished lady has observed, "that the rings (of Saturn) could not maintain their stability of rotation if they were everywhere of uniform thickness; for the smallest disturbance would destroy the equilibrium, which would become more and more deranged, till, at last, they would be precipitated on the surface of the planet. The rings of Saturn must therefore be irregular solids, of unequal breadth in different parts of the circumference, so that their centres of gravity do not coincide with the centres of their figures*." With this consideration before us, have we not, then, a right to conclude, in the absence of any other assignable cause of their disappearance, that if rings had been the original condition of the planetary spheres, rings would still have continued to be the predominant condition of the planetary space? That instead of rings being the exception and that in *one* instance alone, and planets the general rule, planets must have been the exception and rings the general rule? And that, since such is not the case, since rings are not the predominant condition of the planetary space, but the solitary exception to the general rule, rings could not have been the original condition of the planetary spheres, and that, consequently, no such

* SOMERVILLE'S *Connexion of the Physical Sciences*, p. 81. Second Edition.

disruption of them, as we are here called upon to believe, has ever taken place?

8. We have now come to the last in order of the events, by the successive occurrence of which the 'formation and arrangement' of the heavenly bodies is assumed to be accounted for; namely, the recombination of the fragments of the broken annular incrustations into separate masses, answering to the character and circumstances of the secondary orbs of space. And this event is itself the representative of a variety of conditions equally imperative and abstruse. In the first place, there must be a concurrence. The scattered fragments must be re-collected into a common centre, and, as it is explained, by virtue of their own mutual gravitation. And truly this is a most marvellous occurrence, and one, for the reception of which we must, indeed, stretch our powers of belief to the utmost verge of their endurance. That a ring, investing the whole or by far the greater part of the whole solar system, thrown into a single nucleus, occupying and nearly filling the included area, should be broken up, and its fragments, escaping the paramount attraction of the central mass, should yet concur, and be collected together into a single orb at one side of it, appears so monstrous a speculation, that I can hardly think more than a mere representation of the circumstances can be required to refute it*. Taking

* The concurrence of the fragments of the broken ring would depend upon the origin of the disruption. If that were

the case of the rings of Saturn set before us as 'the living picture of the arrangement, if not the condition, in which all the planetary masses at one time stood' (p. 16), will any one, I would ask, contend that if either of these rings were now to lose its adhesion and be broken up, the fragments would coalesce into a single and separate orb? And if not, if these would not, as it most assuredly could not be imagined they would, what reasons can be assigned why we should come to a different conclusion with reference to the rest of the twenty-nine, which are alleged to have originally answered in all respects to the same conditions?

9. This, however, is but the simplest of the requirements which have to be fulfilled in order to the due production of the secondary orbs of space. It has already been observed, that the intervals of distance between the planets and the sun are regulated according to a scale of proportions, exhibiting an uniformity of increment as they recede from the centre, which the boldest sceptic would hardly be satisfied to refer to chance. For this regularity in the order of their recurrence, the author, doubtless upon the authority of the school which he represents, has assigned a reason which, at first sight, appears in some sort to weaken the force of the objection to which

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in the least degree violent, they would not preserve their original centrifugal tendency or force. They would either increase it, in which case they would be impelled farther into space; or they would diminish it, and be drawn towards the centre. In neither case would they coalesce into a single orb.

the consideration of this regularity is obviously calculated to give rise. The reason assigned is 'some law presiding over the refrigeration of heated gaseous bodies,' by which the stages whereat rings would be formed and detached would be regularly determined. 'We do not know any such law,' he very frankly avows; 'but what we have seen assures us it is one observing and reducible to mathematical formulæ.'—(p. 15.) It is much to be wished that the author had been liberal enough to have communicated anything that 'he had seen' that could have led him to this conclusion; if indeed by 'what he had seen,' he did not really intend to refer to those effects for the occurrence of which this law was intended to serve as an explanation. Passing over, however, such a specimen of reasoning, as would seek to account for physical effects by reference to causes, for proof of the existence of which causes reference is obliged to be made back again to the effects, we have ample evidence in the nature of the transaction itself and the character of the law, to justify a denial of any such law as is here so confidently asserted. And, first, with regard to the character of the law, *periodicity* in the operation of a natural law is a combination of terms essentially anomalous. A natural law is a quality of matter which can no more be suspended than matter itself can cease to exist. It is operating at all times and with the same force. It may be *resisted* and its sensible effects neutralised, but not by any exertion of its own. To admit of any variation of its effects, the *circumstances* must be

varied under which it is exercised; and to this variation it can no more conduce than it can to the variation of its action under the same circumstances*. If we cannot find a cause for periodicity in the circumstances, apart from the law, we can assuredly get none from the law itself. And for this periodical variation in the circumstances, neither has the author assigned any grounds, nor are there any in the conditions of the transaction, so far as we are furnished with the means of ascertaining.

10. But the existence of such a law is, moreover, directly contradicted by the facts represented in the scale to which reference is made for the elucidation of its alleged results. The peculiar character of this scale consists in the uniformity of the progression in which the differences between the relative distances of every two adjacent planets taken in succession, are shewn to increase, each being exactly twice that of the preceding. Thus the difference between the relative distances of Mars and the Earth is equal to twice the difference between those of Venus and the Earth, and one half of the difference between the relative distances of Mars and the next adjacent

* To make this clearer;—Gravitation is a natural power, (or law, in the sense in which that word is used in the text;) its action is incessant and universally equal under the same circumstances. It cannot be supposed to act *periodically*, or by fits, regular or irregular. Its effects, however, may be made to present periodical phenomena; for instance, the tides, which rise and fall at stated intervals. But this is not owing to a periodical action or suspension of the *law*, but to a periodical recurrence of circumstances.

interval beyond it; and so on. This uniformity, however, fails in respect of the difference between the relative distances of Mercury and Venus, which is just twice as much as it should have been consistently with the character assigned*. This deviation, I contend, is fatal to the presumption of a natural law. An exception is here proved to a rule founded upon a principle that admits of no exception; and the only conclusion that can be fairly come to is, that the rule is false†.

11. The evidence we possess of the non-existence of such a law is not, however, confined to a single exception to a solitary rule. The exigencies of a natural law are co-extensive with the sphere of its imputed operation. If such a law of periodicity prevailed as is here alleged, we should expect to find its results exemplified in the case of all the bodies sup-

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* See page 28, where the second line of figures represents the intervals alluded to.

† The argument here adopted requires a word or two of explanation. I am contending that the disposition of the planets cannot be accounted for by reference to chance, because of its uniformity; nor by reference to natural law, because of its irregularity. To relieve the argument from the effect of this contradiction it is necessary to observe, that the regularity which is conclusive against chance in favour of design, is far less rigorous than that which is requisite to sustain a natural law; as a slight consideration of the character of their respective principles is sufficient to evince. Design implies freedom of choice—natural law means a necessity. The fact of design may be inferred from any degree of regularity, however imperfect, which cannot *reasonably* be ascribed to chance. The establishment of a single exception is fatal to the hypothesis of a natural law.

posed to be produced by the same means—in the case of the satellites with respect to each of their primaries, as of the planets with respect to the sun. Here, however, the law fails, or rather a new one is substituted for it; if *law* that can be called which is only the expression of a regularity in the disposition of them, equally to be expected if they are to be regarded as the immediate work of Him who 'is not the author of confusion,' but of order and 'of peace.' —(1 Cor. xiv. 33.) How far I am borne out in this assertion will appear from the following Table of the relative distances of the satellites from their respective primaries in the cases of Jupiter, Saturn, and Uranus, which alone have them in sufficient number to admit of comparison:—

	Satellites.						
	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.
Jupiter.....	11·6	18·4	29·4	51·8	—	—	—
Saturn	12·0	15·8	19·5	25·0	35·0	81·1	236·6
Uranus.....	13·1	17·0	19·8	22·7	45·0	91·0	—

Whatever may be thought of this Table as indicative of the operation of a physical law, one thing is certain; it is conclusive against the operation of *that* law, by reference to which the uniform disposition of the planets is presumed to be accounted for.

12. But in truth, had we not been equally concerned to ascertain the absurdity of the author as the

fallacy of his system, we might have spared ourselves all this trouble to investigate the conditions of a law which, whether it exists or not, is totally inefficacious to explain the results upon which the present objection to the theory before us is founded. The regularity in the order of the occurrence of the rings, for which alone this pretended law of refrigeration would be competent to account, is not the regularity upon the observance of which I am now commenting, but the regularity in the order of the occurrence of the spheres into which these rings are supposed to have resolved themselves, and which regularity the law in question neither does nor pretends to explain. The establishment of such a law, admitting its efficacy to the fullest extent claimed for it, does in no way cancel the objection arising out of the consideration of the condition in question. It only removes it from one part of the proceeding to another; from the process of incrustation and disruption to the process of the re-combination of the fragments into a separate orb, occupying the same interval of distance as the ring from the destruction of which it is assumed to have been produced. Here it is that the true force of the objection lies; that we should have to believe that not only one ring, but a series of rings, successively encompassing the mighty nucleus of the whole solar system, should become broken up, and the fragments concur into separate orbs at exactly the same intervals of distance that were previously occupied by the rings themselves!

13. But this is not all. The *forms* of the orbital

courses of the heavenly bodies, and their *dispositions in space*, are equally definite with their *extents*, and involve conditions for which it is equally necessary to account. To the constitution of a given orbit another circumstance besides that of a given *interval* is required; namely, a given *direction of motion*. It is well known that when the parts or particles of which a body is composed have come together from different quarters, if the forces and directions of their previous motions be represented by a series of right lines taken in order, the body after concurrence will continue to advance in a direction and with a force represented by the right line completing the figure. It is also equally well known that, in order to the fulfilment of a given orbitual course, the impulse originally impressed upon the object must be exactly in the direction of a tangent to the orbit in which it is subsequently to move. But the number of directions in which lines can be drawn from any one point in the periphery of a given ellipse that shall not be tangential to it, are exactly two less than infinity—these two being those of the tangent itself in opposite directions — of which two one only will give the course in the proper direction. Now what we are expected to believe, and what is necessary to the truth of the hypothesis before us, is simply this; that out of that infinity of directions, the side of the figure representing the equivalent of the forces and directions of all the parts into which each ring became resolved, exemplified in the progress of the resulting body, did actually coincide with that *one;* and this

not in one instance only, but in every one which comes within the scope of our observation.

14. That the fulfilment of this condition cannot be accounted for upon the hypothesis of any natural cause, is clear from the exceptions to the rule observable in the case of the four minor planets occupying the interval between Jupiter and Mars, and also in that of the satellites of the planet Uranus, the plane of whose motions, it is satisfactorily ascertained, is at right angles to the ecliptic, or nearly perpendicular to that of the rotation of the planet itself. Had the four planets in question been produced in the manner asserted—namely, by the separate spherification of the fragments of one broken ring—and were the direction of the motion of all the planets the consequence of a natural law, or the effect of a natural cause, the direction of the motions of all must have been alike. This however is not the case, the orbits of these four bodies being in planes not only variously inclined to each other, but all of them unusually inclined to that of the ecliptic—the representative of the supposed plane of the rotation of the supposed original incrustation.

15. The same conclusion is even yet more strikingly exemplified in the case of the satellites of the planet Uranus, the plane of whose orbits is so disposed with respect to the plane of the ecliptic, as to make the directions of their courses appear almost, if not decidedly, retrograde. To account for this phenomenon, totally at variance with his theory of their production, the author has had recourse to the hypo-

thesis of a *bouleversement* of the primary (p. 9); a most unfortunate hypothesis which, if it were true, would only introduce another anomaly to be accounted for, without affording the least explanation of that for which it was devised. For if we were to suppose that the planet ever rotated in a plane that coincided with that of the revolution of the satellites (which is necessary to the connexion between them, which this explanation is intended to establish), it is clear we should only involve the planet in the same dilemma of a rotation at right angles to the ecliptic, equally anomalous and embarrassing with that which it is now sought to avoid. In order to be of any avail to the satisfaction of the argument, the *bouleversement* referred to should have been a *bouleversement* of the satellites, and not of the primary; and the question would then be as to the possibility of the occurrence of such a *bouleversement* as is here contemplated. For such events as these do not occur fortuitously, and the interposition of a special Providence is too clearly foreign to the whole design to be had recourse to upon this occasion; more particularly after it has been so sedulously excluded from every other share in the proceedings. These examples, I humbly submit, are quite sufficient to show that the directions of the primitive impulses of the bodies of space cannot have been the result of any natural law; but, if the theory of their construction here relied on be true, are attributable to chance alone.

16. But we have not yet exhausted the conditions which enter into the constitution of the true courses

of the secondary orbs of space. Stringent as are the exigencies of *interval* and *direction*, that of *force* is equally rigorous, and its fulfilment no less inexplicable by reference to any principles which the theory before us furnishes or suggests. We have already noticed the singular relation which exists between the rates of motion of the different members of the planetary system, by virtue of which each of them has a velocity of translation assigned to it, as definite and peculiar as any other of the conditions by which it is distinguished. This velocity is the result of that force which was impressed upon it at the moment of its creation or establishment as an independent body; that is to say, if the adopted hypothesis of our author be true, at the moment and in consequence of the coalition of the fragments of the broken ring, out of which it is supposed to have been constructed. It is of no avail, in explanation of this result, to refer to any law governing the condition of the parent mass; such as we have seen assumed to account for the regularity in the relative distances of the several orbs. The question is not (as the author seems to regard it, and as he has taken the pains of adducing the elaborate calculations of M. Comte to determine), what might have been the condition of velocity of the original mass at the several periods of annular incrustation and detachment; whether they corresponded or not with those of the orbs respectively supposed to be produced from them; but, how it has come to pass that, in the process of detachment, disruption, and recomposition, the same conditions

exactly should have been preserved—that not one iota of this wonderful relation of velocity to distance should have been compromised; and this, not in the case of one orb only, but in that of every individual planet and satellite whereof the system is composed.

17. One more condition yet remains to be noticed, as characteristic of the secondary orbs of space, for which the theory in question is bound to account. It is well known that all the heavenly bodies, which are sufficiently near to be definite objects of examination, are invested with a motion of rotation upon their own axes. For the establishment of this motion of rotation in the secondary spheres, no explanation whatever is either assigned by the author or deducible in any way from the principles of the theory he has undertaken to propound. The argument deducible from this consideration against the reality of his hypothesis becomes immensely strengthened, even to the extent of demonstration, when we reflect that this condition of rotation is itself governed by another condition—namely, that the direction of rotation is in all the same. This is a coincidence which I assert to be utterly inexplicable by reference to any natural causes, or the circumstances of the transaction as it is related; and for which, therefore, in the absence of any other assignable reason, we are compelled, as in respect of all the preceding conditions of concurrence, interval, direction, and force, to recur to mere chance. What this chance would be we have not indeed far to seek. Referring to this uniformity of

motion in the rotation of the orbs upon their axes, in conjunction with the like uniformity observable in their revolutions in their respective orbits, the author himself has cited the authority of Laplace (p. 9), to show that, had all these matters been left to accident, the chances against their being as they are would amount to no less than four millions of millions to one*!

18. Hitherto our investigations have been directed exclusively to the development of the conditions of a single nucleus—a unit and its fractions out of the great and indeed immeasurable sum of the celestial creation, which, by the terms of the theory before us, we are required to regard as composed of like units with our own, observing the same conditions, presenting the same phenomena, and in all respects answering to the character of the system with which we are connected. For the co-existence of these units this theory is equally bound to account; and this it undertakes to do with reference to the same machinery as that by the operation of which the production of each integral portion is assumed to have been effected. The pretensions of the theory have therefore to be further tested in respect of this requirement; and herein, if I mistake not, will it be found no less defective than it has

* I think this ought to have been stated *four millions to one.* At least I believe that is the term at which Laplace fixed the probabilities that the motions of translation and rotation in the bodies of the solar system were derived from an original common cause.

been proved to be in respect of those particulars which we have just had under our review.

It is obvious that a number of independent masses, freely suspended in space, and subject to the laws of gravitation, could not continue for any unlimited period of time without collision or coalescence, unless kept apart by the instrumentality of some other power equally general and efficacious. With a view to this obligation modern astronomers have adopted the hypothesis (first, I believe, suggested by the elder Herschel) that all the bodies of space are connected together in a system of revolution about one common centre; at least so we must understand it, if it is to be understood as embracing the whole universe, without which it is evidently an imperfect and nugatory speculation. This hypothesis, which, whatever may be thought of it, is yet the only one that has hitherto been proposed, our author has embraced, and assumes to explain in accordance with the principles upon which the rest of the scheme has been constructed. But these terms are essentially inconsistent. The establishment of *independent* nuclei, however they might be supposed capable of contributing to the production of the systems of which they were respectively the centres, could by no means account for, but is in fact opposed to, the conclusion of a *mutual* connexion, having reference to a common force. The only relation, agreeably with the hypothesis of universal gravitation, which the bodies of space can have to one another, whereby their tendency to

coalesce can be overcome, is a relation of motion; and to this the condition of independence is decidedly adverse. What is really wanted to establish this relation upon the basis of the '*nebular hypothesis*' is the common rotation of the whole nebulous mass in the first instance, by the institution of *one* primitive nucleus or centre of agglomeration, and the production of the different systems, astral as well as solar, from that original by a process of detachments, contrived in any way that shall account for the generation of a centrifugal tendency in the several parts. But this, as it is not contended for by the author, so is it inconsistent with the principles of his theory, and altogether unsupported by the experience of observation, so far as we are able to appreciate its results.

And now I have completed the analysis of that part of the *Vestiges of the Natural History of Creation* which relates to the theory of the 'formation and arrangement of the bodies of space.' I have traced the proceeding throughout all the stages of its development, as I may say, '*ab ovo usque ad mala;*' and I have pointed out what appear to me insurmountable objections against each and all the positions which it successively assumes. These objections, it will be seen, amount to eighteen; in other words, there are no less than eighteen distinct offences against the laws of nature, probability, consistency, and truth, with which this scheme stands charged; and from all of which it must be satisfactorily purged before it can lay claim to the

title of being even a *possible* mode of accounting for the phenomena which it professes to explain. I do not pretend to assert that all these objections are equally successfully maintained; but this I assert, that they are all founded upon strictly physical principles—that they are entirely independent of each other—and that if but *one* only of them should be effectually substantiated, the whole scheme falls to the ground.

With regard to those appearances of conformity or agreement between the circumstances of the case as they now are, and as it is alleged they would have been had they been produced in the manner and by the means ascribed, supposing that such an agreement does exist, a little reflection will suffice to convince us that, as an argument in favour of creation by natural law, against creation by the immediate act of God, it is literally of no avail. At the most it is but the elucidation of a result assignable by both to the same cause; namely, of an *order* in the works of creation, which, whether it be ascribed to the operation of the Divine laws or of the Divine word, is equally only an expression of the same Divine will. For is it at all surprising that the Almighty, when He summoned the worlds into existence, should have called them forth according to a certain plan? That, when He intended to produce a system, He should have made it systematic? Or that, when He ordained an order to the works of His word, it should be the same order that would have attended the operation of His laws?

Order and regularity are in truth no less essential attributes of God himself than of His laws. They belong to Him as a *Perfect Being* as well as an *Almighty* one, from whose perfection and power every irregularity that is not for a purpose, is a detraction. Regularity, even to the utmost extent of mathematical precision, is the *natural* character of the Divine working. It is that condition which we can alone suppose Him to affect without *special effort* and *intention.* With man, to work regularly or according to order, is the result of exertion and design. Irregularity is the natural rule, and order the exception. But with God it is exactly the reverse; order is the rule, and irregularity the exception. The former is the *inherent* quality, for the exemplification of which no reason needs to be assigned—it is the exceptional irregularity alone that requires to be explained.

So far, then, as the evidences of conformity or regularity extend, they certainly afford no support to the hypothesis of a creation by natural law. But I contend for more than this: I contend that the conditions of the system in both respects are much more consistent with the hypothesis of a creation by the special exercise of Divine power than by the uncontrolled agency of natural law; and this I do upon the grounds of those exceptions by which the integrity of that order and conformity is, more or less, occasionally interrupted. I have already observed that an exception is totally irreconcilable with the working of a natural law; but not so with the

working of a Divine will. And such exceptions are everywhere to be met with. The regularity observable in the conditions of the celestial creation is not that regularity which we have a right to expect from the operation of inflexible causes, but may very well consist with the working of that Power which does nothing in vain, and among the distinguishing characteristics of whose productions the extremes of uniformity and variety are equally prominently displayed.

GEOLOGICAL CONCLUSIONS. PRE-ADAMITE CONDITION OF THE EARTH.

I now pass on to the examination of the remaining sections of the volume, in which the same principle of natural causation is sought to be extended to the rest of the visible works of creation, and more especially to the production and conditions of subsistence of the various organic beings inhabiting the earth.

The first class of facts by reference to which this doctrine of an organic creation by natural law is attempted to be sustained, presents us with a statement of particulars respecting the primitive condition of the terrestrial globe and its pre-adamite inhabitants, professedly compiled from the researches of modern geologists, and intended to represent the actual state of that science according to the views of those by whom it has been reduced into its present form. It is not my intention to follow the author

through the mazes of a disquisition which occupies no less than nine out of the eighteen chapters of which the work is composed. To enter into anything like a sufficient examination of the evidence by which the views in question are really supported, and to point out the numerous errors and misstatements in respect of them into which the author of the *Vestiges* has been betrayed, it is to be hoped, by an insufficient acquaintance with the subject, would indeed require a volume no less capacious than that which I have undertaken to review. And this I the more readily refrain from attempting because I conceive the facts or assumptions themselves, in whichever light they may be regarded, are not such as it is at all necessary to dispute, in order to be enabled to determine the fallacy of the conclusions in aid of which they have been so elaborately adduced.

It is to be observed that the evidence in favour of creation by natural law, which the author of the *Vestiges* has had in view to establish by reference to these details, and the only one which by any construction they can be imagined to supply, is that which arises out of the consideration of a correspondence between the circumstances of the earth, constituting the conditions of organic existence, and the nature of the organic productions themselves, supposed to be evinced in the frequent changes in the one, and the concurrent adaptation to those changes in the other. Accordingly with a view to this conclusion it has been the author's aim, following the principles of the modern geology, to

represent the history of the world as consisting of a series of distinct dispensations, technically denominated 'eras,' brought about by a succession of modifications or changes in the superficial character of the earth, and concurrently signalized by the introduction of new and appropriate forms of life. What remains therefore for us to examine in that branch of testimony which is now before us, is whether this correspondence be really thus evinced. And in this examination I am perfectly willing to concede the question of the pre-adamite occupation of the earth with all its particulars of superficial modification and concurrent introduction of appropriate organic species, as far as they are required by the tenets of the modern school, or even as they are claimed by the author himself; so satisfied am I that, even upon these grounds, the argument in favour of the former hypothesis will be found of no avail.

Regarding, then, the fact of this correspondence —As organic life is to be the result of natural laws, requiring no further conditions of operation than their own free and unobstructed agency, (which is the whole substance of the qualification implied in 'the presence of favourable conditions of existence,') it will not be enough merely to show, in a general way, that certain modifications or changes have taken place in the circumstances of the earth, and that, concurrently with these modifications, and conformably with their general character, certain changes took place in the forms of organic life; which are points we have already agreed to consider

as established. Creation by natural law involves a *necessity for creation*, whenever the presence of favourable conditions, or (which I have observed to be the same thing) the absence of conditions unfavourable for its exercise, shall happen to permit. In order to support such a correspondence as is requisite to justify the hypothesis of a creation by natural law, it is absolutely necessary that the connexion between the creatures and the alleged conditions of their existence be without any exception, inevitable, invariable; that the conditions of existence shall never have prevailed without or apart from the beings to which they are presumed to give rise. If creation were assignable to an independent source, or assumed to be the result of a voluntary power, the conditions of existence might be supposed to prevail without a necessity for any creatures following. But when the conditions of existence are themselves the creative power, the creatures must follow as a matter of course; unless a cause may be supposed to exist without its appropriate effect.

In consideration of this characteristic, something more is required than what it has been agreed to admit upon the authority of the acknowledged principles of the geological science, as it now stands. A definition must be given to those principles which they have never hitherto been considered legitimately calculated to sustain. The changes which are assumed to have taken place in the superficial character of the earth, must no longer be regarded

in the light of mere modifications of pre-existing circumstances, the enlargement or extension of conditions of life, before partially or sparingly distributed, but as the sources of *entirely new* means of existence, by virtue of which each succeeding era was, *for the first time,* made *capable* of sustaining those new and appropriate forms of life, whose remains are the conventional evidences of what they were, and of the era to which they are to be referred. If these changes be not admitted to have this character, if the conditions of existence be not assumed to have *originated* in the several eras to which they are respectively assigned, but to have prevailed to however small an extent before, then would not the correspondence between the earth and its inhabitants be proved by reference to the fossilized memorials of the age, but the reverse. For looking to these memorials as the indications of what beings existed at the time, and assuming the earth to have been anywhere fitted for others, the adaptation of the species to the conditions of their existence would be actually disproved and the connexion between them really invalidated.

But this is a position which a very slight consideration of the facts and circumstances of the case, as they are admitted and set forth by the author of the *Vestiges* himself, will be sufficient to show could never be maintained with reference to any of the modifications to which our globe is assumed to have been subjected. Beginning with the earliest of the series in which the traces of organic life are stated

to have been discovered*, comprising the 'clay and grawacke slate,' and 'lower Silurian' systems, what is there I would ask, in the circumstances of the case, to authorize the conclusion that the earth at the time in question was not just as well fitted for the production and existence of the various tribes of marine animals belonging to the succeeding era as

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* Although I have declined entering into the consideration of the merits of the geological statement by which the author assumes to support his hypothesis of organic production by progressive developement, I must observe, once for all, that the evidence deducible from that source, fairly and properly represented, is decidedly adverse to the conclusion which it has been his design to draw from it. Thus, for instance, with respect to the earlier series of animals here alluded to, although, perhaps, it may be true that the *sub-kingdoms* discoverable in the 'systems' to which they are referred generally appear to bear out the idea of a gradually improved succession, radiata and mollusca occupying the inferior, and the first traces of fishes presenting themselves in the superior formation, yet any advantage derivable from that circumstance is more than overbalanced by the fact, of which the author makes no account, that among the *species* so discovered, no such order is observable; but, on the contrary, the higher species are found occupying the earlier, and the humbler species the later deposits of the systems in question. In the five bands or strata of different ages, of which the first era above referred to is composed, the species of mollusca and radiata occupy stations entirely contradictory to the order of their natural precedence; while the *first* species of fishes, (which make their appearance in the succeeding formation,) belong to the *very highest* genus of their class, the Cestracionts. The reader who may desire to pursue this investigation further into its details, will find the whole matter lucidly represented by an author, whose name alone is authority, in an article upon the same subject in *The Edinburgh Review* for the month of July in the present year, 1845.

for the specimens of the same class, to which its population, consistently with the indications of its remains, has been exclusively confined?

The only circumstance which is anywhere alluded to, by reference to which such a restriction might possibly be attempted to be explained—namely, the prevailing temperature of the globe—is clearly insufficient for the purpose; for even if it could be proved that the temperature of the earth was higher at the period in question than it has since become, (which is itself an hypothesis, and one of the most problematical,) still what is there to induce us to believe that the fishes of the second era were less suited to the temperature of the first, than those of the first to the temperature of the second, throughout which they both afterwards concurrently flourished without any apparent depreciation? Or that if the temperature of the first had been in the beginning too high to suit the natural character of the inhabitants of the second, it would not have suited them when that temperature had been reduced at the close, after a lapse of time, the duration of which it is left to the imagination to define?

Again, transferring our attention to the second stage in this supposed process of remodelling the earth, which has already been designated as the epoch of the extended domination of the subaqueous tribes, and having in view the approaching introduction of 'land plants,' the peculiar manifestations of the succeeding era, we come to inquire in what consists the distinction between these two epochs, by

reference to which the absence of the productions alluded to from the one, and their presence in the other, is held to be explained? And here, in reply, we are met with an hypothesis so absurd, that one can hardly imagine it was intended to be seriously understood; namely, the universal submersion of the earth during the antecedent ages of the world, and the appearance of dry land for the first time upon the occasion of the modification by which the latter of the eras in question was ushered in. But surely, in making this assertion the author of the *Vestiges* must have altogether lost sight of the conditions of the globe at the period which he had so short a while before been describing. It can require, one would think, but little knowledge of physics to be aware that, the quantity of water being fixed, the question of the total submersion of the earth at any particular time must be entirely dependent upon the actual irregularity of its surface. If by reason of such a condition this catastrophe is rendered impossible at present, (otherwise than by a miracle,) how much more certainly so must it have been at a time when those irregularities were in the extreme; when, according to the author of the *Vestiges* p. 50,) we are to imagine 'seas not less than a hundred miles in depth, however much more,' and mountains in proportion, while the quantity of water is admitted without question to have been uniformly the same?

With regard to the evidences in favour of such a position, whether adduced by the author of the *Vestiges*, or otherwise existent, it will be sufficient to

say, there are none of them that pretend to more than to establish the fact that all parts of the earth have been submitted to the action of the sea. But this is very far short of the attainment of the proof required. Water may have covered all parts of the earth in succession, without the whole having ever been submerged at once. In this instance, therefore, as in the preceding, I submit there is no assurance of any essential distinction between the circumstances of the two eras to which the total absence from the earlier, of the creatures peculiar to the later, could be satisfactorily referred.

And this assertion will be found to hold equally good with respect to the next change which is assumed to have taken place in the circumstances of the earth regarded with reference to the means of life. We have now arrived at what is called the 'carboniferous era.' Dry land is already supposed to exist. The appropriate vegetation has made its appearance; but no land animals are as yet destined to inhabit the globe. This is reserved for the succeeding era, technically termed the 'era of the new red sandstone.' To what is to be ascribed this delay? In what respect did the theatre of their existence differ at the one period from what it was at the other, by reference to which this otherwise anomalous deficiency is to be accounted for? The only semblance of an answer to this inquiry which is anywhere to be discovered in the pages of the work before us, is an hypothesis, rather ambiguously suggested, that as yet the atmosphere was

unfit for the existence of animals of a higher grade, by reason of the excess of carbonic acid, with which it is alleged to have been charged, and from which it is presumed to have been freed at the epoch in question by the agency of a vegetation whose alleged luxuriance is itself the reputed evidence of the condition asserted to have prevailed.

That the atmosphere was at one time impregnated with many foreign substances in a state of vapour is, indeed, highly probable; or rather, certain, if the accredited hypothesis of the original fluidity of the earth be received for truth. This, however, is a condition which, as it was occasioned by an exceedingly high temperature, so was it in a great measure only maintained by such, and consequently in the same degree must have ceased long before the earth had by cooling been rendered fit for the support of vegetable or animal existence. This would have been particularly the case with respect to carbonic acid, so far as lime and the other earthy, alkaline, and metallic bases could be concerned in its abstraction. The chemical affinities by which that gaseous compound is united with those bases come into operation at a temperature much above that of boiling water, in which no one will imagine the zoophytes and fishes of three successive eras to have been existent.

Whether the purification of the atmosphere (so far as it has been purified) was completed by this process, or whether any surplus of carbonic acid remained to be removed by other means, I will not

take upon myself to determine. But this I assert, that no proof of its existence or removal at the period under consideration is contained in anything which the author of the *Vestiges* has advanced upon the subject. For admitting, what is still questionable, and by many contradicted, that vegetation is beholden to the presence of carbonic acid in the air for its perfection, and that its natural operation would be to purify the atmosphere of that ingredient*, still I deny that any proof has been adduced of such a vegetation existing at the time as might be taken to warrant these conclusions. But two circumstances are anywhere alluded to in support of this opinion, neither of which I can perceive to be competent to this effect; I mean the superior magnitude of a few specimens of equisetacea, ferns, and other shrubs, over those of the same species at present existing, and the predominance of the coal-beds peculiar to that era, attesting the *debris* of the vegetable covering of the earth, out of which they are considered to have been formed.

But surely it is a most vague and unphilosophical mode of reasoning to assume a few straggling specimens of a few productions as a criterion of the general character of the organic tribes prevailing at the time. Almost as well might we argue for the superiority of the whole animal creation during the

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* The adverse opinion is maintained by Saussure, Ellis, Woodhouse, Senebier, Ingenhousz, and Scheele. Priestley, Professor Liebig, and Dr. Daubeny, are in its favour.

eras immediately preceding our own from the superiority in bulk of many of the mammalia attributed to those epochs whose remains attest their comparative dimensions; and certainly just as well might we now contend for the perfection of vegetable life in the jungles of Bengal over all the rest of the world at the present day from the superior magnitude of its bamboos, (the arundo Benghalensis,) which are just as much larger than those of the same species existing elsewhere, as the equicetacea of the carboniferous era exceed those of the present or any intervening dispensation. The mere discovery of a few specimens of extraordinary growth, *more particularly while the aggregate of the genera are only of the humblest of those we now have, and of no larger dimensions,* can never be regarded as evincing any superiority in the general character of the vegetable creation; and I confidently affirm would never have been imagined to do so, if it had not been for the suggestions of the theory itself which needed such a support.

As to the other branch of testimony referred to, in corroboration of the same position—the coal formations of the period—however they may be taken to attest the peculiar prevalence of the conditions favourable for the elaboration of the material, they are altogether insufficient to establish any advantage in respect of actual vegetation for the era to which they are ascribed, even over the comparatively degenerate age in which we now live. Admitting their extension to the utmost degree claimed for them, I entirely deny that they form a mass anything like in

magnitude what would accrue from the repetition of the same process applied to the forests and woods now existing, or which have flourished at any period since the commencement of the present era, including the peat marshes and bogs everywhere scattered over the surface of the earth, all of which would be available for the purpose if the requisite conditions for their conversion should happen to recur.

And this concludes all that I have to remark upon the subject of the distinctions between the several eras, attributable to the changes in the superficial circumstances of the earth, upon the grounds of which the limitation of the species to their respective epochs is held to be explained. With regard to the remainder of the series, comprehending some of the most interesting and important of the alleged variations in the succession of the organic tribes, there is literally not even the shadow of an attempt to establish, or even to point out the slightest difference by reference to which such a limitation could be accounted for. So far as anything appears in the arguments or statements of the author of the *Vestiges*, there is not the slightest reason why the organic inhabitants of the present age might not just as well have subsisted during any or all of the four preceding eras as in that to which they appropriately belong. Where then is the proof of the correspondence between the circumstances of the earth and the nature of its inhabitants evinced in these details, upon which the hypothesis of their creation by natural law is assumed to be established? We have already ob-

served that in order to support such a correspondence as is necessary to justify the inference of a creation by natural law, the connexion between the species and the conditions of their existence, must be taken to be without any exception. But such a connexion as this, so far from being proved by the events before us, has been really set aside; and with it falls to the ground the only evidence in favour of creation by natural law which the relation of those events was expected to supply.

GENERAL CONSIDERATIONS RESPECTING THE ORIGIN OF THE ANIMATED TRIBES.

Adhering, however, as might naturally be expected, to his own view of the case, the author of the *Vestiges* proceeds to deduce therefrom some general considerations in favour of a creation by natural law, which, although perhaps unimportant as direct evidences, yet as calculated to give a tone or character to the argument, from the truth of which I entirely dissent, I cannot pass over without observation.

Plea of Consistency.—It must be admitted that if a case could be satisfactorily made out, of absolute inconsistency with the Divine character in any particular mode of operation, it would certainly constitute a strong argument in favour of any other mode of operation by which that inconsistency would be avoided. Such a case the author of the *Vestiges* conceives he is able to make out against what may be termed the *vulgar hypothesis* of an original creation

by the special exercise of Divine power, by reference to the facts which the preceding geological investigations are supposed to have elicited, and from the objectionable consequences of which he proposes his own scheme of a creation by natural laws as the only rational mode of escaping.

The nature of this case will be best represented in his own words. After a general statement of the popular doctrine referring the creation of the progenitors of the existing species to the immediate act of God, he goes on to observe (p. 153),

'But how does this notion comport with what we have seen of the gradual advance of species, from the humblest to the highest? How can we suppose an immediate exertion of this creative power at one time to produce zoophytes, another time to add a few marine mollusks, another to bring in one or two conchifers, again to produce crustaceous fishes, again perfect fishes, and so on to the end? This would surely be to take a very mean view of the Creative Power—to, in short, anthropomorphize it, or reduce it to some such character as that borne by the ordinary proceedings of mankind. And yet this would be unavoidable; for that the organic creation was thus progressive through a long space of time, rests on evidence which nothing can overturn or gainsay.'

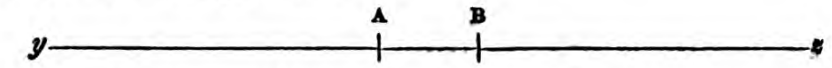
'It is also to be observed,' he goes on further to remark (p. 160), 'that the thing to be accounted for is not merely the origination of organic being upon this little planet, third of a series which is but one of hundreds of thousands of series, the whole of which again form but one portion of an apparently infinite globe-peopled space, where all seems analogous. We have to suppose that

every one of these numberless globes is either a theatre of organic being, or in the way of becoming so. This is a conclusion which every addition to our knowledge makes only the more irresistible. Is it conceivable, as a fitting mode of exercise for creative intelligence, that it should be constantly moving from one sphere to another, to form and plant the various species which may be required in each situation at particular times? Is such an idea accordant with our general conception of the dignity, not to speak of the power, of the great Author? Yet such is the notion we must form, if we adhere to the doctrine of special exercise.'

Now to me it appears that the mode of reasoning here adopted is founded altogether upon the very error which it is professedly intended to reprove; namely, an insufficient or improper estimate of the nature of the Divine Being. For is it not, in a much higher degree than the advocates of the vulgar hypothesis could be chargeable withal, to reduce to the standard of our own humble abilities, or to 'anthropomorphize,' as he terms it, the Creative Power, to conceive that it can make any difference in what manner soever it may be imagined to be displayed? God is infinite—infinite in all His attributes—the only Infinite in fact, possibility, or conception. To a Being thus distinguished, every interval of time or space, every exercise of power, as all the works of His hands, are necessarily alike in their proportions, all equally nothing; and *this*, not figuratively or metaphorically, but *absolutely;* for, however finite quantities may differ *inter se*, in respect of infinity they

are really all the same, equally devoid of assignable magnitude and proportions.

That this is so, is a fact, the force of which we cannot expect to be *felt*. It is indeed one of those stupendous truths which can only be known, but cannot be understood. Nevertheless, that it is a truth may be shown by reference to a very simple mathematical formula. Imagine a right line, *y*, *z*, extended *in infinitum*.



It is clear from the nature of infinity that any point bisects or divides an infinite right line into two equal parts, there being necessarily as much of that which has no end on one side of it as on the other. The two points, A and B, therefore indifferently bisect the line assumed. The portion B *z*, is therefore equal to the portion A *z*, each being one-half of the whole, notwithstanding the latter is equal to the former *plus* the quantity A B, which is therefore, in this relation to infinity, a quantity of no assignable magnitude, a mere mathematical point; and as this would be equally the case with any other portion of the same line short of the whole, it is clear that all parts bear the same relation to the whole—the relation of equal infinite insignificance. It only remains to observe for the benefit of unpractised readers, that what is true of linear dimensions is equally true of all other properties, attributes, or modes of existence which are capable of being represented in the same terms.

To object therefore to any particular scheme of creation upon the score of any superfluous trouble or unnecessary expense of power which it may appear to involve, is grossly to mistake the nature of the Divine subsistence; it is to confound things finite with things infinite—to assign limitations where there is no measure—to institute comparisons where there are no degrees. Referred to the same standard of infinite proportion, all emanations of the creative energy are seen to be coincident and co-extensive—all created things alike in their dimensions, and exigent of the like amount of power for their production. A man or a mollusk, a planet or a polype, a zoophyte or a universe are all of them, in comparison with their Almighty Author of equal *absolute* magnitude, and, except in so far as He may please to distinguish them, of equal worth. Whether they be created at once or in succession, whether in one place or different places, at the same or at various times, must be to Him a matter of the supremest, that is, of infinite indifference, and can never affect the question of their production, to whatever cause it may be assigned*.

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* How singularly different are sometimes the views entertained by different minds with respect to the same transaction! I cannot refrain from quoting a sentence or two of a discourse by an eminent minister of the Church, in which the agency of the Supreme Being in the work of creation and preservation is set forth in terms not more remarkable for their brilliancy than their truth. 'There is nothing more wonderful in respect to Deity than that universality of operation which is always

The Divine Foresight.—Equally unsubstantial is the argument in favour of creation by natural law founded upon the assumption that the doctrine of creation by special agency involves a detraction from the foresight of God, from the charge of which the former hypothesis is contrariwise asserted to be free (p. 156). This is indeed a most unfortunate alle-

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ascribed to Him. One grand distinction between the Infinite Being and all finite beings, appears to us to be, that the one can be working a thousand things at once, whilst the energies of the others must confine themselves to one work at a time.' 'And thus it is that the omnipresence of Godhead is that property, which, more than any other, outruns our conceptions.' 'It is not that God should be in the midst of this sanctuary, and that he should be ministering life to those gathered within its walls. It is, that He should be no more here than He is elsewhere, and no more elsewhere than He is here; and that, with as actual a concentration of energy as though He had no other occupation, He should be supplying our fast-recurring necessities; and yet that, with such a diffusion of presence as causes Him to be *equally* everywhere, He should superintend each district of creation, and give out vitality to each order of things.' 'It is an august and overpowering thought, that our God should be alike present on every star, and in each of its minutest recesses; and that, though there be a vast employment of the mechanism of second causes, there is not wrought a beneficial effect, throughout the boundless expansions of creation, whose *actual authorship* can be referred to anything short of the Great First Cause. It is a noble contemplation, though one by which our faculties are presently confounded, that of the whole universe hanging upon Deity; archangel, and angel, and man, and beast, and worm, receiving momentary supplies from the same inexhaustible fountain; and every tenant of every system appealing to the common Parent to preserve it, each instant, from destruction.' *Sermons*, by Mr. Melville, vol. i., p. 72-76. Fourth edition, 1840.

gation, inasmuch as, if I understand the author's meaning aright, it implies an objection that is particularly and solely applicable to the hypothesis it is intended to recommend. Taking it for granted that by 'foresight' is here meant that kind of knowledge of future events which is peculiar to the Deity as distinguished from man, then do I most confidently assert that such a kind of knowledge is not only not exemplified in, but is actually incompatible with the terms of a creation by natural laws. Foreknowledge may be distinguished into two kinds; the knowledge of events that are the necessary consequences of conditions already ascertained—and the knowledge of events that are not necessary, that may or may not happen so far as the conditions of their occurrence are concerned. It is evident that of these kinds of knowledge the latter alone is exclusively attributable to God. The former is a knowledge that is equally, though in a different degree, participated in by man, and indeed hardly deserves to be included in the same category. Thus, that the sun will rise to-morrow, that a stone dismissed from the hand will fall to the ground, are contingencies which any man may assume to predict without establishing any claim to a share in the Divine prerogative. Now, of this description precisely and of necessity, is the kind of knowledge which respects events that are the consequences of the operation of natural laws. Such events are, in the strictest sense of the term, necessities; and the prospective view of their occurrence, in the Author of their appointment,

can therefore never be deemed a proof of 'foresight,' in that sense of the word in which it is here understood. To have so constituted laws as to be productive of all the varied and wonderful consequences ascribed to them, (admitting this to be possible which, however, I shall hereafter take upon myself the responsibility of denying) may be regarded as an illustration of Almighty power, greater, it may be than what would accrue from the adoption of the theory of creation by special agency or decree. But in regard of the attribute of 'foresight,' it not only affords no evidence of it, but absolutely removes the only grounds upon which such an attribute could have been presumed.

Evidence of a Creator.—But the most extraordinary allegation to which the author of the *Vestiges* has had recourse in defence of his adopted theory, (p. 157), yet remains to be noticed. Will it be believed that it could ever be advanced as an argument in favour of creation by natural laws against the vulgar hypothesis of an original creation by the immediate *fiat* of God that, in adhering to the latter we disparage the testimony in favour of a Divine creator—we forego a proof of the existence of a Supreme Being which the former is pre-eminently calculated to supply? That absolute *materialism* should be regarded as more inductive of the existence of a God than the supposition of His own immediate agency appears a paradox so preposterous that I certainly should not have considered myself justified in setting about a formal refutation of it,

were it not for its constant occurrence among the arguments of philosophers of the present day in recommendation and defence of the same views. To me nothing appears more certain than that by recurring to the hypothesis of a natural causation, the strongest arguments in favour of the existence of a God, which reason apart from revelation is competent to supply, are virtually superseded.

For, in the first place, observe what it is in substance that we are called upon to believe in the doctrine of a creation by natural laws;—that all things have been produced by the exclusive intervention of the powers and properties of matter. In order then to divest ourselves of the necessity of believing in the existence of a God upon this hypothesis, (looking merely to the evidence which the works of creation are of themselves calculated to afford,) all that is requisite is to admit the belief that matter with its properties and powers, in essential connexion, may not have been created at all —that they are eternal; and the question then is, whether this is so obviously incredible a supposition that it could not possibly be entertained. In the case of the vulgar hypothesis no such alternative exists, no such proof is required of the original creation of matter. According to that view the existence of God is declared in His works, and would be equally so if the co-eternity of the material were to be allowed. But not so with the hypothesis before us. In this, the proof of the existence of a God resolves itself into the question

of the proof of the creation of matter; and it can only be upon the supposition that such a proof exists—that the creation of matter is either demonstrable or so self-evident, that its eternity could not be maintained or believed—that the latter theory can be said to vie with the former in its attestation of the existence of a Supreme First Cause. But that this is not so, that the independent existence of matter with its imputed properties and powers is a very possible thesis, is proved in the fact that wherever the light of the Christian revelation has not extended, such an opinion has ever, more or less, been found to prevail: and that, moreover, such an hypothesis is opposed to a belief in the existence of a God, is further shown in the fact, that, upon the basis of this hypothesis has been constructed every system of atheism which has ever been devised.

There is also another reason why the hypothesis of a creation by natural laws is particularly adverse to a belief in the existence of a God: namely, that it removes or weakens the evidence in favour of such a conclusion arising from the consideration of the analogous conditions of our own souls. Among the strongest impediments to the reception of a belief in the existence of a God in the minds of those who are unhappily disposed to reject it, is the difficulty of conceiving the possibility of a mode of subsistence so foreign to all our natural experience, and contradictory to all the principles upon which our notions of personality,—form, place,

and substance,—are wont to be constructed. Of the reality of this impediment, and the efficacy of its resistance any one may indeed convince himself by merely looking into his own mind, when he will infallibly perceive that, notwithstanding all his efforts to grasp at the assurance of a spiritual existence from the suggestions of natural reason, and even with the firmest persuasion of its truth from the instructions of revelation and the natural tendency of his own inclinations, the difficulty of accomplishing the notion of an *immaterial individuality* will still continue to baffle all his efforts to reconcile himself to its existence, and the more he considers the more he will be disposed to doubt. Under these circumstances, the most powerful, or rather, I should say, the only available resource for the alleviation of the difficulty, which nature apart from revelation is capable of affording, is the conviction that he possesses within himself an exemplification of the very mode of subsistence which he finds it so difficult to comprehend; that, besides the material structure of his frame, he has a soul which is immaterial, which partakes of the nature of the Being whose existence his ignorance of that nature alone or mainly inclined him to disbelieve. Of this resource it is the unquestionable effect of the adoption of the hypothesis of a creation by natural laws altogether to deprive him. Concerning itself entirely with the operations of matter and the powers of nature, (evidenced only, to us at least, in their connexion with matter,) the existence of a soul is a fact entirely

apart from its legitimate speculations, heterogeneous to its principles, which it neither contemplates, nor for which it is in any way competent to provide.

It is useless to contend against this, that the theory in question, although it does not make provision for such a purpose, yet leaves it open to believe in the endowment of a soul, if not through the same means by which it accounts for the creation of the body, by some other means which yet remain to be unfolded. The question is not as to the possibility of reconciling a belief in the existence of a soul with the principles of the theory alluded to, but as to the likelihood of such an inference conformably with the premises upon which it has to be constructed. What we are now considering is, the validity of the claims of the one hypothesis over the other, to favour a belief in the existence of a God, dependent upon its tendency to favour a belief in the existence of a soul; and the real question at issue is, whether a person having no other reason to believe in the existence of a soul but what the light of nature affords, would find most inducement or discouragement to the adoption of such an article of faith, from the consideration that he was produced simply and solely by the agency of the laws and properties of matter; and I leave it to any unprejudiced reader to decide, whether, under the circumstances, the probability is not rather that he would infer that he had *not* a soul, than that he would adopt the conclusion that he was really gifted with an addition to his material organ-

ization that had none of the properties of matter attached to it, that was no less opposed to the hypothesis of his construction than it was unnecessary in accordance with its principles and views. In respect, therefore, of this consequence also, I have no hesitation in saying that the hypothesis of natural causation is decidedly opposed to the reception of a belief in the existence of a Great First Cause.

Population of Space.—I cannot quit this part of the subject without protesting against the adoption of a conclusion which the author everywhere affects to assume as established, and upon which he relies for much of the apparent force of his objections to the doctrine of creation by the immediate act of God; I mean, the existence of other bodies in space in which the same phenomena of organization and life are presumed to be displayed. I have said, *apparent* force, because, from what has already been stated in contravention of those objections, it will be seen that no *real* aggravation of the difficulties of the case is involved in the admission of all that the author contends for or has assumed in the conclusion to which I am adverting. The character of infinity, by which the Almighty Creator of all things is distinguished from His works, places His relationship with all things upon exactly the same footing, however vast or however limited the quantity that expression may be taken to represent. Whether, therefore, we confine the creation of organic beings to the one globe wherein we perceive them to exist,

or extend it in hypothesis to any number short of infinity, can make no real difference so far as the character and attributes of God are concerned in the transaction. Nevertheless, as an assumption which, however irrelevant, is calculated to give a fictitious preponderance to the side of the argument in favour of which it is adduced, it is but right on the other hand to observe that there is not, nor ever has been conjectured, a tittle of evidence by which it can be sustained.

I admit at once that in assuming the earth to be 'third of a series which is but one of hundreds of thousands of series,' the author has done no more than avail himself of the current opinion of the present day. It has long been a favourite maxim with modern astronomers that the stars are but the luminous centres of systems answering in all leading particulars to that of which we ourselves form a part. How far they may be correct in such an opinion it is not for me to pronounce. But this I assert, and without fear of contradiction, that there is not the slightest particle of evidence, real or presumptive, circumstantial or direct, to warrant a suspicion that there is a single other habitable globe in all space besides the earth, except those belonging to the same system; nor of these any that are fitted for the occupation of organic beings of the same construction with those with which alone we are acquainted*.

* It is certain that the conditions of the secondary orbs of our system could not admit of animal or vegetable life in any

That the stars themselves are not habitable, is what no one pretends to deny; and nothing has ever been observed to induce a belief that there are any other bodies in space beyond the precincts of our own system, except such as are referrible to the same class.

This is not the place to enter into an examination of the reasons which have conduced to the establishment of the opinion now so currently received; yet I may be permitted to observe that none of those reasons are effectual to the support of any such conclusion. The necessity of assigning a higher purpose

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way resembling what we witness upon the earth. Very few of these bodies have any or *appreciable* atmospheres. In this respect Mars, Vesta, Jupiter, and Saturn, are deficient, as well as the Moon, and, I believe, the other satellites. Indeed, I imagine, it is impossible that an atmosphere of any appreciable density could ever be existent on these latter bodies, as they would most probably be deprived of it by the superior attraction of their primaries. Mercury, Venus, and Uranus, with the three remaining minor planets, are those only in which any atmosphere may be admitted to exist; and these are excluded from the list of habitable globes by the extremes of heat and cold by which they are characterized. The author seems to think that this objection could be removed by reference to the constitution of the orbs themselves (p. 31); that the density of the nearer and the internal heat of the more remote, may enable them to maintain an uniform temperature with the rest. But this is inadmissible; for (to say nothing of the fact that the density of Venus is about the same with that of the Earth), the conditions referred to are merely *temporary* ones. The temperature of Mercury, whatever his density, must soon have attained the equilibrium of his station by absorption, and that of Uranus and the rest by radiation, let their original supplies of heat have been ever so vast.

to the manifold bodies of space than what they appear to fulfil, and the inference as to that purpose drawn from the analogy of our own system, are a necessity and an inference for which there is no real foundation. Regarding the infinite nature of the Supreme Being, no one *material* purpose can be higher than another, nor any specimen of His works a rule whereby to judge of the remainder. If it should appear extravagant to suppose that the multitudinous host of heaven were created for the purpose of illumining and adorning the skies for the sole benefit of the smallest orb among them, we may rest assured that the extravagance would not be a bit lessened, the purpose of their creation would not be brought a bit nearer to the measure of the Divine character, by the assumption that every globe was the centre of light and ornament to a whole series of habitable spheres; and if in endeavouring to escape the former conclusion we should be led to take refuge in the latter, as the only mode apparently open to our conceptions by which the character of God could be reconciled with the evidence of His works, we should be adopting a conclusion, the probability of which is not in the least heightened by the analogy it affords with any other arrangement of which our experience has made us aware. The designs and devices of the Infinite One must be as infinite as His power to execute and His wisdom to conceive; and though nothing higher or nobler in the material world may come within the scope of our observation than what planets and planetary systems are calcu-

lated to display, He may have purposes to be developed in space beyond organization or even life, which the stars may be conjectured to subserve, without the necessity for our regarding them as the centres of systems, involving the collateral hypothesis of an apparently endless succession of habitable globes.

With regard to the subsequent conclusions of the author respecting the organic population of these imaginary spheres, and its identification with the species inhabiting the earth, it is not my intention to offer any remarks, founded as these conclusions are *exclusively* upon the hypothesis of the nebulous origin of matter, the more than apocryphal character of which I trust I have already sufficiently exposed*.

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* In a note by a correspondent introduced in the third edition (p. 40), mention is made of *meteoric stones*, as confirmatory of a common origin and character of matter throughout space. These stones generally consist of the same substance, 'an earthy material, having disseminated through its substance globules and small masses of iron containing nickel in the state of alloy;' and are claimed, 'as by common consent,' of an origin foreign to the earth. The absence of any *new element* in their constitution is the particular to which reference is made in support of this hypothesis. But the force of this conclusion is more than counterbalanced by the consideration that the elements they do present are always the same, and *those* only *a few* of the number with which we are acquainted. I would humbly venture to assert that the true philosophical inference which this consideration is only qualified to sustain is, that these bodies come all from the same place, and that this place is limited in its extent, or the nature of its ingredients; as for instance, a volcano in the moon, whence they may be supposed to be ejected, and thus brought within the sphere of

What force there might be in the argument deduced from the occurrence of the two ships at sea, (pp. 161, 162), the inferences which the crew of the one might be supposed to adopt with respect to the other when they first begin to heave in sight, it will be time enough to consider when we shall have seen the ship. At present we have seen nothing but an obscure appearance which, for aught we know, may turn out to be a mere log. It is more than the conditions of the analogy require of us, first to infer the ship and then to anticipate the nature of its contents.

With the remaining argument in favour of an analogous organic inhabitation of the bodies of space from the circumstance of the universal presence of light (p. 163), I shall deal yet more summarily. It is not true that 'where there is light there will be eyes;' in verification of which I need assuredly do no more than refer to the sun and stars themselves, wherein, although there is no question as to the presence of light, I believe it is equally agreed on all sides that there are no eyes.

And this concludes the list of 'general considerations respecting the origin of the animated tribes,' with which the author has thought proper to prepare the way for the introduction of those particular facts and observations upon which he relies for the fuller establishment of his hypothesis of organic creation

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the superior attraction of the earth. If they are to be regarded as *samples*, then, if anything, they prove that the composition of matter throughout space is *not* the same with what it is here.

by natural law, and the merits of which it is our next duty to examine.

PARTICULAR CONSIDERATIONS RESPECTING THE ORIGIN OF THE ANIMATED TRIBES.

Taking these considerations in the order in which they are related, our attention is first directed to certain crystalline productions, the resemblance of which to the phenomena of natural vegetation is assumed as indicative of a mutual relation between them, having reference to the agency of electricity as a common cause. The reasoning by which this conclusion is supported is so singular, and so truly characteristic of the general style of argument pervading the volume, that I cannot refrain from transcribing it at length.

'Crystallization,' he observes, 'is confessedly a phenomenon of inorganic matter; yet the simplest rustic observer is struck by the resemblance which the examples of it left upon a window by frost bear to vegetable forms. In some crystallizations the mimicry is beautiful and complete; for example, in the well-known one called the *Arbor Dianæ*. An amalgam of four parts of silver and two of mercury being dissolved in nitric acid, and water equal to thirty weights of the metals being added, a small piece of soft amalgam of silver suspended in the solution, quickly gathers to itself the particles of the silver of the amalgam, which form upon it a *crystallization precisely resembling a shrub*. The experiment may be varied in a way which serves better to detect the influence of electricity in such operations. A glass tube is to be bent into a

syphon, and in the bend is to be placed a small portion of mercury, not sufficient to close the connexion between the two legs; a solution of nitrate of silver is then to be introduced until it rises in both limbs of the tube. The precipitation of the mercury in the form of an Arbor Dianæ, will then take place, slowly, only when the syphon is placed in a plane perpendicular to the magnetic meridian; but if it be placed in a plane coinciding with the magnetic meridian, the action is rapid, and the crystallization particularly beautiful, taking place principally in that branch of the syphon towards the north*.

'Vegetable figures are also presented in some of the most ordinary appearances of the electric fluid. In the marks caused by positive electricity, or which it leaves in its passage, we see the ramifications of a tree, as well as of its individual leaves; those of the negative, recal the bulbous or the spreading root, according as they are clumped or divergent. These phenomena seem to say that the electric energies have had something to do in determining the forms of plants. That they are intimately connected with vegetable life is indubitable, for germination will not proceed in water charged with negative electricity, while water charged positively greatly favours it; and a garden sensibly increases in luxuriance, when a number of conducting rods are made to terminate in branches over its beds.

'With regard to the resemblance of the ramifications of the branches and leaves of plants to the traces of the positive electricity, and that of the roots to the negative, it is a circumstance calling for especial remark, that the

* This experiment with the syphon has been omitted from the later editions. Although I have included it in the quotation I do not vouch for its truth.

atmosphere, particularly its lower strata, is generally charged positively, while the earth is always charged negatively. The correspondence here is curious. A plant thus appears as a thing formed on the basis of a natural electrical operation—the *brush* realized. We can here see at least traces of secondary means by which the Almighty Deviser might establish all the vegetable forms with which the earth is overspread.' (p. 165—168.)

Of the resemblance which some crystalline productions bear to vegetable forms scarcely anybody indeed, *rustic* or *refined*, can fail to be aware; but I certainly question whether even the 'simplest rustic' ever thought of carrying out the resemblance so far as to imagine a common character between them. There is nothing in the whole range of philosophical reasoning more dangerous and delusive than the analogy of outward forms or visible resemblances. In the department of physiology above all others this is particularly the case. Organization is a matter entirely of structure and not of shape. The nearest approximation that can possibly be conceived, amounting even to *identity* of outward appearance, as in the case of a statue to the human form, gives not the most distant expectation of an approach to the nature of the object it is considered to represent. Were the resemblance, therefore, in the instances to which we are referred, even yet more striking than it really is, it would afford not the slightest grounds for the establishment of any analogy between them. Vegetable forms are not leaves and branches; but leaves and branches *of a*

certain structure, the character of which crystallization in *no form* has ever been imagined to display.

With regard to the influence of electricity in determining these forms, and the inference from thence in favour of the like effect in the case of natural vegetation, nothing can be more fallacious. In the first place, there is not a particle of proof that electricity exercises any influence whatever in determining crystalline *forms;* but on the contrary, strong presumptive evidence that it does not. This is shown in the fact that the process of crystallization is carried on with invariably the same result as to the *form* of the crystals produced, whatever be the electric condition of the solution from which they are precipitated. If crystalline *forms* were dependent upon electric action they certainly could not be produced alike under opposite conditions of the creative agent, or with the same results when that agent was deficient in the negative as superabundant in the positive conditions of the elements assumed*. The utmost that the example adduced, of the formation of the Arbor Dianæ in the experiment with the syphon, can be taken to establish is the fact, that electrity is favourable to the process of crystallization in *expediting its results*. But there is a vast difference between originating an effect and merely favouring it, between producing a form and merely facilitating its development; and that this is all that

* Crystalline forms seem rather to be dependent upon some quality of the ultimate atoms of which the substance is composed; perhaps, the *shape* of the integral particles themselves.

is done by the interposition of the electric power in the case before us is proved in the fact that the crystallization proceeds in exactly the same manner, though not in the same degree, whatever be the position of the vessel in which the process is carried on, and consequently whatever be the operation of the force to which it is subjected.

Equally futile is the attempt to extend this influence to the determination of the forms of plants by reference to the visible effects of the action of the electric fluid in certain cases, and its results in the promotion or obstruction of vegetable growth or life. What, for instance, can be more absurd than to assign a specific form to the action of the electric power from the mere consideration of its effects upon a given object? The form which electricity displays in its operation upon any material is owing to the nature of the material and not of the electricity, and can never be made the foundation of any conclusion as to its general effects. Admitting however that electricity had peculiar forms of action, and that these forms were susceptible of the distinction assigned to them, by virtue of which the positive could be said to represent the ramifications and the negative the radical structure of the plant, still this would afford no grounds for ascribing the production of these forms to the separate action of the fluid, however backed by the consideration that the general electrical conditions of the atmosphere and of the earth were respectively answerable to the same effects. If electricity is to be considered as the

determining cause of vegetable forms in the manner alleged, it must be so universally and not partially; it must be so in all vegetables alike and not only in a few. But this is certainly not the case. There are many plants whose outward forms deviate entirely from this rule, whose roots pre-eminently exemplify the expansive character of the positive and their superior extremities the bulbous nature of the negative: witness the whole tribe of mesembryanthemums and cacti, not to mention the many plants which grow entirely in the air, and consequently whose roots and branches have to be developed under the same electrical conditions, whatever they may be.

From the consideration of the influence of electricity upon vegetable life and growth nothing more conclusive is capable of being deduced. 'Electricity favours the growth of plants and sensibly increases the luxuriance of the soil.' But so does horse-dung or guano; yet no one ever thought the more on that account that either were instrumental in determining the form of the plants to which they might happen to be applied. The fact that 'germination will not proceed in water charged with negative electricity, while water charged positively greatly favours it,' is nothing more remarkable than any other case of mutual agreement or disagreement, and is only interesting from the curious inconsistency it establishes with the leading principle of the author's whole argument detailed in the adjoining sentence, where, in referring the construction of the roots and

branches of plants to the action of opposite electricities developed in the earth and in the air, the earth is stated to be always *negatively* electrified; so that the condition which in the one case is alleged to be unfavourable to vegetable existence, in the other is considered to be the source of life itself!

Elements of Organization.—Having disposed of the question of vegetable creation by natural law upon the grounds which we have just examined, the author transfers his remarks to the organization of the animated tribes, the conditions of which, as the more important subject of the two, occupy the principal share of his speculations throughout the remainder of the work. As a first step towards the establishment of that origin to which it is his design to refer their production, an attempt is made to determine a common fundamental form of all organic beings, identical with the rudimental particles of their material structure, and to show that these are such as the ordinary laws of nature, electrical and chemical affinities, are competent to produce. In pursuance of this design, it is observed that the material of all organized bodies is ultimately referrible to four simple elements—carbon, nitrogen, oxygen, and hydrogen; by the various combination of which are formed certain definite compounds, termed proximate principles, such as albumen, fibrin, allantoin, urea, &c., out of which all organic structure is immediately composed. This structure is described as consisting of what are called 'nucleated cells;' that is, of cells having granules within them, by the successive deve-

lopment of which, the contained granule escaping and becoming in its turn another nucleated cell, the mass of organic matter is supposed to be multiplied and enlarged. Into these nucleated cells, nutriment in the living animal is said to be converted before it is conveyed into the system, and assimilated with its substance. Between these nucleated cells and the ovum of the mammal tribes in the earliest stages of its growth, a certain resemblance is stated to be found; indicating, it would appear, a community of structure and of purpose, and leading to the inference that the full grown animal, constructed, as it is alleged, entirely of these nucleated cells systematically arranged, was originally a single one, subsequently augmented by successive developments after the manner above described.

These are interesting facts, no doubt, admitting them to be true. There is only one thing wanting to connect them with our present subject, and give them a paramount importance in the inquiry in which we are now engaged; and that is, some evidence that such a form of structure is capable of being attained by the operation of the ordinary laws of nature, independently of the laws of life. This desideratum the author assumes to supply by showing that *some* of the so-termed proximate principles, allantoin and urea, have actually been produced by artificial means, and that globules, such as he supposes those to be of which we have just spoken, have been occasioned in *another* of those principles, albumen, not hitherto so produced by the agency of the electric fluid.

With regard to the former part of this assertion, taking the account as it is given by the author, it by no means follows that any of these proximate principles have been produced as described; at least in that form in which they exist in and constitute part of an organic frame. It is of the utmost importance that the distinction here implied be properly understood. Organization, as we before had occasion to remark, is entirely a matter of structure, and not either of form nor of elementary composition. It consists in a certain disposition of parts, or fixed arrangement of rudimental forms, not dependent upon any inherent property of the substance or principles of which it is composed. Thus, for instance, an apple is an organic body which the simple possession of its elements could never enable us to construct. On the other hand, a ball of wax or tallow, though constituted immediately and exclusively of one of the proximate principles referred to, is certainly not organic. It has none of the characteristics of organization any more than a like ball of congealed water, which may be dissolved and reconstructed without any alteration in any of the features by which it is distinguished. Sometimes the rudimental structure is so very refined as to elude observation, and then it is very possible that substances of a similar nature and appearance may be mistaken for it; as we may suppose to be the case with respect to the proximate principles themselves, when existing in, or only simply removed from the animal frame, compared with such

imitations of them as art is able to produce, or as they themselves may become by subsequent treatment, as for instance by fusion, coagulation, solution, and precipitation, or the effect of partial decomposition by exposure to the air without the influence of vitality to counteract decay. Admitting, therefore, the artificial production of a substance exactly similar in all its chemical and mechanical properties, it by no means follows that such a substance has really been produced as any of these proximate principles in their relation with organic structure, or capable of answering the same purpose in the economy of the vital frame.

As to the production of the nucleated cells, or rudimentary globules themselves, nothing can be more fallacious than the evidence to which the author has referred in support of this position. 'That globules could be produced in albumen by electricity,' is what every one who is versed in chemical and electrical experiments is well aware of. But no analogy whatever exists between the inorganic globules thus produced, and the globules which are the alleged basis of organic structure and rudimental forms of life. Of this, indeed, the author appears to have subsequently become aware; and accordingly, in a note appended to this description in the later editions of his work (p. 176, Third Edition,) makes that acknowledgement, which had he done so in the first instance, would have saved us the necessity of noticing it at all.

Production of Shell.—Another argument to which

the author next refers in support of his hypothesis of natural causation, is the production of *shell* by artificial means, of which an interesting example is afforded in the incrustation upon the surface of the wheel used in bleaching establishments for rinsing cotton stuff free from the lime employed in its purification. But shell, although a natural production, is not an organic one. It is a mere mechanical composition, having none of the properties of organization any more than a crystal or a piece of talc; and nothing therefore can be inferred from its construction favourable to the conclusion which it is intended to illustrate.

Spontaneous Germination. — The next class of facts adverted to in defence of the same hypothesis, are the cases of plants and insects alleged to have been spontaneously produced. Several of these cases have indeed been so long before the world without requiring the interposition of new modes of accounting for their production, that it could hardly be thought much to affect the question either way, were we to leave them to that mode of explanation which has hitherto been deemed sufficient to satisfy the exigencies of the case upon the grounds of the ordinary doctrine of successive generation. The growth of plants where no seed has been expressly sown, as in the instances adduced of white clover upon the simple application of lime, and of mushrooms by the mere admixture of cow-dung and horse-dung, admitting them to be true, appear to be so reasonably accounted for by reference to the fact

of seeds lying dormant until duly awakened by appropriate conditions of existence, that nothing more seems wanted to relieve the argument from the weight of any doubt which such phenomena might be expected to interpose. Seeds, it must be recollected, are probably very plentiful in the ground at all times, and in all places; witness the quantity of weeds that spring up whenever occasion is allowed. Many are capable of transportation through the air by their own levity, others in the intestines of birds and other animals. Mushrooms especially seem to be of such a nature, as that the seed may well be supposed to pass through the intestines of the cow or horse, and being discharged uninjured, like many other seeds, with the alvine excretions, continue in their seminal form until excited to germination by the exhibition of the other fæcal matter, which, for aught we know, may be necessary to render the mass suitable for its development; as lime may be with regard to clover in fertilizing and adapting the soil.

Infusory Animalcules.—The same remarks, *mutatis mutandis*, apply to the production of insects in vegetable infusions, the appearance of which, without sensible communication, is thought to imply their aboriginal development in the liquid in which they are found. The difficulty of accounting for their existence has never been considered such as to necessitate this conclusion; and nothing could possibly accrue to the argument from allowing it to remain upon the same footing in that respect on

which it has hitherto so long been reposing. Previously to the experience of minute research which is peculiar to the science of the present age, it had been conjectured that the ova or first germs of living animalcules, and even the objects themselves in their earliest and simplest forms, were at all times largely diffused throughout the atmosphere, and of course present everywhere that a medium fit for their reception and further development might be found. Upon this ground the production of the insects in question was wont to be explained. And the accuracy of this explanation has since been fully confirmed by experiments, in which it has been shown that when the atmospheric air is excluded, or, more properly, when it is first made to pass through strongly heated tubes or through a fluid, such as sulphuric acid, which, without affecting its purity, would destroy all germs of animal life it might happen to have contained, animalcules do not make their appearance.

I confess I cannot see anything in the circumstance upon which so much stress is laid, of some of the creatures discoverable in infusions propagating subsequently by the division of their bodies, (after the manner termed, fissiparous); assuming even, which is certainly not true, that this is their natural and only mode of continuing their kind. The same way is surely open for the introduction of the fissiparous individual as for its ovum, and the same explanation which would have served for the one may well be considered sufficient to account for the

other. With regard to the invariable relation of the animalcules to the quality of the infusion, this follows as a matter of course alike upon either hypothesis of their production; the adaptation of the creatures to the conditions of their existence being equally necessary in both.

Entozoa.—A still stronger argument in favour of creation by natural law is alleged to be afforded in the consideration of the *entozoa*, or animals which are found exclusively within the bodies of others. Some of these are observed 'to take up their abode in the *viscera*, some in the chambers of the eye, some in the interior of the brain, the serous sacs, and other places having no communication (apparently) from without.' Some are stated to be *viviparous*, that is, producing their offspring alive, others *oviparous*, or effectuating the same result through the medium of eggs; and the question arises as to the manner in which they make their first appearance within the several bodies to which they are attached.

With the various modes of solving this question proposed by those who desire to reconcile these facts with the usually received notions of organic creation, we have nothing to do; our only object at present being to ascertain the comparative pretensions of a theory that looks to account for their production by reference to other principles. Does then the author of the *Vestiges* mean to allege that these creatures are produced in the several localities in which they are found by virtue of a law or laws ordained to that particular effect? That the combinations of matter

by which they are constituted are the results of the exercise of a power originally conferred by the Almighty upon the material elements, with a special view to their production, as we are instructed to believe is the case with respect to the other works of the Almighty, equally assumed to be the effects of natural law? Then do I say that I see nothing more extraordinary, nothing more inconsistent with the character of God, or consequently nothing more improbable, in the supposition that they were individually produced there by His own immediate *fiat*. If it can be considered consistent with the character of God to frame laws especially for the production of an insect in the chambers of the eye, by virtue of which laws such an effect ensues, it is surely as consistent with His character to create the insect itself without the intervention of an eternity-devised means for the purpose.

From the force of this comparison there is no escape for the advocate of creation by natural laws, except in the admission that those laws operate in creation by chance alone; that God did not construct His laws with a design that they should produce any particular results: an alternative to which I am sure the propounder of the views detailed in the volume before us could never accede. As for myself, of course, I equally reject them both. I am perfectly satisfied with the ordinary hypothesis of their production, although I may be unable with certainty to point out how in these particular instances it may have been carried into effect; and I

hold it to be much more rational, as well as philosophical, (the express declaration of the author to the contrary notwithstanding,) to adhere to this opinion which has the sanction of universal experience for its truth, and only a few dubious cases against it, than to give it up for another which has only the chance of these few cases for it, and the certainty of all that experience decidedly against it.

Independently however of these considerations, the existence of these creatures gives no help to the theory of the author of the *Vestiges* in respect of the explanation it is presumed to afford of their production. None of these animals are of a class that could be considered to represent the first efforts of unassisted nature in the development of the living form. On the contrary, many of them possess a highly complicated structure, and belong to a subkingdom, the articulata, which stands the highest but one in the arrangement of Cuvier, adhered to by the author himself*.

* A *new* argument, which the author describes as 'a more general, but more arresting one,' in favour of primitive production is subjoined in a note in the third edition (p. 185); being a quotation from the *British and Foreign Medical Review*, (January, 1845,) which it appears has signified its adherence to the doctrine of spontaneous generation in a favourable critique upon the work before us. I should have felt myself bound to notice this argument in the text, had I been able to comprehend it; but as I am not, I must console myself for the omission, with the author's assurance that, however *arresting*, it is 'not conclusively so;' which is a gratifying admission for those who may be limited in their apprehensions of it, like myself.

Subjunctive Creations.—But, to continue, there are other insects and even animals of a higher grade, the circumstances of whose existence, it is alleged, oblige us to assign to their creation a date posterior to that in which the rest of the organic species are generally supposed to have commenced. Such are an *hydatid* which infests the domestic pig, (and is supposed to be the cause of the disease in that animal termed the measles,) from which the wild animal is stated to be free—a *tinea* which attacks dressed wool but never touches it in its unwashed state*—a particular insect which disdains all food but chocolate—the larva of the *oinopota cellaris*, which lives nowhere but in wine and beer cellars—and, lastly, a creature called the *pimelodes cyclopum*, which is only found in subterranean cavities connected with certain specimens of the volcanic formation in South America, dating (it is imagined) from a time subsequent to the arrangements of the earth for our species.

But where, I should like to know, did the author derive his information that the several particulars with reference to which he dates the origin of the

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* The author is, however, mistaken in supposing that the *tinea* alluded to (of which there are more species than one,) is confined in its ravages to wool in the prepared state. It really exercises no preference in the case. If it appears less frequently in connexion with the undressed material, it is simply because the latter is seldom left to fulfil the conditions necessary for its occurrence. It is well known that the moth will not settle or deposit its ova in furs that are in use or liable to be disturbed.

several creatures connected with them, are modern compared with the commencement of the rest of the organic species? That 'the domestication of the pig is comparatively a recent event?' (p. 183.) That dressed wool, chocolate or wine, are not of primæval antiquity? Or that 'the time posterior to the arrangements of the earth' for the habitation of man, to which the production of the *pimelodes cyclopum* is assigned, was not yet sufficiently *anterior* to its occupation to allow of the animal in question having been produced along with the rest of the organic world? If he had consulted his Bible, he would have seen that the views of those who adhere to the ordinary hypothesis of organic creation, involve no such conclusions as are here relied upon. He would have seen that there was reason to believe that all animals were originally in a state of domestication, from which they deviated at the fall—that furs, most probably *washed*, were the first articles of dress worn by the progenitors of the human race—that all trees, and therefore, most probably, the chocolate among the rest, were produced before any insect or creeping thing—and that although wine is first mentioned in connexion with Noah after the flood, (a time, by the bye, when some persons* are

* See work by the late Earl of Rosse, upon the *Truth of the Christian Revelation*. The opinion, however, is not in strict accordance with the Scriptural account, which includes 'all creeping things' in the same category with the rest of the animal creation. See Gen. vi. 20; vii. 8, 14, 21, 23; viii. 17, 19.

inclined to think that a large body of the existing species, and particularly all land insects were reproduced,) yet there is nothing to deter us from believing that the grape was pressed for its rich treasures as early as ever there were hands to perform the operation. Not that I conceive the determination of these coincidences to be of the slightest importance as regards the question of creation by natural laws, in contradistinction to creation by the special exercise of Divine power. If, as I before observed, the purposes of God really demanded the production of these creatures, (and that they did is as much a part of the one hypothesis as of the other), it was just as competent and reasonable for Him to have introduced them severally at the epochs of their respective necessities, as to have provided for their appearance by an additional qualification of His laws especially conferred upon them at the original period of their appointment.

Electro-Chemical Experiments.—But one more, the last in point of order, though, as is usual in similar disquisitions, the first in point of repute, remains of those particular considerations upon which the author chiefly relies for the support of the hypothesis he is preparing in the next chapter more exactly to disclose. I allude to the experiments of Mr. Crosse, which created so much sensation a few years ago, in consequence of the announcement of the production of a supposed unknown species of insect as one of the accompanying results.

'Mr. Crosse,' it appears, 'was pursuing some experiments in crystallization, causing a powerful voltaic battery to operate upon a saturated solution of silicate of potash, when the insects unexpectedly made their appearance. He afterwards tried nitrate of copper, which is a deadly poison, and from that fluid also did live insects emerge. Discouraged by the reception of his experiments, Mr. Crosse soon discontinued them; but they were some years after pursued by Mr. Weekes, of Sandwich, with precisely the same results.'

'The changes undergone by the fluid operated upon, were in both cases remarkable, and nearly alike. In Mr. Weekes' apparatus, the silicate of potash became first turbid, then of a milky appearance; round the negative wire of the battery, dipped into the fluid, there gathered a quantity of *gelatinous matter*, a part of the process of considerable importance, considering that *gelatin* is one of the *proximate* principles, or first compounds, of which animal bodies are formed. From this matter Mr. Weekes observed one of the insects in the very act of emerging, immediately after which, it ascended to the surface of the fluid, and sought concealment in an obscure corner of the apparatus." (p. 185—187.)

In order to exclude the possibility of the development of the insects from any pre-existing germ of life, every precaution, it is stated, was taken, that ingenuity could devise.

'The wood of the frame was baked in a powerful heat; a bell-shaped glass covered the apparatus, and from this the atmosphere was excluded by the constantly rising fumes of the liquid, for the emission of which there was an aperture so arranged at the top of the glass, that only these fumes could pass. The water was dis-

tilled, and the substance of the silicate had been subjected to a white heat.' (p. 189.)

Whether and in what respect these precautions might be considered sufficient to satisfy the exigencies of the case, or what merit is due to the several explanations, in conformity with the generally received doctrine of organic creation, which were proposed at the time, or have since been suggested in the same design, it is not my intention to examine; satisfied as I am that, in the terms of the experiment itself, taken as it is related, there is enough to set aside the conclusion which has been drawn from it in respect of the aboriginal creation of the insects which are stated to have been produced*. We have already had occasion to observe that the material structure of all organized beings, is constituted of certain proximate principles ultimately composed of four simple elements, carbon, nitrogen, oxygen and hydrogen, in certain definite proportions. No matter what its size or importance, no animated creature is known to exist without realizing in its material construction these elements, into which, as its essential principles, its body is ultimately resolvable.

To this rule, as partaking of the general nature,

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* I ought to premise that the insect in question is by no means a *new* production, or of a species 'heretofore unknown' as the author imagines and describes it (p. 190), but a rather common animal, the *acarus horridus* (so termed from its bristly appearance), which is to be found in all places where rubbish is allowed to accumulate without disturbance, and consequently a very frequent denizen of the studio or the laboratory.

the insects under consideration are, of course, equally amenable. And these creatures are stated to have been produced in a solution of silicate of potassa by the agency of the electric current. But the elements of a solution of silicate of potassa are exclusively silicon, oxygen and hydrogen; of which the two latter alone are of the number of those which constitute the animal material. Whence then did these aboriginal types of the organic creation obtain the elements of carbon and of nitrogen, which we are bound to suppose equally present in their construction? Will it be said that these creatures are exceptions to the universal rule, and exhibit in their framework those of the four elements only then present, oxygen and hydrogen? To say nothing of the fact that no solid combination of these two elements has ever yet been produced, it is one of the features of the experiment upon which the largest share of consideration is bestowed, that the appearance of the insects in question was preceded by the production of a quantity of *gelatinous* matter; one of the proximate principles, the constitution of which equally involves the whole of the four elements alluded to. I shall not stop to anticipate the various modes by which this unexpected intrusion of the two most material elements of organic matter might possibly be explained; although in truth, if the terms of the experiment were duly adhered to as described, any explanation must be at variance with the truth. It is enough for my purpose that *some* faculty of entrance must be allowed for the un-

welcome elements; and by *that*, whichever it may be, I claim the right of assuming the introduction of the individuals themselves.

HYPOTHESIS OF DEVELOPMENT OF THE VEGETABLE AND ANIMAL KINGDOMS.

We have now completed our examination of the several facts which have been adduced as attesting the probability of an original organic creation by natural law. Preliminary, however, to the final definition of the scheme, some further observations have been thought necessary with a view to the elucidation of the other branch of the hypothesis, the principle of progressive development, which yet remain to be considered.

Classification of Animals.—Notwithstanding the apparently interminable variety of organic forms with which the earth in all its different departments of water, land, and air, appears to teem, it is the result of modern observation that there is yet a very limited number of *models* to which the whole are capable of being ultimately referred. The views of Cuvier, with which in this particular those of the rest of the physiological world at present coincide, have limited these models to four; with reference to which the whole animal kingdom has been divided into four sub-kingdoms, named according to the peculiar characteristics of each, in the following order:—*Radiata*, animals whose parts are uniformly distributed around a common centre, as starfish, &c.;

Mollusca, pulpy animals, as cuttlefish, &c.; *Articulata*, jointed animals, as lobsters, &c.; and *Vertebrata*, or animals with an internal skeleton, as the *Mammalia*, &c., including man. With respect to these subkingdoms, the classes into which each of them are capable of being subdivided, and, finally, the several species which are comprised under each class, it is remarked that a certain gradation is perceptible, by virtue of which they are all in their several lines capable of being ranged in a regular order of succession, beginning with the most simple and advancing to the more complex. 'Starting,' to use the words of the author, (p. 192,) 'from the primeval germ, which, as we have seen, is the representative of a particular order of full-grown animals, we find all others to be merely advances from that type, with the extension of endowments and modification of forms which are required in each particular case; each form, also, retaining a strong affinity to that which precedes it, and tending to impress its own features on that which succeeds.'

This 'unity of (design in the) structure' of the organic tribes, is considered to be more particularly exemplified in what are called the 'rudimental organs;' that is, organs belonging to and employed for evident purposes in certain species, less fully developed or only represented by faint indications in others where they are not (apparently) required. Of these, instances are afforded in the fœtal teeth of the whale superseded at its birth by the baleen—in the traces of lungs in fishes, and of gills in some of

the mammal tribes*—in the internal appearance of the feet in serpents—in the (alleged) useless mammæ in the male human being—and the (supposed) unrequired process of bone in the male opossum, which is needed in the female for supporting her pouch.

Such curious features are said to be most conspicuous in animals which form links between various classes.

'As formerly stated, the marsupials, standing at the bottom of the mammalia, show their affinity to the oviparous vertebrata, by the rudiments of two canals communicating with the external surfaces of the viscera, which are fully developed in fishes, being required by them for the respiration of aërated waters, but which are not needed by the atmosphere-breathing marsupials. We have also the peculiar form of the sternum and rib-bones of the lizards *represented* in the mammalia in certain white cartilaginous lines traceable among their abdominal muscles. The struthionidæ (birds of the ostrich type,) form a link between birds and mammalia, and in them we find the wings imperfectly or not at all developed; a diaphragm and urinary sac, (organs wanting in other birds,) and feathers aproaching the nature of hair. Again, the ornithorhyncus belongs to a class at the bottom of the mammalia, and approximating to birds, and in it behold the bill and web-feet of that order.' (p. 194.)

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* I have stated this upon the authority of the author of the *Vestiges*, but I believe it to be entirely without foundation. No traces of gills, that I am aware, have ever been discovered in any of the mammal tribes, nor of lungs, properly so called, in fishes. The air-bladder, with which this organ is afterwards confounded, is not a type of the respiratory apparatus of the mammalia.

As a further illustration of the unity of design pervading the construction of the several sub-kingdoms, it is remarked that, various as may be the appearance of the analogous members in the different species, the same number and general arrangement of the parts are observable throughout. Thus we are informed, that—

'The giraffe has in its tall neck the same number of bones with the pig, which scarcely appears to have a neck at all. Man, again, has no tail; but the notion of a much ridiculed philosopher of the last century is not altogether, as it happens, without foundation, for the bones of a caudal extremity exist in an undeveloped state in the *os coccygis* of the human subject.'—'In the paddles of the whale and other animals of its order, we see the same bones as in the more highly developed extremities of the land mammifers; and even the serpent tribes, which present no external appearance of such extremities, possess them in reality, but in an undeveloped or rudimental state.'—'These facts,' the author concludes, 'clearly show how all the various organic forms of our world are bound up in one—how a fundamental unity pervades and embraces them all, collecting them, from the humblest lichen up to the highest mammifer, in one system, the whole creation of which must have depended upon one law or decree of the Almighty, though it did not all come forth at one time.' (p. 197.)

That all organic creation should appear to be formed upon one, or more properly, a definite number of models, supposing it an established truth, is, of itself simply, a fact that can afford no grounds for any conclusion whatever in respect of the mode

in which that creation may have been effected. Taking it for granted that it was the design of the Almighty that His works of a certain class should observe a certain uniformity of character, (and that it was so is proved in the result,) the mere fulfilment of that design can never be construed to favour one mode of operation more than another, supposing both to be equally available for the purpose.

The fact that all the objects in each class should be capable of being arranged so as to present the phenomena of a certain number of regular successions of forms, is a necessary consequence of the fulfilment of the design, and therefore liable to the same exception. A number of *different* things constituted upon *one* model *must* be susceptible of such a mode of arrangement, however they may be supposed to have been produced; and the individuals, or the species which they may be taken to represent, must, as a matter of course, exhibit some of the features belonging to each of the adjacent terms of the series, as in the cases referred to, of the struthionidæ and ornithorhyncus, connecting the classes of aves and mammalia.

That the resemblance between the objects standing next one another in the succession should be very strong, is merely a consequence, and a necessary one, of the *number* and *equable distribution* of the species, and has no reference to any other kind of connexion between them. If a number of chairs or tables be taken, for example, and arranged according to some order of magnitude or construction, the more the interval between the extremes is filled up

by the introduction of new ones, the closer will become the resemblance between those that are placed together, until the operation is stopped by the difficulty of inventing new forms sufficiently distinct to entitle them to a separate standing.

And thus it is with the classification of the organic tribes. The bounty of the Almighty has supplied them in such lavish profusion, that the whole interval from one extremity to the other appears, as it were, filled up; while the unity of the design confines the individuals to the one or a few definite lines, and leaves that road only open for classification, which embraces them all in one or more systems. Had it pleased Him yet further to have multiplied the species, adhering ever to the same designs, the only effect would have been to have closed up the intervals more completely, and to have given us a chain of classification in which the distinction of the terms would have been yet more refined. In that case, instead of wondering at the presence, in the ostrich, of members peculiar to the mammalia, or in the ornithorhyncus, of members belonging to the bird, we should have had races of beings so variously endowed with the properties of each, that we should have been almost or altogether unable to tell to which of the two classes to refer them. And all this without implying the slightest connexion between them in the way of cause and effect.

From these facts, therefore, of a parity of structure, uniformity of succession, and close resemblance

of adjacent terms, nothing can possibly be deduced to favour either hypothesis of creation beyond the other. The only question then, that remains for our consideration is, with respect to those peculiarities of structure, the 'rudimentary organs,' before alluded to, whether they are calculated to sustain the preference for that mode of production in support of which they have been adduced; which I have no hesitation in asserting they are not. For these things must be regarded in the light either of perfections or of imperfections, of things designed and serving a purpose, or of things undesigned and of no use. Upon the former hypothesis no reasoning is necessary to prove that their existence can infer nothing as to the mode of their production. Whatever God designed and had occasion to produce, the propriety of His producing by any assignable means can never be called in question. It is only, therefore, upon the grounds of their being imperfections, things needless and undesigned, that any argument could be raised with reference to the manner in which they were created. And in this light regarded, I really cannot see how it can possibly be deemed to be less inconsistent with the character of God, to suppose them to have been produced by the instrumentality of His appointed laws, than by His own immediate decree. In whichever manner they may have been produced, they are equally the productions of the same Power; and the same responsibility must attach to the Agent, whatever the instrument by which He works.

The only plea whereby the force of this argument can be avoided, is the plea of necessity—the assertion that the imperfections in question were unavoidable upon the hypothesis of a creation by natural laws; a plea, however, by which the cause would certainly be not improved. For what greater imputation could there be upon the character of God and the perfection of His power, than to allege that He was unable to have constituted His laws so as to work without defects? or what greater inconsistency than to ascribe to laws such wonderful powers as to have been sufficient for the production of all things, and yet deny them the little that would be necessary to qualify them for doing it right? And these are positions we cannot avoid assuming if we resolve to regard these peculiar developments in the light of things useless and undesigned; the only grounds upon which it has been observed we can attach any importance to them at all in an inquiry as to the mode of their production.

But the true probability is that these rudimentary developments are not the useless and imperfect productions in the light of which they have been considered. Whatever has been produced by the creative power of God, must be taken as an evidence of the *design* of God that it is so. To suppose it otherwise, would be to suppose the infinite attributes of God concerned in the production of things He had no intention to produce; which is too evidently absurd to be admitted. That God *intended* the production of anything is equally an unanswerable

argument that it is *required.* To suppose this otherwise would be to suppose the infinite attributes of God concerned in the designation of things for which there was no need; which is likewise an absurdity that admits no explanation. Whatever therefore exists by God's own creation, through whatever process accomplished, is itself an evidence that it is required—that it has a purpose to fulfil, of some kind or other—that it is an essential part of His design.

That we be unable precisely to ascertain this purpose is no argument whatever in bar of this conclusion. There are many things existing by God's unquestionable ordinance, for which no specific purpose has ever been discovered, but which are not the less on that account considered to have their use. The spleen, for instance, in the human subject, is an organ of undoubtedly vital importance; without it, no being possessing it could live, and yet no certain explanation of its purpose has ever yet been devised. And many animals of all classes, from the zoophyte to the mammal, and vegetables of every denomination exist, which perform offices in the economy of nature we have never been able to apprehend, but which we have nevertheless certain conviction they are destined to fulfil.

In judging of the purposes of God it is also necessary to bear in mind that all *finite* purposes must in His sight be of equal importance, the most (apparently) insignificant alike with the most elaborate and enlarged. We are not therefore to reject

an explanation of the use of any organ on the mere grounds that the purpose appears trifling or unworthy of a special exercise of power for its production. It can never be less worthy than no purpose at all; the alternative to which we should otherwise be obliged to have recourse. And thus the *mammæ* of the man, although useless for the purpose of lactation, may be well accounted for by reference to the adornment of his person; an office which every sculptor knows them to fulfil, and the importance of which will be readily appreciated by any person of taste who will only take the trouble of endeavouring to conceive the human form without them.

Nor are we to consider the object of any organ confined exclusively to its more appropriate and physical uses. It is essentially characteristic of the working of God as compared with that of man, that whereas the latter has to make many things conduce to one purpose, the former contrariwise makes one thing subservient to the fulfilment of many purposes. Thus, although the eye is expressly made to see, the brows to shade, the nose to smell, the mouth to taste, and the ear to hear, they are all made to contribute to the perfection of the human countenance, to give a character to the 'face divine;' nor, with such associations to guide us, should we for a moment hesitate to assign a like purpose to the contour of the chin or the colour of the cheek, though we may be unable to ascertain precisely any physical advantage to which that form or colour can be as-

serted to conduce. And so with respect to the rudimental developments under consideration, supposing there were no physical purposes which they could be discovered to subserve, should we be debarred from concluding that they might have a moral purpose to fulfil, even if it were no other than merely to preserve the character of uniformity which the Almighty has thought proper to impress upon all His works of the same class, and to attest the unity of the design in which they have been conceived? Upon the whole then, I submit that nothing whatever is deducible from the physical characteristics of the several species to justify the conclusion in behalf of which they are adduced.

Embryotic Mutations.—The next argument in favour of the successive development of the species is somewhat more imposing but not a whit more conclusive. It is founded upon the consideration of certain changes which the animal form is stated to undergo during its progress from the period of its conception to its final entrance upon the perfect state. The reliance placed upon these phenomena, and my desire to do justice to the author in a branch of his argument hitherto less familiarly understood, require a specification of its details, which I cannot give more briefly than by adopting his own descriptions*.

* The phraseology of this description is much altered in the later editions, but without any modification of the sense requiring special notice.

'It is,' he states, 'only in recent times that physiologists have observed that each animal passes, in the course of its germinal history, through a series of changes resembling the *permanent forms* of the various orders of animals inferior to it in the scale. Thus, for instance, an insect standing at the head of the articulated animals, is, in the larva state, a true annelid, or worm, the annelida being the lowest in the same class. The embryo of a crab resembles the perfect animal of the inferior order myriapoda, and passes through all the forms of transition which characterize the intermediate tribes of crustacea. The frog, for some time after its birth, is a fish with external gills, and other organs fitting it for an aquatic life, all of which are changed as it advances to maturity, and becomes a land animal. The mammifer only passes through still more stages, according to its higher place in the scale. Nor is man himself exempt from this law. His first form is that which is permanent in the animalcule. His organization gradually passes through conditions generally resembling a fish, a reptile, a bird, and the lower mammalia, before it attains its specific maturity. At one of the last stages of his fœtal career, he exhibits an *intermaxillary bone*, which is characteristic of the perfect ape; this is suppressed, and he may then be said to take leave of the simial type, and become a true human creature.' (p. 158, 159.)

These changes as regards the brain, more particularly of man, are thus concisely given from Fletcher's *Rudiments of Physiology.*

'It is a fact of the highest interest and moment that as the brain of every tribe of animals appears to pass, during its development, in succession through the types of

all those below it, so the brain of man passes through the types of those of every tribe in the creation. It represents, accordingly, before the second month of utero-gestation, that of an avertebrated animal; at the second month, that of an osseous fish; at the third, that of a turtle; at the fourth, that of a bird; at the fifth, that of one of the rodentia; at the sixth, that of one of the ruminantia; at the seventh, that of one of the digitigrada; at the eighth, that of one of the quadrumana; till at length, at the ninth, it compasses the brain of Man!' (p. 224.)

Similar changes, we are informed, are also displayed by the heart during the progress of its development.

'This organ, in the mammalia, consists of four cavities, but in the reptiles only of three, and in fishes of two only, while in the articulated animals it is merely a prolonged tube. Now in the mammal fœtus, at a certain early stage, the organ has the form of a prolonged tube; and a human being may be said to have then the heart of an insect. Subsequently it is shortened and widened, and becomes divided by a contraction into two parts, a ventricle and an auricle; it is now the heart of a fish. A subdivision of the auricle afterwards makes a triple-chambered form, as in the heart of the reptile tribes; lastly, the ventricle being also subdivided, it becomes a full mammal heart.' (p. 201.)

Perhaps it might be reckoned a sufficient answer to the whole of this argument, simply to continue the quotation just given from Fletcher's *Rudiments*, upon the subject of the fœtal changes of the brain.

'It is hardly necessary to say,' he observes, 'that all this is only an *approximation* to the truth; since neither is the brain of all osseous fishes, of all turtles, of all birds, nor of all the species of any one of the above order of mammals, by any means precisely the same, nor does the brain of the human fœtus at any time precisely resemble, perhaps, that of any individual whatever among the lower animals.'

With this qualification to the main fact upon which the argument is raised, we could hardly be accused of prejudice or precipitation, were we at once to reject as utterly unworthy of consideration, any train of reasoning that could be constructed upon so frail a support. A case which is built upon *resemblance* can hardly be said to have a standing at all when the resemblance itself becomes the subject of dispute.

And what has been here stated with reference to the brain is equally applicable to the other points of comparison, the animal itself in its totality, and the several organs of which it is composed. The resemblance is exactly of that vague and general description which is just sufficient to suggest the comparison, but totally disappears when any attempt is made to investigate the details.

That some resemblance should be found to prevail, is, in fact, no more than might naturally be expected. For in the first place it is to be observed that the comparison which is here implied, is not a comparison of the higher fœtus with the lower animal *in its perfect state,* but only with some form

of it at some indefinite period of its development. Thus it is not that the fœtus of the man at any time resembles 'the adult fish or the adult reptile, but only the fish or reptile *at a certain point in their fœtal progress*' (p. 212); which '*certain point*' is, however, only *any point* at which the resemblance may be thought to be most exact. And this comparison is, moreover, only a *partial* one. It is not pretended that at any time the objects are *entirely* alike,—that the fœtus of the one, if it could be transported into the womb of the other to which it is referred, could take its place as one of its legitimate offspring. Throughout the whole career of each, each has *its own* parts or organs in which the object with which it is compared is entirely deficient. It never at any time is other than the distinct and appropriate fœtus of the creature in whose womb it exists, or who administered to its production. The man born at the seventh month is not the more a digitigrade, whatever may be the construction of his brain; nor is he an ape, notwithstanding his *intermaxillary bone*, whenever he happens to be born at the eighth.

To what effect then this analogy, if it go no farther than to express a resemblance which is the type of no connexion, which serves in no way to identify the objects between which it is asserted to prevail? Is it that the force of the analogy consists in the *succession* of the resemblances? That a connexion is to be inferred, not because one object resembles the other, but because it goes through a *series of changes* corresponding with a *series of forms* that is

supposed to connect them both with a common origin? But this is only a necessary consequence of circumstances which we have already seen to be entirely independent of any such conclusion; namely, the uniformity of design in the construction of the animated tribes according to their type, and the number and equable distribution of the species connecting the extremes. We have already observed that all the species in each sub-kingdom, and consequently all the individuals of which they are composed, are constructed upon or referrible to a common plan, and that a graduated succession of them may be traced, proceeding from the small and simple to the larger and more complex. Is it then surprising, or is it not rather a matter of course, that each individual of them, avowedly constructed upon the same model and going through the same routine, should exemplify in its career all the forms by which the interval is filled up? We have a common progression conducted upon a common design. Is it wonderful that it should give rise to a common result?

There is, however, a decided objection to the hypothesis of progressive development as founded upon the consideration of the fœtal resemblances, according to the view of them propounded by the author of the *Vestiges* and those from whom his information has been derived. It involves a position, the negative of which is among the most established facts in physiology; namely, the unity of the organic type. There is perhaps nothing in the science more decidedly ascertained than that the forms of the

organic tribes are incapable of being represented by reference to a single type. It would occupy pages merely to recount the attempts which have been made to overcome this difficulty, or the controversies of which it has been the constant and fruitful source. It will be enough for our purpose to observe that after having exercised the ingenuity of almost all who have devoted themselves to the study of that branch of natural history to which the subject appertains, the attempt has at length been abandoned, and the world, by common consent, has accepted, and regards as final, the quadruple arrangement suggested by Cuvier, to which we have already referred. But this arrangement is entirely inconsistent with the view of the organic creation involved in the hypothesis of the development of the species according to the progression indicated by the fœtal changes of the brain and heart. In the early stages of the germinal history of the human subject, for instance, we find the embryo occupying the position of an *avertebrate* animal (p. 227), referred to the type *articulata* by the structure of its heart (p. 201), and to the *radiata* by that of its brain (p. 227). Now if this is to be taken as an evidence of its extraction, it must have passed from one type into another, and, in fact, through all the types; an hypothesis which is tantamount to a declaration that they are no types at all,—that there is in reality but one type. On this ground then also I reject the testimony of these germinal changes as affecting the question of the progressive development of the organic tribes.

Hypothesis defined.—The reader is now prepared for the enunciation of the hypothesis towards which the previous inquiries, as so many steps in the scale of communication, have been gradually conducting him. Bearing in his recollection what has already been stated concerning the *structure* of the organic tribes, (the 'nucleated cells,' the 'fundamental form of all organization,') and the alleged influence of electricity in the production of the globules in albumen and of the insects in the experiments of Mr. Crosse, he will not be surprised to learn, in the words of the author (p. 204), that 'the first step in the creation of life upon this planet was *a chemico-electric operation, by which simple germinal vesicles were produced;*' the nucleated cells before alluded to.

'This is so much, but what were the next steps? Let a common vegetable infusion help us to an answer There, as we have seen, simple forms are produced at first, but afterwards they become more complicated, until at length the life-producing powers of the infusion are exhausted. Are we to presume that, in this case, the simple engender the complicated? Undoubtedly, this would not be more wonderful as a natural process than one which we never think of wondering at, because familiar to us—namely, that in the gestation of the mammals, the animalcule-like ovum of a few days is the parent, in a sense, of the chick-like form of a few weeks, and that in all the subsequent stages—fish, reptile, &c.,—the one may, with scarcely a metaphor, be said to be the progenitor of the other*.

* The comparisons in the last sentences above, are omitted in the later editions, but without any reason assigned.

I suggest, then, as an hypothesis already countenanced by much that is ascertained, and likely to be further sanctioned by much that remains to be known, that the first step was *an advance under favour of peculiar conditions, from the simplest forms of being, to the next more complicated, and this through the medium of the ordinary process of generation.'*

In this description there is one feature which, as differing from the ordinary hypotheses of specific transmutation, requires to be more particularly noted. The object aimed at—the deduction of one species from another—is not, as in the only cases of organic modification referrible to the same principles with which we are practically acquainted, an effect brought about by imperceptible degrees, the consequence of the operation of a law that evinces itself throughout the whole course of the approach to its final accomplishment, but an effect that takes place, as it were, *per saltum*, the result of a power that appears to lie dormant through a certain number of terms, (supposed in reality to extend to thousands of years,) and then all at once displays itself in a complete change of character and form.

Progression of Numbers.—Of the operation of such a law there is an illustration, and a most specious one I grant it is, founded upon the character of the changes which take place in the succession of the numbers elicited during the revolution of the wheel in Babbage's calculating machine, extracted from the volume by that author, supplemental to the *Bridgewater Treatises.* I regret that the length to

which it extends prevents me from laying it before the reader in the words of its own author. I can only briefly describe the result as establishing the fact, which certainly needed no such elaborate attestation, that it is possible for a succession of numbers to present, throughout a vast series of terms, the appearance of being governed by *one* law, while the next term shows that it was really governed by *another*. Thus the succession of numbers presented by the rim of the wheel in the calculating machine as it revolves, observes the character of a regular increase by *one* at every interval of change till it reaches the number 100.000.001, when the apparent character of the law is altered, and instead of exhibiting at its next interval, as might naturally have been expected, the number 100.000.002, it presents the number 100.010.002, which is followed by the number 100.030.003, and that, again, by the number 100.060.004, and so forth, according to a new character of progression equally definite with the former, which is itself destined to be changed after a series of 2761 terms, for another, which continues 1430 terms more, when a new law is again introduced, which extends over about 950 terms, and this, too, like all its predecessors, fails and gives place to other laws, which appear at different intervals.

But these facts, although they are the consequences of a legitimate arrangement previously established, and might have been fully foreknown at the commencement by any one acquainted with the laws under which the machine was originally constructed,

afford no grounds for establishing any analogy with the case under consideration. For, in the first place, these are the results of a mechanical contrivance, and *art* works in subjection to no such law of uniformity as *nature* ever observes in her proceedings. A deviation from the ordinary course, however apparently established, in the work of man's hands or the productions of his mind, contradicts no fixed principles, and is therefore no more than may ever be reasonably expected; a deviation from the ordinary course in the operations of nature is an anomaly, and cannot therefore be reasonably expected or inferred.

Secondly, it is to be observed that the succession of terms in the calculating machine is a succession of *changes*, and the variation in the succession is only another instance of what has been exemplified all throughout. In the ordinary process of generation, the succession of terms is not a succession of changes, but a successive repetition of the *same* term, and the variation in the succession is therefore a new feature, not illustrative of, but contradictory to, the general nature of the case.

Thirdly, the changes in the successions of terms in the calculating machine are the results of new laws which come into operation at the periods of the change, and govern the succession to which they are supposed to have given rise. In the case of the progressive development of the species, the variation in the succession of the terms is supposed to be the result of a law which does not govern the succession

at all—which comes into operation and disappears, having effected nothing but the introduction of the new term. Thus the ordinary law of generation, governing the succession of the individuals, is supposed to continue up to a certain number of terms; a new law (or modification) then develops another species, and the old law comes again into operation, and continues the race. To make the cases parallel, the succession of numbers accompanying the first change inclusive, should have been, not 100.010.002, 100.030.003, 100.060.004, &c., but 100.010.002, 100.010.003, 100.010.004, &c.; or else the organic developments should have continued the invariable reproduction of the *species* instead of the *individuals*, according to the new law by which they were introduced.

And, finally, the analogy, after all, if *admitted to be complete*, would only prove (what is self-evident and needs not to be proved), the *possibility* of the development of the species as a thing within the compass of the Divine abilities, should such have been the Divine design. But something more than a bare proof of its possibility is required to reconcile us with the adoption of an hypothesis which has nothing in *nature* to recommend it, and which is moreover contradicted at every step by invariable observation and experience.

Influence of Conditions.—In what manner this principle of development might have been carried out, some attempt is made to explain by reference to the phenomena of the fœtal changes already under

our consideration. Assuming these changes to be indicative of the transition of the individual through the several stages they are supposed to represent, nothing appears wanting (in the estimation of the author) to the development of one species from another next in the scale below it, but the protraction or extension of the process of gestation over the space that divides the one from the other, so that the fœtus may have time and opportunity to attain its improved condition; an effect which it is considered might be accomplished by external circumstances operating upon the parturient system. The nature of these circumstances, the author admits, can only now be conjectured; the efficacy of their operation, which he would confine to the earlier ages of the world, 'having,' he observes, 'been long interrupted, and now only allowed to work in some of the lowest departments of the organic creation, or under extraordinary casualties, in some of the higher, to which the attention of science has as yet been little directed' (p. 213).

But this is, in the first place, an entirely gratuitous assumption, for the truth of which there is not a particle of evidence adduced; and, in the next place, it is directly opposed to the principles which the author has been previously at such pains to establish; namely, the improved condition of the circumstances of life favouring the improved progression of the organic tribes. Having so largely insisted upon the development of the species from the humbler examples afforded in the memorials of the past

ages of the world, to the higher grades of life now occupying the earth, as the effect of regularly improved conditions of existence, with what countenance can he now turn round and contend against the sufficiency of those same conditions to favour the continuance of the same effects? If the conditions of existence have really been so much improved as to be taken as a reason of the advanced condition of the organic world at the present day, evinced in the addition of a race of beings superior to any previously known, surely those conditions must be sufficient to favour the process of development among some at least of the inferior orders of creation which we are instructed to believe exercised the same power when the conditions of existence are supposed to have been at a much lower ebb? And this I take to be one of the most striking evidences of the fallacy of the hypothesis of organic development, that, with every thing to favour it in the highest degree, according to the author's own account, no known or accredited example should yet be discoverable, of what ought to be a prevailing phenomenon of the present age.

As to what is intended by the assertion that 'these conditions are now only *allowed* to work in some of the lower departments of the organic creation,' considering the peculiar characteristic of the work before us, its declared object to maintain the sufficiency of the laws of nature for all the purposes of creation, and the consequent anomalousness of any appeal to the Divine interference or control, we can

only regard it in the light of a defective mode of expression, not designed to be literally understood. To suppose that the laws of nature only operated under the special guidance of the Almighty, would be to make him the immediate agent; which is equivalent to a virtual concession of the whole matter in dispute.

The fallacy of the author's reasoning is only further confirmed by the very facts to which he afterwards refers in explanation of his views. Amongst the principal agencies supposed to be capable of affecting the progress of organic development, light and air are pointed out, and an attempt is made to sustain this hypothesis by reference to facts.

'Light,' he observes (p. 228), is found to be essential to the development of the individual embryo. When tadpoles were placed in a perforated box, and that box sunk in the Seine, light being the only condition thus abstracted, they grew to a great size in their original form, but did not pass through the usual metamorphose which brings them to their mature state as frogs. The proteus, an animal of the frog kind, inhabiting the subterraneous waters of Carniola, and which never acquires perfect lungs so as to become a land animal, is presumed to be an example of arrested development, from the same cause. When, in connexion with these facts, we learn that human mothers, living in dark and close cells under ground, —that is to say, with an inadequate provision of air and light,—are found to produce an unusual proportion of defective children, we can appreciate the important effects of both these physical conditions in ordinary reproduction.'

'Now there is nothing to forbid the supposition that

the earth has been at different stages of its career under different conditions, as to both air and light. On the contrary, we have seen reason for supposing that the proportion of carbonic acid gas (the element fatal to animal life) was larger at the time of the carboniferous formation than it afterwards became. We have also seen that astronomers regard the zodiacal light as a residuum of the matter enveloping the sun, and which was probably at one time denser than it is now. Here we have the indications of causes for a progress in the purification of the atmosphere, and in the diffusion of light during the earlier ages of the earth's history, with which the progress of organic life may have been conformable. An accession to the proportion of oxygen, and the effulgence of the central luminary, may have been the immediate prompting cause of all those advances from species to species which we have seen, upon other grounds, to be necessarily supposed as having taken place.'

But this statement, instead of relieving, only encumbers the author's argument with additional proofs of its incorrectness: first, in the attestation which it bears to the force of the objection we have just urged against the hypothesis of development upon the score of the deficiency of examples under circumstances admitted to be most favourable for their occurrence; and, secondly, in the evidence which it affords of the operation of the causes assigned *without* the production of the contemplated effects. For the effects alleged, be it observed, are not those which are asserted and required to sustain the theory in aid of which they are adduced. None of the variations or deviations from the proper course

of development here adverted to are, or are pretended to be, the result of any variation in the period of gestation; so that all that is proved in these examples is simply the fact, directly opposed to the conclusions of the author, that it is possible for the conditions in question to be varied to an extreme *without* producing the effect for which they are designed to account.

Protraction of Gestation.—Waving, however, the consideration of the manner in which the conditions in question might be supposed to operate upon the parturient system to the effect of protracting the process of gestation, I entirely deny that there are any grounds to conclude that any such consequences would ensue as are here anticipated. For why should we believe that effects would accompany the *protraction* of gestation, to which none analagous would be occasioned by its *curtailment?* If the offspring of a man born at the seventh or eighth months would not be either of the animals which it is said at those epochs to represent, but a perfect being of the same nature with its parents, how can we suppose that it would become another species by a simple *extension* of the same process, during the previous continuance of which no real alteration had taken place?

Economy of the Bee.—The illustration of this effect afforded in the economy of the bee is nothing to the point, and, indeed, in one sense, rather calculated to disparage the hypothesis it is intended to support. The bee, it is said, has the power of modi-

fying the *larva* of what would otherwise have been a 'sterile worker,' by a certain mode of treatment expediting its maturity, so that when it emerges from the *pupa* it is found to be a queen, or true and fertile female. But, in the first place, this is an illustration really of the effect of *curtailment*, and not of *protraction*, which, as a general law, we know to be false. Secondly, no change of species is involved in the result, nor absolutely even of sex. Thirdly, it is built upon an assumption, for which there is not the slightest authority, and which really has the appearance of an absurdity; namely, that sterility is an *advanced* condition of the female sex. Fourthly, there is no *tangible* evidence that the larva selected would have become a *worker* had it been left to its proper course. There may be no signs discoverable to us of any difference in the larvæ, which may nevertheless be sufficiently evident to those of its own kind. And, lastly, admitting the whole transaction as related, I contend that it is in reality an argument in favour of the opposite hypothesis to that in support of which it is adduced.

I remember to have read somewhere of a statement respecting the migration of the wood-pigeon, (which in parts of North America is regarded as a bird of passage,) how that a single individual had been accidentally discovered sleeping in the hollow of a tree, during the period when, according to the general opinion, it ought to have been absent from the country. Now what was the legitimate conclusion which this discovery has been universally con-

sidered to establish? Is it that the general opinion was mistaken, and that the birds in question did really hybernate at home, only so closely secreted that they had theretofore escaped detection? By no means, but directly the reverse. It was well argued that in this instance the exception proved the truth of the general rule. The discovery of the individual, showing the absence of extraordinary precautions, negatived the probability of the whole race being similarly secreted; and the migration of the wood-pigeon became an established maxim by virtue of what at first sight appeared to militate against its reception.

And so I say of this case of the bee. If the development insisted upon was the result of natural laws common to it with the whole of creation, we should expect to see it exemplified, not in one instance alone, but constantly, throughout the whole department of organic life. It should have been a common phenomenon, instead of a solitary and perhaps dubious exception. The probability then, I contend, under the circumstances, is, that such a power of development in the bee is the result of a *special* provision in the structure of that insect, conferred upon it with the rest of its peculiar endowments by its Almighty Author with a view to those particular emergencies which are proper to it alone of all the organic tribes.

National Distinctions.—Nor is the argument carried a step farther by the consideration, next adverted to, of the changes wrought in the external appear-

ance of the several races of mankind, by the influence of the physical conditions in which they live. In the first place, none of these changes arise from any deviation from the ordinary period of gestation, which is exactly of the same length in the most degraded individuals of the Hottentot tribes as in the highest examples of the Caucasian races. Neither, in the second place, do they partake in any degree of the character of *specific* differences. They are merely structural peculiarities, the easily-understood result of the operation of external circumstances, exemplified to a far greater extent in the modifications which we see effected in the various tribes of animals and plants by the influence of domestication and culture, without compromising in any degree their specific characters. And, lastly, if they were essential differences, if they could be defined as the features of particular species towards which the objects displaying them were about to tend; nay more, if they were such as to mark the very change itself, they would only the more strongly attest the fallacy of the hypothesis of the author of the *Vestiges*, in that they would be really indicative of a mode of development entirely foreign to that which he is endeavouring to establish. For none of these characteristic distinctions are presumed to have been *suddenly* acquired, but to be the effects of a gradual accumulation of *slow* change; a kind of development entirely different from that which we are now considering, and one which could indeed only consist with the hypothesis of an universal

amalgamation of all species, and the establishment of an infinite series of undistinguishable individuals.

Monstrosities.—Another class of evidences quoted in support of the same principles of uterine development are certain cases of monstrous birth, infants in which the heart is stated to have been left in the three-chambered form of the reptile, and the two-chambered form of the fish (p. 218). Assuming these defects to be 'the result of a failure of the power of development in the system of the mother occasioned by weak health or misery,' the author proceeds to deduce therefrom an argument in favour of a contrary result accompanying a contrary condition of the parturient system; in other words, an advance in the species following an improvement in the moral and physical conditions of existence.

'Here,' he observes, 'we have apparently a realization of the converse of those conditions which carry on species to species, so far, at least, as one organ is concerned. Seeing a complete specific retrogression in this one point, how easy it is to imagine an access of favourable conditions sufficient to reverse the phenomenon, and make a fish mother develop a reptile heart, or a reptile mother develop a mammal one. It is no great boldness to surmise that a super-adequacy in the measure of this under-adequacy (and the one thing seems as natural an occurrence as the other), would suffice in a goose to give its progeny the body of a rat, and produce the ornithorhyncus, or might give the progeny of an ornithorhyncus the mouth and feet of a true rodent, and thus complete at two stages the passage from the aves to the mammalia.'

But the whole of this train of reasoning, in the first place, is founded upon a mere illusion. There is no accordance whatever between the objects through which the connexion of the species is assumed to be sustained. The hearts in question are not in any sense the hearts of a reptile or of a fish, but the true, though incomplete, hearts of a human fœtus, resembling the former in nothing whatever but in the fact of a corresponding number of cavities, and differing from them, perhaps, *more* in other respects than they would if they had been complete in that particular in respect of which alone they resembled.

Secondly, it is an entirely gratuitous assumption that these malformations are the result of a 'failure of the power of development in the system of the mother.' The influence of the male sex in the origination and establishment of the fœtal character is probably to the full as great as that of the female; nay, in the estimation of many, more so; inasmuch as it has been remarked that the resemblance of children to their fathers is even yet more generally striking than to their mothers.

Thirdly, there is no proof that these malformations are the result of any definite or *specific* influence affecting the parturient system. But unless this be shewn, unless the action by which the imperfect development has been occasioned be of a *specific* character, it can afford no grounds for concluding that a further extension of it would lead to a further extension of the *same* kind of imperfection, and

issue in the production of a *complete* individual of the species indicated, or of any particular species at all.

And, lastly, the application of the argument involves the assumption of a leading conclusion which is entirely unsupported by evidence, and as a general rule contrary to truth; namely, that opposite conditions necessarily lead to opposite results—that a superabundance of any particular influence would be productive of consequences opposite to what an analogous deficiency would have evinced. An excess of grief, it is said, turned the hair of the unfortunate Marie Antoinette grey in the course of a single night; there is no reason to believe that an equal excess of happiness would have made it black. And these conclusions become particularly strengthened as against the hypothesis before us, by the consideration 'that the capacity of change, and of being influenced by external circumstances, such as we really find it in nature, and therefore such in science as we must represent it, is a tendency, not to improve, but to deteriorate*.' There appears to be no limit to the extent to which an individual or a species may be degraded by the depravation of its circumstances; but there is one in all cases beyond which the utmost refinement appears incapable of urging its advance.

Translation of Species.—We have yet to notice the examples adduced in evidence of such a transition as from one species to another, having actually

* *Indications of the Creator*, by Dr. Whewell, p. 59. London, J. W. Parker, 1845.

occurred. Of these, three are mentioned, though really I cannot see how the production of the acarus in the experiments of Mr. Crosse, which is one of the number, supposing it established, could be held to be illustrative of the question of *progressive* development. The complication of the insects in vegetable infusions, which is likewise quoted to the same effect, has already occupied as much of our attention as we can afford to bestow upon it. I shall only add to what I have already observed on that head, that there is no evidence beyond mere conjecture to warrant the conclusion that the more complex forms, which are stated to make their appearance *later*, have been derived from the simpler, previously produced.

'There is, however,' we are informed, 'one direct case of a translation of species, which has been presented with a respectable amount of authority. It appears that, whenever oats sown at the usual time are kept cropped down during summer and autumn, and allowed to remain over the winter, a thin crop of rye is the harvest reaped at the close of the ensuing summer.'—'This case of the oats,' it is added, 'is the more valuable, as bearing upon the suggestion as to the protraction of the gestation at a particular part of its course. Here, the generative process is, by the simple mode of cropping down, kept up for a whole year beyond its usual term. The type is thus allowed to advance, and what was oats becomes rye' (p. 221).

Whatever credit may be due to this account, one thing is certain—that it affords no support to the hypothesis of development which the author of the *Vestiges* has it in view to establish. The conversion

which is here detailed is not a conversion of the *offspring of the oats* into rye, but of the *oats themselves;* a species of development entirely distinct from that which it is intended to illustrate. As an effect produced upon the *individual,* it is only analogous with many other cases which are traceable to the same laws. It has always been known that any violent interruption or detriment to the generative powers or processes, has an effect more or less influential upon the whole organic system, extending even to the confounding of all sexual peculiarities, and the induction of features entirely foreign to the natural state. In plants, a similar treatment to that above detailed produces many variations of character; as for instance, in the case of the *Reseda odorata,* or mignonette, which may by these means be converted, not only into a biennial, but even into a perennial. Considering, then, that in all the cases in which similar results have been manifested, *no change of species* has ever yet been effected, the only legitimate conclusion which could be drawn from the example set before us would be, that oats and rye are not really distinct species, but only modifications of a common original, induced by culture or other causes; as wheat is considered to be only the cultivated result of a species of grass, the *Ægylops ovata,* indigenous in Sicily, from whence the stock appears to have been derived*.

* It is some confirmation of this hypothesis that both the productions above-mentioned, the *Avena sativa* and the *Secale*

System of Macleay.—In addition to the arguments accumulated in the previous pages, a further accession of testimony to the same principles is claimed to be afforded in the 'system of animated nature,' put forth by Messrs. Swainson and Macleay, the consideration of which forms the subject of a separate chapter. Of the merits of this 'system' it would be needless to our present purpose to enter into any investigation, seeing that the sole object of its introduction is the establishment of certain affinities and analogies as characterizing the organic tribes, the existence of which to their fullest extent I deny to have any influence in determining the question of their creation. Whatever may be proved of them in the way of mutual agreement or dependance, whatever resemblances, moral or physical, may be shown to prevail between them, can never be regarded otherwise than as tokens of the Divine design in their constitution and appointment; and this once established, all inference from them to the mode of their production becomes obviously precluded. What God designed to accomplish, the mere fact of His accomplishing can never be taken to presume the method of its accomplishment*.

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cereale, belong to the same class and order, *Triandria Digynia*, and to the same natural order, *Graminea*. I have treated this experiment as if it were an authentic one, though I might have stated that it is now universally discredited.

* In the later editions of the work the greater part of this chapter has been withdrawn, and with it, as it would appear, that reliance upon the conclusions of the 'system' it was

Early History of Mankind.—I cannot perceive that any further light is thrown upon the subject, or any additional force conferred upon the argument by the speculations of the author in the chapter which here follows in the original upon the early

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intended to develop, and which, with all the devotedness of a perfect sincerity, the author had in the first instance so energetically avowed. This, however, is not the only example of the like conduct, upon which we have occasion to comment. Exactly the same sort of contempt for his previous acknowledgments occurs in respect of a point of evidence given at page 201 of the first edition, in connexion with the hypothesis of fœtal development. Rising with the progress of his argument, after having detailed the principal facts already alluded to on that head, the author comes to wind up the whole with a statement which, from the terms in which it is expressed, we can conclude nothing less than final upon the matter. 'Another illustration,' he observes, 'here presents itself *with the force of the most powerful and interesting analogy.*' And then follows the statement itself, with a concluding attestation and assurance of its effect:—'Here we have apparently very clear *demonstrations of a parity, or rather an identity* of laws presiding over the development of the animated tribes on the face of the earth, and that of the individual in embryo.' And with all this confidence in the efficiency of his arguments, will it be believed that not a word is said about it in any of the subsequent editions, but the whole tacitly omitted, as if it were unworthy even of a formal recognition? And thus with respect to the argument in connexion with the 'Macleay system of animated nature,' which occupies the whole of the chapter in the first edition, and the purpose of which was to ascertain, or rather to confirm the *status* of man, assignable to him on the score of his production by development, not a mention is made of it in any of the subsequent editions, either in the way of explanation or excuse; although the assignment of that status is the only ground upon which the introduction of any allusion to the 'system' at all can be rationally accounted for.

history of the human race. A history which is avowedly founded on fancy, which professes to give the course of events independently of any original document or record, but simply as of inference from the supposed rules of probability and right, is utterly incompetent to the establishment of a single conclusion that is worthy even of a passing comment. Of the early history of man we know, literally, nothing, but what is related in the Bible. In denying or disregarding the testimony of the Scriptures, we place ourselves exactly in the position of persons who have voluntarily extinguished their only light, and are left to grope in the dark through the mazes of a labyrinth, the limits of which they can neither fathom nor define. There is not a work that even *pretends* to give us a clue to aid us in our wanderings, that holds out the prospect of a single gleam to illuminate the depths into which we desire to extend our view. It would be therefore the height of absurdity to devote a line to consideration of arguments built upon premises so utterly unsound as those of an imaginary chronicle of the human race.

I cannot, however, omit to notice an instance of the extraordinary facility with which the author adopts his conclusions, and the equally happy readiness with which he escapes from the consequences of his own reasoning, when they are discovered to be injurious to his scheme, without even abandoning the reasoning itself from which they are deduced. The object of the author in the chapter which is

now under consideration, it is to be observed, is to confirm the position already claimed as established, that the human family is a development by the ordinary process of generation, from the highest species of quadrumana; a race of beings which, when he published his first edition, he had somehow fixed upon the idea, were natives of the Eastern Archipelago. With a view to this object, his efforts are exclusively directed to the derivation of the human race from the same quarters; a result which he assumes to have ascertained by tracing the progress of civilization and the arts from the East. And thus the matter stands in his earlier editions. In the mean while, between the publication of his second and third editions, a specimen of the chimpanzee, a native of Western Africa, makes its appearance in this country, and eliciting the observation of an eminent professor of physiology to the effect that, this, of all known species, most nearly resembles the human race, establishes Africa as the quarter from whence, according to the author's principles, the human family should have been derived. What is to be done in this dilemma? And how does the author attempt to reconcile this intrusive anomaly? Does he give up his chapter of arguments to prove the eastern origin of his monkey-offspring, and write a new one to show that they have proceeded from the quarter which he now finds to be more favourable to his views? or does he contest the assertion of Professor Owen, and contend for the superiority of the oriental simiæ in

characters connecting them with mankind? Does he, in short, reject the premises because they negative his new conclusion, or repudiate the conclusion because it contradicts the premises? He does neither. He retains them both. Preserving intact all his arguments to prove the Eastern origin of the human race, and admitting (what he could not deny) the claims of the African species to that supremacy which, according to his own views, establishes their mutual connexion as parent and offspring, he slips out of the conflict by the alteration of a word, which, after all, has only the effect of introducing another inconsistency, to the full as ridiculous as that which it is intended to avoid. Bringing his elaborate reasoning to a close, both editions proceed hand in hand towards the East, when lo! the chimpanzee suddenly makes his appearance in the road. The first edition, unconscious of the appalling spectacle, continues in the same unswerving course in which it was originally proceeding, and tells us (p. 296,) that 'according to the development hypothesis we should expect man to have originated *where the highest species of quadrumana are to be found*,' while its companion, frightened out of its propriety, seeks to propitiate the unlucky apparition by alleging, (p. 281,) that the same hypothesis 'demands,' equally *of course*, 'that the original seat should be in a region *where the quadrumana are rife;*' forgetful that in this admission is conceded the whole principle of the hypothesis of development which it has been the exclusive object of the chapter to sustain.

But, however reasonably the physical conditions of the species might appear to be explained with reference to the principles of a natural development, whatever degree of assurance the correspondence between those conditions and the testimony of the facts adduced might be thought calculated to establish, important phenomena would still remain to be accounted for, before the hypothesis of a creation by natural laws could be regarded as unequivocally confirmed. A train of effects which have hitherto formed no part of our speculations, the functions of life and mind, have yet to be explained upon the same principles, ere the bond of union between the creature and its Creator can be said to be effectually dissolved, and the independence of a material origin satisfactorily ascertained. This desideratum the principle of *organization* is considered to supply. What the simple elements of matter are of themselves confessedly incapable of accomplishing, their combination in the living body, it is thought, may be competent to fulfil.

Principles of Phrenology.—As nothing can be known beforehand of the influence of organization upon the organic elements, of course the confirmation of this opinion is entirely confined to the consideration of the correspondence of the phenomena observed, with some particular forms of organization to which they are ascribed. Regarding the brain as the source of these effects, and looking to its develop-

ments as the indications of their particular location, the science of *phrenology* professes to register this correspondence; and the question of the reality of the hypothesis before us in respect of this particular, may be regarded as the question of the truth or falsehood of the principles of phrenology, with which it is so far virtually identified.

One can hardly be expected at this time of day to enter into a formal consideration of the pretensions of a science which has occupied the pens of its professors for upwards of fifty years without being able to establish any conviction of its truth. A science which is avowedly founded on facts can have no claim to be called a science at all, if it be not susceptible of demonstration. Had phrenology any real existence it could never have remained until this day, not only unproved but actually repudiated by every person of scientific eminence, who has delivered himself upon the subject. 'We count not,' observes a shrewd writer upon physiology, 'small authors in a matter so important; for new faiths easily take root among the ignorant, and the latter are by no means unwilling to become either the apostles or the prophets of doctrines which they but imperfectly understand*.'

Moreover, it is to be observed, that such is the nature of the so-called science of phrenology, that a single fact by which it is contravened, a single case of discrepancy between its indications and the re-

* MAGENDIE'S *Physiology*, with notes by Dr. Milligan, p. 559. Fourth edition. Edinburgh, 1831.

sults, is fatal to its pretensions, notwithstanding all the evidences that could be accumulated in its behalf, be they ever so many, or ever so clear. The presence of a quality where the organ is deficient, or the absence of a quality where the organ abounds, though but in a single instance, as effectually overturns the hypothesis that ascribes the quality to the organ, as if the same could be shown to be the case in every instance to which reference is capable of being made.

Now it is well known that it is not in a *single* instance alone that this disagreement has been evinced, but in *hundreds* of instances in which the comparison has been made under circumstances which admit of no dispute.

'Our own trials in this,' to continue the observations of the author above quoted, 'had so often met with results unfavourable to phrenology, that we felt much inclined to attribute to chance the few favourable cases reported by its supporters. We had moreover seen Mr. G. Combe fail publicly in the case of Haggart, (*Edin. Journ. Med. Sc.*, Vol. iii., p. 180; *Haggart's Life*, p. 167,) and scores of amateurs and professed phrenologists blunder in their alternate attempts to divine the characters of men from their cranial development, or their cranial development from their acknowledged characters.'—'At last came the paramount atrocities of Burke and Hare, and with them the final settlement of the fundamental question of phrenology. The *instantia crucis* was fairly, liberally, and most publicly decided on the heads of those two wretched beings, and with results so repugnant to the assumed correspondence of development and faculty, that, to any unprejudiced mind, these two admeasurements alone must

have sufficed to overthrow the whole doctrine. In short, Mr. Stone, to whom the public is indebted for these valuable facts, found the manifestations of destructiveness small in both Burke and Hare; conscientiousness large, and amativeness small, in Burke, contrary to his well-known character; his benevolence large; and the ideality of Hare, who was little better than an idiot, measured greater than that of a poet distinguished for his ideality.'

'In order to have an average standard of comparison, Mr. Stone took the measurement of one hundred crania, preserved in the public museums of Edinburgh, and one hundred living heads, amongst soldiers and other persons that could be classed, and having thus, after much ingenious labour, established a series of average measures, which are now the same thing to phrenology that the length of the pendulum is to statics, he proceeded, by the aid of his callipers, to examine whether the organs of destructiveness, acquisitiveness, &c., are really to be found larger in acknowledged murderers than in the heads of other men, or of the average of mankind. After eighteen trials by measurement, it fairly resulted that a very great number of such persons have what may be called their characteristic organs somewhat below the average dimensions; while the benevolent and intellectual organs are occasionally larger in them than in the most gifted individuals. This curious discovery was made by Sir William Hamilton, but has been fully confirmed by the researches of Mr. Stone, who, extending his inquiry, was willing to ascertain whether the organ of acquisitiveness was as largely developed in thieves as had been frequently asserted, and whether their organ of conscientiousness was proportionally smaller than usual. In fifteen out of twenty-two acquisitiveness was below average, and the organ of conscientiousness at the average measure.'

With regard to the cases of alleged concordance, in which the organs developed and the qualities assigned have been found to correspond, it is to be observed that these are entirely confined to single organs out of each head examined, and are more than sufficiently accounted for by reference to the doctrine of chances.

'It is a rare case,' remarks the same author, whom we have hitherto been following, 'to meet with any person who may not lay claim, from fact, vanity, or imagination to nine-tenths of the whole faculties, in a greater or less degree, and therefore when they (the phrenologists,) once met with the cranial eminence, they need be little afraid of not hearing something of the talent or disposition it represents. But to make up a balance-sheet, having all the *faculties* on the first side, and all the *eminences* on the second, would exhibit a frightful discrepancy: and they prudently adhere to solitary organs, but never give a survey of the entire cranial surface. It is thus that a pretender to craniology can never fail. It is only a few ill-constituted individuals who want altogether any of the creditable faculties described; and in those few the eminence corresponding may be wanting also, and thus by the mere laws of chance account for cases of their mutual deficiency. As to the *discreditable* bumps, *only one-ninth of the whole*, vanity will lead *nine* persons to lay claim to creditable, for *one* to deny the discreditable, faculties. In the extraordinary developments of faculties, chance is still much in his favour; since bumps are very common things, and great faculties uncommon. Lastly, the chances could only be even, or as many misses as hits, if bumps were as often wanting as present; or bumps being constant, if the faculties were as often absent as present.'

Necessity of a Soul.—I have thought it right to say thus much on the subject of a science which has been allowed to engross a much greater share of public attention than ever it was entitled to, although the general answer I am prepared to give the question would, I humbly submit, have exempted us from the necessity of entering thus far into its details. Regarded as an abstract proposition affirming the sufficiency of a material organization to account for the phenomena of life and mind, the fallacy of the presumption is, I contend, susceptible of distinct demonstration. The presence of a soul, as necessary to the functions of the mind, follows from considerations, the truth of which physiology herself has largely contributed to establish.

Among the operations of the mind, none is more striking than the sentiment of his own individuality which each man possesses, and is enabled to realize at will by reference to his own feelings. This sentiment, which is termed the *consciousness of identity*, is a conviction which cannot be founded in a mistake. It is the acknowledgment of a truth, the perception of a fact, that cannot be disputed. That each man is what he feels himself to be, the same individual that he ever was since he had a being at all, is no more to be questioned than any conclusion in mathematics which is founded upon and in accordance with its admitted principles. It is an *axiom*, which requires no more proof than its mere enunciation.

Now this conviction would be a false one if the hypothesis of the materialist were true. It is a

well-known fact that all the material particles in the human frame are subject to change—that a perpetual renovation of the elements is carried on during the whole course of life, whereby the body is really, in respect of these, its material constituents, no longer the same body that it was at any definite period of its previous life. In fact, life itself may be said to consist in this change. Nutrition, which is the primary means of life, is nothing but the supply of material particles which are taken up and assimilated with those pre-existing in the frame. This function implies an equal dissipation of particles, where the organic structure is not augmented. It is impossible for new particles to be continually added without enlarging the substance, unless the removal of an equal quantity of the old be understood.

In consideration of this undoubted fact, to the truth of which, as a general law, all physiologists accede, the human body cannot be regarded as the same at any two distinct, and, *à fortiori*, at any two remote periods of its existence. Any sentiment of identity of person founded upon these premises must therefore be false. The person is really *not* the same so far as its material constitution is concerned; and, therefore, no sentiment or conviction of its identity could have any real subsistence. In order to the due satisfaction of this requirement, it is absolutely necessary that the individual be possessed of something which does not change, which as truly constitutes his person as its organic elements, to which this idea of identity is capable of being

referred. He must have a permanent representative of himself within him which is not material—which is his Soul*.

Purpose and General Condition of the Animated Tribes.—It would be beyond the compass of my design in these remarks to enter at large into the consideration of the doctrines and sentiments of the author, arising out of the adoption of principles which I hold, and trust I have shown sufficient reasons for holding, to be indefensible and untrue. Taking that general view of the case, to which I must for the present be content to restrict myself, I have no hesitation in asserting that the doctrines

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* Another proof of the necessary presence of an immaterial agent in the economy of the vital frame might be deduced from the consideration of the effect of association in aiding the development of ideas pre-existent in the mind; as in the process of *recollection*, where one idea is made subservient to the reproduction of another to which it is allied. If the mental functions were merely material, if the idea were only the result of a physical impression, and memory but the continuance of that impression, as in the theory before us is presumed, association would be unnecessary, as it would be inefficacious, to facilitate its perception or occasion its reproduction. If the idea were, so to speak, a *thing* imprinted on the sensorium, it could require no suggestions to render it discernible while it endured, and could receive no aid from them to recover it when lost. A picture on the wall *is* there to be seen, and has only to be looked at to be perceived, so long as it remains. When really removed no relation to others still remaining can cause it to re-appear. It is only upon the supposition that the object is *not* there, that it is an immaterial existence, that there could be any difficulty in re-producing or perceiving it, or that the difficulty could be alleviated or removed by the intervention of a process which is itself immaterial.

consequentially propounded are as decidedly fallacious as is the theory to which they are allied. In the chapter to which these observations have reference, the author assumes to explain the purpose of God in the work of creation, and to review the general condition of the animated tribes, in accordance with those principles which he has elsewhere unhappily pledged himself to support. And the results of such an alliance are perceptible in the very outset. The first step is upon a fallacy, the character of which every succeeding movement only tends more and more clearly to evince.

The principle, 'that all beings were created for their own enjoyment,' is one of those specious propositions which so readily catch the approval of the ignorant or the thoughtless, and form the staple revenue the materialist and the demagogue. It appears to flow so naturally out of the consideration of the Divine goodness, and withal affords so plausible an excuse for the indulgence of those appetites and passions which man finds it so difficult to withstand, that it is no wonder it should be so largely insisted upon and so generally received. Nevertheless, it is a proposition which bears upon its face the evidence of its own untruth. It can hardly require more than a simple indication to satisfy any one that a proposition must be intrinsically false that asserts, as a means to an end, a circumstance which only comes into operation with the end itself—that alleges, as the occasion of an act, a purpose which is only the consequence of its own fulfilment. The purpose of

God in creation could not have been the happiness of the creature; for that supposes a purpose which could have had no existence at the time it was designed, but was itself the produce of the same act. Just as reasonable would it be to suppose a carpenter to make a tool for a use which is equally created with the tool itself. The enjoyment of the creature may have been contemplated as a result attendant on or accompanying the result of its creation; and it may be that through that enjoyment the purpose of its being created might be fulfilled. But assuredly the object of the creation must have had reference to something which pre-existed the creation—which did not simply grow out of the act it was intended to subserve.

To the Creator Himself can the purpose of creation alone be reasonably referred. The fulfilment of His will and designs can alone be reasonably regarded as the object and occasion of the creature's existence, and, consequently, as the standard by which the accomplishment of that purpose can alone be reasonably computed. In one sense, indeed, it may be true that the creature, (confining ourselves in these remarks entirely to the human race), was made for his own enjoyment—when that enjoyment and the real purpose of his production happened to coincide. Coming pure and perfect from the hand of his Maker, the fulfilment of that Maker's designs must have been his enjoyment, and his enjoyment the fulfilment of those designs. When, however, the nature of man changed, or, if

that is too much to presume, taking it as we now find it, the case no longer admits of the same solution. The enjoyment of man is not the fulfilment of His Maker's will, and, consequently, can never be set up as the criterion of the purpose for which he was created.

Independently, however, of this reasoning, there is another proof of the fallacy of the proposition which admits perhaps of readier appreciation. If the creature's enjoyment have been the purpose of God in his creation, then has God been most grievously baffled in the execution of His designs. For who can look around him in this world and not perceive that enjoyment is the lot but of a few, and that the great mass of God's creatures, including all the worthiest and the best, lead a life that more nearly exhibits the opposite extreme of misery and distress. To allege, therefore, that enjoyment is the purpose of man's creation, is to ascribe insufficiency to the undertakings of the Almighty, to allege a purpose that has never been carried out, and that moreover never can be carried out so long as the nature of the creature remains as it is.

Mistaken in his views of the purpose of creation, it is hardly to be wondered at that the author is wildly confounded by the actual condition of the creature. Ignorant of what *ought to be*, he is totally unable to explain what *is*. Assigning as the purpose of creation, the enjoyment of the creature, and perceiving that the creature has not that enjoyment which he believes to be the moving cause of his

existence, he is naturally bewildered by a result which contradicts his notion of the cause, and assumes for an explanation what is merely an admission of the charge. For it is to be observed that the point here at issue is the character of the Godhead in connexion with the actual condition of His creatures. A world of misery and a world of God's creation are facts which have to be reconciled. According to our view of the case, deduced from the pages of revelation, there is no difficulty in the matter. Regarding the purpose of man's creation to be the fulfilment of the will and designs of his Creator, we see at once in the non-fulfilment of that purpose all that is necessary to exempt the Creator from any charge whatsoever in respect of the condition of the creature. Upon the grounds of the author's hypothesis, the matter assumes an aspect, the anomalousness of which all the powers of human reason are utterly incompetent to explain. Here we have the outrageous spectacle of the creature burning to fulfil the purpose of his Creator, (for who does not long to accomplish his own enjoyment?) and yet, by the Divine appointment in the laws of his constitution, incapable of success and suffering the penalty of failure. And how does the author seek to avoid the consequences of this inconsistency? Simply by the hypothesis of an imperfection in the Divine appointments; by a view of God's designs which describes them as only good in the main, but productive of evil in the detail. Alluding (p. 351) to the system upon which he has just been expatiating,

'the general good results of this arrangement,' he observes, 'are obvious, *but exceptions of evil are inseparable from such a system.*' 'We see,' he adds further on (p. 363), 'the Deity operating by fixed laws; an arrangement which, it is clear, only admits of the main results being good, *but disregards exceptions.*' But this, even if it were a correct statement of the case, is no explanation of the fact at all. It is merely a repetition of the charge itself. The objection to the scheme is the imperfection it implies in the character of the Divine appointments, and the answer is the allegation that this imperfection is inseparable from the system,—that the objected cases are exceptions which it is the principle of the arrangement to disregard. But the statement is *not* correct, even if it were sufficient. The exceptions here form the general rule. It is the good results that are the exceptions, and the objectionable cases the main condition of the scheme; that is, admitting, what I by no means agree to, that there are any exceptions to the general condition of mankind in respect of enjoyment in this present life. I deny that *perfect* happiness is the portion of any; and less than perfect will not satisfy the exigencies of the argument. And this is all that the author has to say for a scheme that professes to give an exclusively rational account of the proceedings of the Almighty in the work of creation!

Special Objections.—The reader has now before him the whole array of evidence by reference to which the derivation of the species from a common origin by successive self-developments is assumed to be established. The condemnation of the hypothesis which we have just been considering is not, however, confined exclusively to the *negation* of the premises upon which it has been constructed. There are essential inconsistencies in the scheme, by which its utter fallacy is capable of being, I conceive, *positively* ascertained.

The length to which I have already gone in these investigations compels me to restrict myself to little more than a bare enumeration of a few of these inconsistencies, which the circumstances of the case appear the most readily to suggest. In the first place, the period of gestation in many of the inferior species is already as long as, and in several very much longer, than in the species above them in the scale. For example, the elephant carries its young twelve months, while the human parent only carries it nine. This, then, affords a flat contradiction to the essential article of the author's creed.

Secondly, it is to be observed that many of the species standing next one another in the scale are exceedingly different as to size; so much so, indeed, that the offspring of some of those placed highest are as large as, if not in some instances actually larger than, the mature individuals of the species in the scale next beneath. Here, then, we should be presented with the anomaly of parents smaller

than the progeny to which they are supposed to give rise.

Thirdly, many species produce their young under circumstances which would be fatal to the species next above them in the scale. Fishes, for instance, deposit their young in the water, while several of the reptile tribes, which are supposed to issue from them, are incapable of living in that element. These, therefore, if they could have been produced, could never have survived their birth.

Fourthly, one entire class of beings, the class of birds, which come in between the reptiles and the mammalia, are oviparous, (that is, producing their young in eggs,) and so constructed that they could not produce in any other manner. Being destitute of an ordinary uterine system, gestation could never be carried on in them so as to suit the needs of a mammal offspring; while, on the other hand, it would be equally impossible for any of the viviparous species that we are acquainted with to pass their fœtal career in an egg.

And lastly, even if it were possible for all animals to produce the infant progeny of the species next above them, *insuperable* difficulties would still remain to be encountered in the subsequent treatment of them. But few animals are so constructed as to be able to take charge of any offspring but their own. An ape might be supposed to give birth to a human infant; but without a miraculous influence to overrule its natural disposition, amounting, in fact, to as great a change in the parent as in the

offspring, it never could rear it to maturity. Supposing that its milk were suitable (which, however, I believe it is not,) for the lactation of a human progeny, it could never continue the supply long enough to meet the necessities of its novel charge. The infant ape is, moreover, able to take care of itself after a few months, in all cases; but it is many years before a child left to itself could avoid starvation.

Origin of Evil.—If anything further were wanting to evince the utter fallacy of the scheme whereof we have just concluded our review, it would be found, I conceive, in the consideration of the consequences to which the author himself acknowledges its liability to conduce, and the effects of which in his latter chapters he sedulously labours to remove. A theory that ascribes to God the origination of evil, that exhibits the perfect Majesty of Heaven as the immediate author of sin, must needs be false, whatever be the evidence by which it is sustained. I cannot stop now to do more than briefly to point out how such must be the inevitable character of a theory that makes sin the result of organic development, and includes that development in the original design of God. According to the principles of the hypothesis before us (p. 356), every man is born into the world with a *physical* obligation to sin, differing in each individual merely in its degree, from the more open indulgence of which he is only, if at all, deterred, not by the removal or abatement of the noxious propensity, but by the influence of other

propensities which happen to prevail. As this is a part of his *original* constitution, for which he is indebted to God Himself, there is no possibility of avoiding the conclusion that the Author of life is equally, absolutely, and unreservedly, the Author of sin.

General Objection. — I commenced this analysis with a general proposition affirming the impossibility of deducing the varied forms of nature out of the elementary principles of matter diffused throughout space, by the simple operation of natural laws. I shall conclude the same with another proposition to the like effect: a proposition in which I affirm, in equally general terms, the absolute impossibility of any organic creation, embracing the animated tribes, through the instrumentality of any natural laws which we are acquainted with, or can imagine to exist.

The laws of nature, it is to be observed, is a widely comprehensive term, including two perfectly distinct classes of laws or properties:—the laws of matter, such as are proper to all matter, however constituted; and those laws, which may be more correctly denominated the 'laws of life,' which are only exemplified in matter organically composed. In addition to these, there are certain powers or agents in nature, such as electricity, light, heat, &c., which have their own laws equally definite and immutable with the former, with which indeed they are most generally classed. Now it is clear that in an argument concerning the original production of

life or living structure out of inanimate material, the only agents to which we can refer are the laws or properties of matter, and those powers whose laws we have observed to be subject to the same rules. With the laws of life, however *natural*, we have, in the first instance, obviously no concern. Indeed the real question at issue is the deduction of the laws of life from the operations of the laws of matter. Before, therefore, we can make any use of them in an argument respecting the production of life, we must first establish that life, whereof they are the properties, out of such elements as are proper to matter without life.

Among the former of these laws, which have thus to be deduced, one of the most characteristic is the power which every animated being possesses, of controlling or directing its own impulses, of suspending or continuing its own operations; in a word, of performing or not performing, of doing and undoing any actions which it may contemplate or have commenced. This power is termed *volition*, or the exercise of the will. It is scarcely necessary to observe that this is a quality of the laws of life which is essentially opposed to the nature and character of the laws or properties of matter. All material laws have a definite course of action, from which it is impossible for them to swerve. Gravitation, for instance, draws a stone to the earth in the direction of the centre of gravity, and can neither do so in any other direction, or avoid doing so in the direction prescribed. Immutability is, in fact, the essence

of the laws of matter, the very circumstance by reference to which they are appointed and denominated its laws. Now it is an admitted axiom, the truth of which it would be superfluous to enlarge upon, that no agent can confer a faculty which it does not itself possess. But no laws ot matter possess the faculty of controlling their own operations; therefore no laws of matter could ever give rise to the laws of life.

Conclusion.—I have but one observation further to make respecting the issue of the inquiry in which we have been so largely engaged. Whatever may be the result of these investigations in the mind of the reader, to whichever side of the argument he may be disposed to assign the victory, the main point in dispute, the actual means employed by the Almighty in the great work of creation, remains altogether unaffected. Should my reasoning seem to him to have the greater weight, of course it is unnecessary to justify this assertion. Should it, however, be otherwise, and the arguments of the author of the *Vestiges* appear to predominate in the scale, admitting him to have established in every instance the correctness of the evidence he has adduced, yet would he only have established the fact, that the theory he advocates is *capable* of being true —that the scheme of creation he proposes is a *possible* mode of accounting for the phenomena he has undertaken to explain. It would still remain for

the reader to determine whether he will adopt an hypothesis which has only the proof of its bare possibility to recommend it, against a view which comes confirmed by all the evidence by which the truth of revealed religion is, in the estimation of all well-regulated minds, considered to be indisputably ascertained.

THE END.

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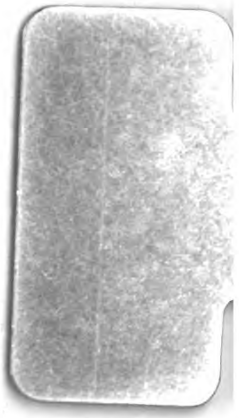
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